USE OF REINFORCEMENT

One of the advantages of Cast Stone over natural stone is its ability to contain reinforcement for added flexural strength. This gives the cast stone an advantage by combining the high compressive strength of the stone with the flexural strength of billet steel reinforcing bars to provide safety and control of cracking. Despite this advantage, cast stone is an architectural element and should not be used to support the building structure or load bearing elements. A structural engineer should design reinforcement for structural or unusual situations.

According to ASTM C1364 – Standard for Architectural Cast Stone the steel reinforcement shall meet the requirements of ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Reinforced Concrete, unless otherwise specified by the purchaser. Other types of reinforcement include wire reinforcement meeting the requirements of ASTM A1064 / A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete, however, welded wire fabric reinforcing shall not be used in Vibrant Dry Tamp (VDT) products. All types of reinforcement should be shown on the shop drawings that are submitted by the manufacturer for approval.

The size of reinforcing bars is classified by a number that corresponds to its diameter in eighths of an inch. The typical sizes used to reinforce Cast Stone are #3 and #4 which are nominally 3/8” or ½” diameter respectively. Deformed bars, with their deformations, are slightly larger than plain bars and do a better job of bonding with the concrete and resisting tension.

Some manufacturers use fiber reinforcement to control plastic shrinkage and thermal cracking. This secondary reinforcement in the form of fibrous nylon meeting the requirements of ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete may be used, but is not a substitute for conventional steel reinforcement.

It is important to understand that Cast Stone units do not always need integral reinforcement included in their design. Many typical applications such as where the material is used as a replacement for natural stone, masonry units or other non-structural applications do not benefit from steel to control cracking. In general, steel should be added to the design only when necessary for safe handling, setting and structural stress.

Typical minimum reinforcement for all other units shall be not less than 0.25% of the cross section area.
Units greater than 24 in. (600 mm) in one direction shall be reinforced in that direction. Units less than 24 in. (600 mm) in both their length and width dimension shall be non-reinforced unless otherwise specified.
Lintels, units supported by suspension connections and other structural applications should have reinforcing requirements reviewed by a professional engineer as needed.

The minimum concrete cover for all reinforced units is twice the diameter of the reinforcing bars and should be non-corrosive when covered with less than 1-1/2” of material. Non-corrosive bars should be touched up with zinc or epoxy paint wherever they have been cut through to plain steel during the reinforcement fabrication process.

The tying together of reinforcing sections prior to unit fabrication is not usually required with the Vibrant Dry Tamp (VDT) units because the reinforcement is embedded into a layer of consolidated fresh concrete material during the manufacturing process. Some structural applications however may require flat bar mats to be used. The use of three-dimensional reinforcing cage assemblies with stirrups is not appropriate for Vibrant Dry Tamp (VDT) units because of the non-fluid nature of this consolidation process.

Units manufactured from wet cast concrete must have their reinforcement materials sufficiently rigid to prevent dislocation during the pouring process and to maintain the required cover over the reinforcement. The reinforcement must be accurately and carefully located and secured within the mold. Rebar chairs, which support the reinforcing away from the face of the mold, are not recommended with Cast Stone. Special procedures must be followed to prevent reinforcing from creating shadow lines on the face of the units when this production method is used.

Reinforcing bar sizes in panels should be kept small even where this will decrease the spacing of the bars, to resist cracking and improve temperature stress distribution. Reinforcement should be placed symmetrically to prevent warping of longer units. Typical spacing of transverse reinforcement, when required, is 12" on-center and should not exceed 18" between the bars.

One important misconception about reinforcement in concrete is that it will prevent cracking, but reinforcing steel will only serve to control cracking from extending and limiting its width. No amount of conventional reinforcing will reduce the likelihood of cracking when units are designed excessively long and thin. To prevent cracking the Cast Stone Institute suggests that designers consult with the manufacturer before drawing units that exceed fifteen (15) times their average effective thickness.