



National Concrete Masonry Association
an information series from the national authority on concrete masonry technology

ARCHITECTURAL CONCRETE MASONRY UNITS TEK 2-3A

Unit Properties (2001)

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INTRODUCTION

One of the most significant architectural benefits of designing with concrete masonry is its versatility – the finished appearance of a concrete masonry wall can be varied with the unit size and shape, color of units and mortar, bond pattern, and surface finish of the units. The term “architectural concrete masonry units” typically is used to describe units displaying any one of several surface finishes that affects the texture of the unit, allowing the structural wall and finished surface to be installed in a single step.

Architectural concrete masonry units are used for interior and exterior walls, partitions, terrace walls, and other enclosures. Some units are available with the same treatment or pattern on both faces, to serve as both exterior and interior finish wall material, increasing both the economic and aesthetic advantages. Architectural units comply with the same quality standards as conventional concrete masonry, *Standard*

Specification for Loadbearing Concrete Masonry Units, ASTM C 90 (ref. 3). In some cases, noted below where applicable, additional provisions govern which are more applicable to the specific unit.

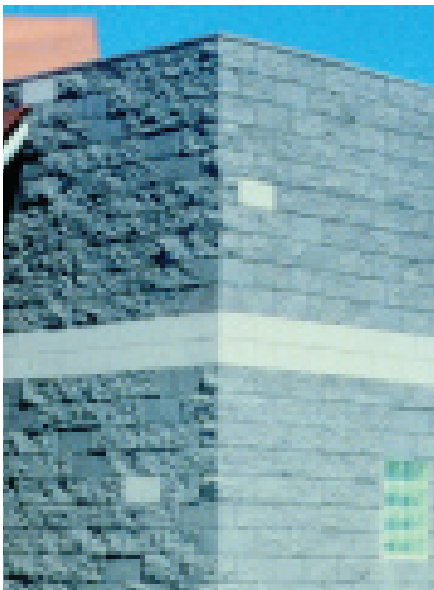
The units described herein are some of the more common architectural concrete masonry units. However, manufacturers may carry additional products not listed here, and conversely, not all products listed will be available in all locations. Consult a local manufacturer for final unit selection.

ARCHITECTURAL UNIT TYPES

Split Faced Units

Split faced units have a natural stone-like texture produced by molding two units face-to-face, then mechanically splitting them apart after curing, creating a fractured surface. Because coarse aggregate is also fractured and exposed in this process, aggregate selection can alter the final appearance.

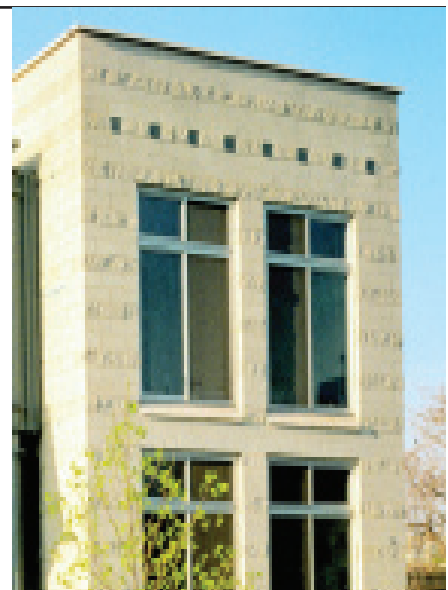
Split-faced units can also be manufactured with ribs or scores to provide strong vertical lines in the finished wall. Rough textures, like those available with split face units, are often used in areas prone to graffiti, as the texture tends to discourage graffiti vandals.



(a) Split Face and Glazed



(b) Fluted Split Face



(c) Split and Ground Face

Figure 1—Examples of Architectural Concrete Masonry Units

Split face units are governed by ASTM C 90, which includes an allowance to account for the rough face. ASTM C 90 prescribes minimum faceshell thickness requirements for all loadbearing concrete masonry units, but also contains a variance for split face units where up to 10% of a split faceshell can be less than the minimum specified thickness, but not less than $\frac{3}{4}$ in. (19 mm). This 10% limit does not apply, however, when the units are solidly grouted. Walls utilizing a variety of split face units are shown in Figure 1.

