TRULY Custom Repair Mortars Are Much More Than Just Color-Matched

Getting the Science Right for Long Term Success

Although esthetic repair systems using prepackaged custom-matched repair mortars have been around for some 40 years, the products available today are significantly different from each other. While immediate esthetic goals usually focus on achieving repairs that aren't too visually obvious, there are important elements to formulating custom mortars that directly impact not only esthetic qualities, but performance and durability as well.

Systems that rely strictly on pigment additions to a "universal" neutral base are not formulated for either best performance or best esthetics. To achieve those goals, custom mortars must be particular to the composition, hardness and thermal expansion characteristics of the substrate to be repaired and should also consider how appearance naturally changes over time.

***Photos**: 1. (Upper left) A color target is used to create calibrated digital color photographs for use in matching color of **REPLIC-8** concrete replication mix, Madison Avenue Bridge over Connecticut's Merritt Parkway. The mix utilized sand and coarse aggregate matching the originals, a blend of white and grey cement to match the tone of the original 1935 cement matrix, and trace amounts of iron oxide pigments to fine-tune overall color.*

*2. (Upper right) Repaired brownstone sill using **Custom 45 Type SD** for sandstone, and a block of the original stone. Initial color of repairs is darker to account for the natural color muting that occurs in all cement products during the first months of cure after application. Courtesy Ganem Contracting.*

*3. Application of **Rosendale 13P Type MR** marble patch at the U. S. Capitol. Most of the repair mortar's composition is natural marble aggregate.*

"Hardness"

It has long been understood that repair systems that are too hard may cause distress and failure in the softer host substrate over time. That's why Edison Coatings formulates its various grades of repair mortars to be close to the strength of the substrate being repaired. While compressive strength is not the only mechanical property of interest, it is a convenient benchmark, as other properties tend to be in proportion to compressive strength.

SUBSTRATE	CUSTOM 45 TYPE	SUBSTRATE COMPRESSIVE STRENGTH	REPAIR MORTAR COMPRESSIVE STRENGTH
SANDSTONE I ASTM C616	Type SD	Min. 2000 psi	2685 psi
LIMESTONE II ASTM C568	Type LC	Min. 4000 psi	4313 psi
MARBLE ASTM C503	Type MR	Min. 7500 psi	4285 psi
HISTORIC CONCRETE	Type CN	Typ. 3000-4000 psi	3739 psi
MODERN CONCRETE	Type CN Custom	Typ. 4000-7000 psi	6700 psi

Matching compressive strengths precisely is generally not feasible, as the original materials themselves can be variable in strength. For softer substrates like sandstone, the repair mortar may be somewhat higher in compressive strength than the minimum stone hardness. The use of polymer-modification technology increases the repair mortar's capacity to deform under load and relieve stress, however, imparting to the repair mortar the behavior of a softer material, even if compressive strength is slightly higher. For higher strength substrates like marble, the need to limit shrinkage and provide good workability are arguments for formulating repair mortars that limit cement content and as a result are softer. For all formulations, however, a TRULY custom repair system includes the capability of creating harder or softer variations on the basic formulas as required.

Matching Aggregates

Although color matches based on pigmented matrices can provide good initial esthetics, as the repair mortar matrix weathers and slowly wears away appearance will become increasingly influenced by aggregate color, shape and size. Standard color bases offered by other manufacturers have no capacity to provide custom-matched aggregates and rely entirely on pigment additions. As such, repairs that may initially appear to be adequate color matches will become more conspicuous over time.

