ARCOSA
LIGHTWEIGHT

WHITE PAPER:

New Product Application: Restoration of Historic Masonry

The world of preservation has a new ally as Arcosa Lightweight finds itself center stage in the development of new product applications for the restoration of historic masonry. Is vacuum saturated expanded shale the answer? VoidSpan Technologies President and PE John Wathne says yes.

www.arcosalightweight.com

"Arcosa has been instrumental in helping us develop a new, state-of-the-art method of restoring and partially rebuilding badly damaged stone structures".

The Need:

As you look at an old stone building you see a well-placed arrangement of variously sized stones on the exterior, which give an overall impression of a very tightly woven matrix of well-placed stones. Unfortunately, other than for historic lighthouses and fortresses, the outer layer of stone is often just a variably thick skin, which is bonded onto a randomly placed back-up masonry structure behind it. The back-up structure might be coursed brick, or very often a haphazardly placed stack of random rubble stone and fragments laid in a soft lime or partially bonded cement and lime mortar.

As these structures age, water seeps through the joints and gaps between the face stones and saturates the material just behind them. In temperate climates these materials freeze, thaw and deteriorate, allowing the face stones to become loose, and the outer portion of the back-up construction to disintegrate.

The most common fix for this condition is to remove and re-set the face stones and lock them into place with stainless steel ties. During this process, the disintegrated portion of the back-up construction must be removed as well, leaving as much as 4 to 8 inches of void space behind the face stones, which must be filled.

The Problem:

Usually when this happens, masons fill the space with lots of mortar and as many loose stones as then can fit in. The mortar then shrinks as it cures, causing micro-cracks to form between the face stones and the back-up construction. For the sake of material compatibility, the re-setting mortar

In 2019, Story Chapel, a historic structure in Cambridge, Massachusetts underwent a two-year exterior masonry repair project. Work included rebuilding many of the building's stone buttresses, and extensive repairs to the stonework on the upper portion of the chapel's tower.

should contain nearly as much lime as the original. However, lime needs carbon from the surrounding atmosphere to harden, and in such enclosed spaces it often does not fully cure, but instead seeps out, causing white streaks to form on the exterior. This can happen slowly over many years.

The Challenge:

VoidSpan manufactures an ultra-low-shrinkage pozzolan-lime-based grout that is used to economically fill such cavities when the gaps are up to about 2- to 4- inches thick. The lime provides compatibility with the historic parent materials, while the pozzolan reacts with the lime to enable it to harden in an enclosed environment. For much wider cavities, however, the cost of a high-volume pozzolan-lime grout pushes the limits of economy, and the large dimensions increase the possibility of shrinkage.

Professionals with Phoenix Bay State Construction of Boston utilized EXTEND AGGREGATE in the replacement mortar for Story Chapel. Here, the product is being mixed to a flowable, fluffy consistency prior to placement.

In order to combat this, VoidSpan started looking for a coarse aggregate to extend its grout. The aggregate had to be less expensive by volume than the grout, and would need to have about the same density as the grout so as not to segregate. The cost differential would lower the overall in-place cost of the mix, and the larger particle size would further reduce the possibility of shrinkage. VoidSpan tested several types of aggregate.

Among these were natural “pea stone”, which is heavier than the grout and separated and piled up in the bottoms of the fills within mock-ups; expanded clay, which was too light and floated to the surface; and typical expanded shale, which while being closer in specific gravity to the grout, was too absorbent and would suck water out of the grout, reducing flow and the ability to cure.

Arcosa to the Rescue:

Faced with this conundrum, Wathne, who is very involved in ASTM, happened to be speaking with Jeff Speck of Arcosa Lighweight, at an ASTM committee meeting.

Jeff said that Arcosa had a vacuum-saturated expanded shale aggregate that would infuse humidity and aid in the cure of the grout, rather than suck the moisture out of the mix. After a period of testing and trials, Arcosa’s vacuum saturated expanded shale was found to be the perfect aggregate to extend VoidSpan’s PHLc Grout, and is now offered by VoidSpan under the fitting brand name, “EXTEND”.

Restoration projects that have utilized EXTEND AGGREGATE include churches, commercial buildings and at least one fortress.

“The beauty of this product is that it can be blended on site with already mixed grout,” says Wathne. “By simply dumping the proper proportion of EXTEND into the grout pail and giving it a stir, the masons can turn a fine flowable PHLc Grout into a PHLc ‘concrete’ in as little time as it takes to mix it.”

For more information on PHLc Grout and EXTEND, contact John Wathne at jwathne@voidspan.com.