Soft Split

A soft split unit is produced using a special mold which textures the face of the unit as it is removed from the mold. The appearance from a distance is very similar to that of a split face, while a closer inspection shows a surface that is not as well defined as that achieved with a conventional split face. In addition, aggregate is not fractured in a soft split as it is in a conventional split face unit. As a result, the final appearance is not significantly affected by aggregate choice.

Scored Units

Scored concrete masonry units are manufactured with one or more vertical scores on the face to simulate additional mortar joints in the wall. Scored units reduce the perceived scale of the masonry while still allowing construction using full sized units. The scores are molded into the face of the unit during manufacture. Units with one vertical score are most common, and give the appearance of 8 in. x 8 in. (203 x 203 mm) units laid in stack bond. Units may also be available with 2, 3, 5, or 7 vertical scores. Figure 2a shows units with 3 vertical scores in a standard sized ground face block.

It is usually desirable to lay units so that scores or ribs align vertically when the units are placed. This may require different bond patterns, depending on the configuration of the scores or ribs. For example, units with two and five scores can be placed in either stack bond or in a one-third running bond to align scores in adjacent courses. Other appropriate bond patterns are included in Table 1. Note that varying bond patterns can impact how the wall responds to structural loads (see ref. 1).

Ribbed Units

Ribbed concrete masonry units (often called fluted units) typically have 4, 6, or 8 vertical ribs which align to form continuous vertical elements in the finished wall. The ribs are molded into the unit using a special mold. The ribs may have either a rectangular or circular profile, and may be either smooth or split for added texture. Figure 1b shows an example of a wall using ribbed (fluted) split face units.

The ribs can be manufactured to project beyond the overall unit thickness (i.e., the unit thickness including ribs is thicker than a typical CMU), or with the rib projection included in the overall unit thickness. In the first case, the net area, and corresponding section properties, will be larger than those published for non-ribbed units, although the effect of this increase is typically neglected in structural calculations. In the second case, where the rib projection is included in the overall unit thickness, the designer should be aware that the actual bearing area, section modulus, and moment of inertia are less than those published for non-ribbed units.

When building concrete masonry walls, mortar is typically placed to all outside edges of the masonry unit. However, with ribbed units, it is difficult to properly tool the mortar due to the projections.

Ground Face Units (Burnished, Honed)

Ground face concrete masonry units are polished after manufacture to achieve a smooth finish which reveals the natural aggregate colors. The units have the appearance of polished natural stone. The finished look of the ground surface can be altered by changing aggregate type and proportions. Often, specific aggregates will be used to enhance the appearance of the polished surface (Figure 1c and 2a), while coatings are sometimes used to deepen the color. Ground face units are often scored to achieve a scale other than the conventional 8 x 16 in. (203 x 406 mm), as shown in Figure 2a.

Sandblasted Units

Sand (or abrasive) blasting is used to expose the aggregate in a concrete masonry unit and results in a "weathered" look.



(a) Scored and Ground Face

(b) Glazed

(c) Slump Block

Figure 2—Additional Examples of Architectural Concrete Masonry Units

Striated (Raked) Units

Striated units achieve an overall texture by means of small vertical grooves molded into the unit face. The striations are most often random, to achieve a naturally rough look, but are sometimes available in uniform striation patterns. Striation can be applied to scored and ribbed units as well (see Figure 3c).

Glazed (Prefaced) Units

Glazed concrete masonry units are manufactured by bonding a permanent colored facing (typically composed of polyester resins, silica sand and various other chemicals) to a concrete masonry unit, providing a smooth impervious surface. The glazed facings must comply with ASTM C 744 (ref. 4), *Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units*, which contains minimum requirements for facing quality and dimensional tolerances. In addition, the unit to which the facing is applied must comply with ASTM C 90 when used in loadbearing applications. The glazed surface is waterproof, resistant to staining and graffiti, highly impact resistant, as well as being resistant to many chemicals and bacteria. Special admixtures and mortars are available for use with glazed units that provide better stain, bacteria, and water penetration resistance.

