Melton Classics Incorporated

DESIGN TIPS – TECHNICAL BULLETIN #50

AIR ENTRAINMENT REQUIREMENTS

In many project specifications today, air entrainment is specified for Cast Stone mixtures when it is only required for units manufactured from wet-cast slump concrete. It is not necessary to add air entrainment additives to units manufactured from zero slump mixes. Accordingly, ASTM C 1364 Standard Specification for Architectural Cast Stone only requires mixtures to contain air entrainment additives for units manufactured from slump concrete mixes.

In order to maintain a durable Cast Stone product, which is subjected to freezing and thawing cycles, it is important to understand what makes the product deteriorate. In the late 1930's, air-entraining agents were recommended for wet (slump) concrete to increase their durability. The air-entraining agents stabilize billions of microscopic spheres in the cement paste that surround the concrete aggregates. These microscopic spheres allowed absorbed water to expand in the spheres during the freezing cycle. Liquid water expands approximately 9% when it freezes. These spheres provided for built-up internal pressure of the freezing water to be released. Without these air spheres the internal pressure would cause the cement paste to rupture and fail. With repeated freeze-thaw cycles the cement paste will continue to deteriorate and cause severe spalling of the concrete. Cast Stone made with slump concrete requires air entrainment in order to minimize freeze-thaw deterioration.

Air-entraining admixtures in dry tamped Cast Stone mixes have not proven to increase the freeze-thaw durability. Petrographic analysis of Cast Stone made with air-entraining admixtures have shown that the microscopic spheres are not uniformly spaced throughout the mix like wet concrete, but have been condensed into pockets during the tamping process. Integral water repelling admixtures, however, have resulted in an improved durability factor over Cast Stone without any admixtures. Tests conducted on dry tamped units manufactured in accordance with ASTM C 1364 with air-entraining agents did not show improved freeze-thaw results.

Unlike wet concrete mixes, dry tamped Cast Stone mixes do not develop a water rich paste to surround the aggregates. Excess water in dry mixes is undesirable because the mix becomes more plastic and tends to slump. Aggregates in dry tamped Cast Stone do not float in a wet paste; they are compacted to such a degree that there is point-to-point contact of the particles. The aggregate particles are coated with a thin cement film to provide bonding and strength with a minimum amount of shrinkage.

Vibrant Dry Tamped Cast Stone (VDT) is manufactured using earth moist mixes having a minimum amount of water in the mixture. This low water content and the tamping process reduces the amount of capillary pores in the VDT thereby minimizing the amount of water that can penetrate into the concrete and potentially cause freeze thaw stresses. Therefore, VDT Cast Stone has an appropriate pore structure, which will accommodate the hydraulic pressure necessary to prevent distress during freezing and thawing cycles. The high strength and low water absorption of VDT cast stone provides a durable building material that can withstand the most severe climates. It is, therefore, frost resistant, provided the degree of water absorption does not exceed a critical amount.

In order to insure freeze-thaw durability, the Cast Stone Institute® and ASTM Specifications require that both wet and dry cast products have a maximum 5% weight loss when subjected to 300 rapid freeze-thaw cycles as prescribed by ASTM C 1364. 300 freeze-thaw cycles is approximately equal to 100 years of natural weathering in the Northern hemisphere climate. This criterion for Cast Stone exceeds other similar types of building products being used today.

Product Type	Specification Number	ASTM C 1194	Air Content Range (Cast Stone Institute® Spec 04 70 00-04)	ASTM C 1195	ASTM C 666
Cast Stone (Dry)	ASTM C 1364	6,500 psi min.	N/A	6% max absorption cycles	5% maximum loss @ 300 freeze-thaw
Cast Stone (Wet)	ASTM C 1364	6,500 psi min.	4% - 8%	6% max absorption cycles	5% maximum loss @ 300 freeze-thaw