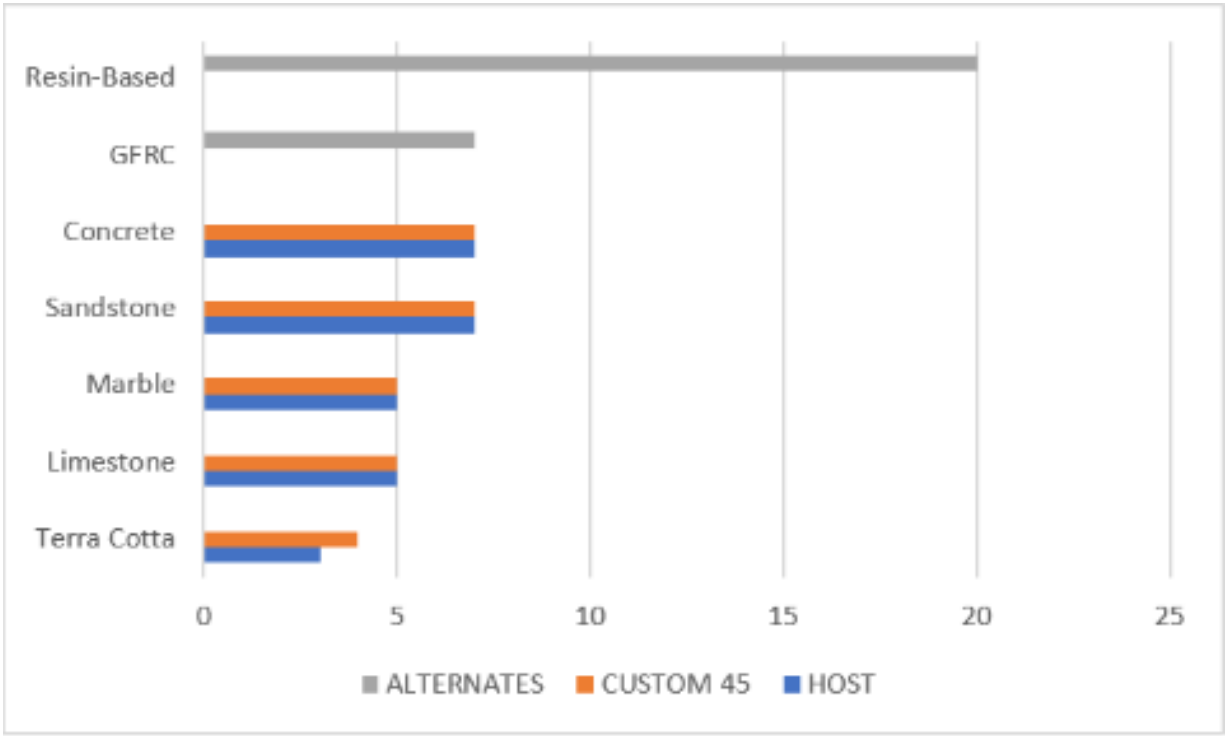
Matched aggregates are an important feature of Custom System 45 repair mortars. Not only do they assure that long-term color compatibility will be maintained, they also allow for better, more detailed matching to the appearance of the host substrate.

***Photo**: Natural Connecticut Valley brownstone sand used in Custom System 45 Type SD Brownstone repair mortars. Aggregates that are close to the color and composition of the host stone provide better detail and long-term color retention than simple pigmented cement matrices. Sands can also be custom-sieved to provide better texture match to each individual host stone.*

Thermal Expansion

Not all substrates behave the same way as temperatures rise and fall. Though all expand when heated and contract when cooled, the extent to which they react to temperature changes can be very different. The ability of a repair mortar to closely match the rates of thermal expansion and contraction of the host substrate is particularly important when installing larger and deeper repairs. Standard repair mortars that are simply pigmented to match color cannot differentiate between substrates, and mismatched thermal expansion properties induce stress between the host and the repair every time temperatures change. Over time, this tends to distress the softer material, leading to failure in either the repair or the substrate.

Custom System 45 repair mortars, formulated in 10 different grades, account for thermal expansion characteristics as well as other properties. (Values below are in/in/^{0}F x 10^{-6}).



Typical Coefficients of Thermal Expansion

Exposed Aggregate Concrete

Exposed aggregate finishes may either be original or a result of weathering and erosion of surface cement paste. Simply matching overall color of the matrix generally does not produce an esthetically acceptable repair, as textural differences and lack of detail are visually obvious, even when viewed at a great distance. Surface-embedding of aggregates into a general repair mix also tends to produce unsightly repairs (*photo, left).*

Edison Coatings Custom 45 Type CN repair mortar and REPLIC-8 concrete replication mixes are designed to incorporate coarse and fine aggregates matching the original components. A series of techniques is then available for exposing the aggregates to match the surrounding area. Sourcing of matching aggregates is often the greatest challenge in executing closely-matched exposed aggregate repairs. Once good, matching aggregates have been identified, Edison Coatings can assist the Contractor in selecting the appropriate techniques for achieving close matching repairs.

Photos: Mockup panel, above. Custom-matched exposed aggregate repairs utilizing REPLIC-8, left. The two scaffold drops on the right are in progress. The four drops to the left are completed. Courtesy Atlantic Co. Of America.