Glazed units are available in a variety of vibrant colors, pastels, earth tones, and even faux granite and marble patterns. They are often used for brightly-colored accent bands, and in gymnasiums, rest rooms, and indoor swimming pools where the stain and moisture resistant finish reduces maintenance. Kitchens and laboratories also benefit from the chemical and bacteria-resistant surface.

Offset Face Units

Units with an offset face produce a very highly textured wall, with strong patterns of light and shadow. The offsets make it appear as if adjacent units are staggered. This effect is accomplished by using a unit mold with the desired offsets.

Slump Block Units

Slump block concrete masonry units have a rounded face that resembles handmade adobe. They are more commonly available in the Southwest United States where adobe is part of the architectural heritage. Conventional concrete masonry units are manufactured using a “no-slump” concrete mix, which holds its shape when removed from the manufacturing mold. Slump units, on the other hand, are manufactured using a concrete mix that slumps within desired limits when removed from its mold (see Figure 2c).

Slump unit widths may vary as much as 1 in. (25 mm). For this reason, the structural design should assume the actual width of slump units is 1 in. (25 mm) less than the nominal dimension.

COLOR

Architectural concrete masonry units are often integrally colored to enhance the appearance or achieve a particular effect. Concrete masonry units are colored by adding mineral oxide pigments to the concrete mix. Mortars can also be integrally colored to blend or contrast with the masonry units.

The final unit color varies with the amount and type of

pigment used, cement color, aggregate color, and the amount of water used in the mix (a wetter mix will generally produce lighter and brighter colors). Both white and gray cements are available. The use of white cement results in more vibrant colors, but also increases cost. The aggregates used in the concrete mix also impact the final appearance. Because of these varying factors, there are typically some subtle variations in color among units. When units must be exactly the same color to achieve a particular architectural effect, uncolored units should be used, then painted or stained the desired color.

Variiegated units provide color variations within each unit, producing a marbled effect. These units are manufactured by mixing two different concrete colors into the same unit mold.

STANDARD UNIT NOMENCLATURE

As with many construction products and systems, there are often regional differences in terminology for the same type of architectural concrete masonry units: ribbed and fluted, ground and burnished, etc. The National Concrete Masonry Association has developed a standardized nomenclature (see Table 1) which can be used to avoid confusion when specifying and supplying masonry units. (See Figure 3 for examples).

Table 1 – Standard Unit Nomenclature (ref. 2)

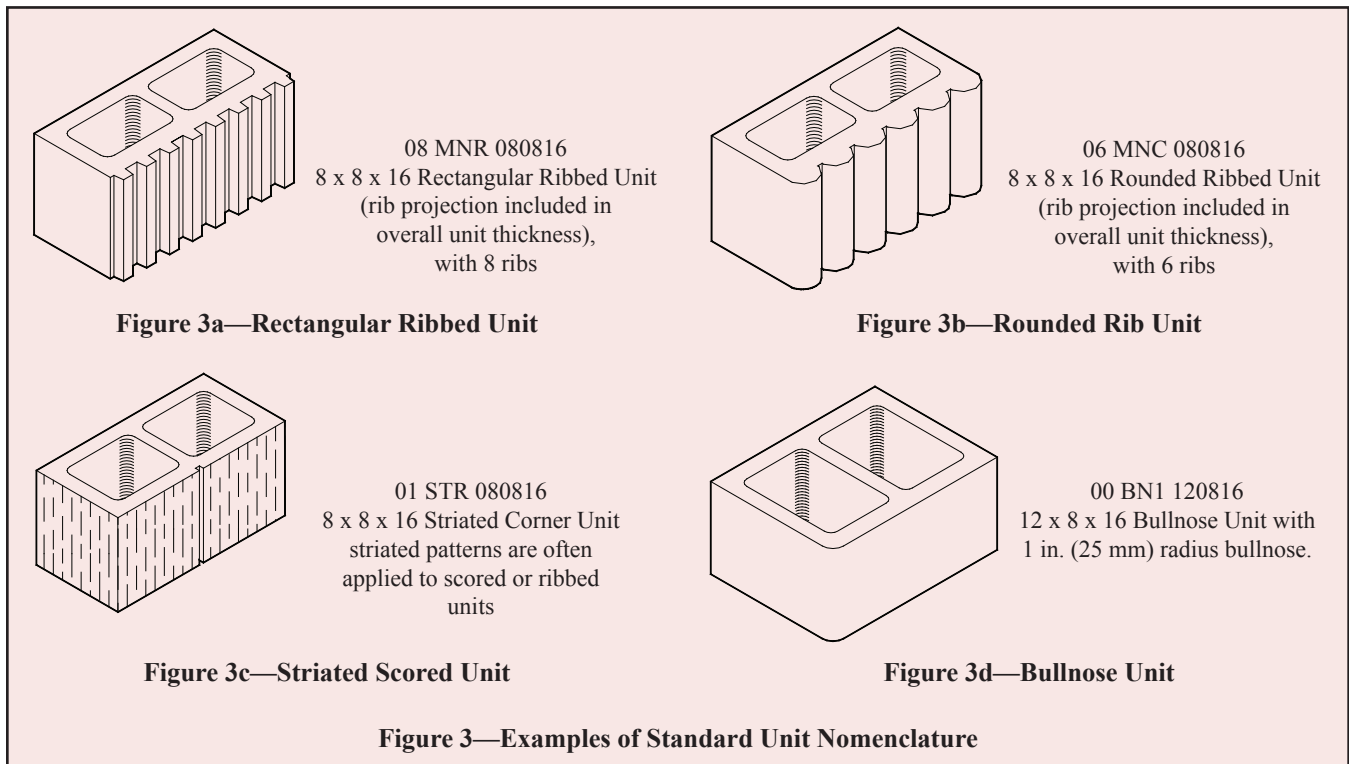
Each unit is described using a three-part code in the following format: XXYYY WWHLL, where “XX” describes the number of scores or ribs, “YYY” describes the architectural finish, and WWHLL describes the overall nominal unit dimensions for width, height, and length. The various codes are described below.

Scores or Ribs:

| | |
|----|--|
| 00 | no scores or ribs, applicable for any running bond |
| 01 | one score, applicable for one-half running bond (units overlap the unit above and below by one-half the unit length) |
| 02 | 2 scores, applicable for one-third running bond |
| 03 | 3 scores, applicable for one-half or one-quarter running bond |
| 04 | 4 ribs, applicable for one-half or one-quarter running bond |
| 05 | 5 scores, applicable for one-half running bond |
| 06 | 6 ribs, applicable for one-half running bond |
| 07 | 7 scores, applicable for one-half or one-quarter running bond |
| 08 | 8 ribs, applicable for one-half or one-quarter running bond |

Architectural Finish:

| | |
|-----|--|
| BN1 | bullnose unit with 1 in. (25 mm) radius bullnose |
| BN2 | bullnose unit with 2 in. (51 mm) radius bullnose |
| SCV | vertically scored unit |
| GRF | ground face unit |
| MDC | circular ribs, rib projects beyond the overall unit thickness |
| MNC | circular ribs, rib projection included in overall unit thickness |
| MDR | rectangular ribs, rib projects beyond the overall unit thickness |
| MNR | rectangular ribs, rib projection included in unit thickness |
| STR | striated unit |
| STS | striated unit, 1 in. (25 mm) uniform striation pattern |
| STT | striated unit, 1/16 in. (1.6 mm) uniform striation pattern |
| SPF | split face unit |
| NPF | split face ribbed unit, rib projections included in unit thickness |
| SLP | slump block |
| **Q | locally provided product |



REFERENCES

1. *Concrete Masonry Bond Patterns*, TEK 14-6. National Concrete Masonry Association, 1996.
2. *Concrete Masonry Shapes & Sizes Manual*, CM 260A. National Concrete Masonry Association, 1997.
3. *Standard Specification for Loadbearing Concrete Masonry Units*, ASTM C 90-00. American Society for Testing and Materials, 2000.
4. *Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units*, ASTM C 744-99. American Society for Testing and Materials, 1999.

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