CHAPTER 18 - REHABILITATION AND REPAIR OF STRUCTURES

M du Rand

18.1 SCOPE

Repair of structures is not defined as reinforced shuttered concrete. Margins for error are smaller and the work must be correct the first time. Repair is done using proprietary products each with their own characteristics. It is of paramount importance that technical representatives monitor and ensure their products are applied in accordance with the manufacturer’s instructions and that the applicator has previous repair experience. Each product has a data sheet and this must be on site and understood by the applicator. Material suppliers should submit a written report to the Contractor after each visit and at a minimum of monthly intervals. It is not necessary that the Resident Engineer receives a copy, but be aware that the materials are correct for the application and are being correctly applied. The Resident Engineer is not the Contractor’s foreman or policeman. Contract Document Specifications are often generic and due care and diligence is needed in the application. Experience is pivotal to success. It is good practice that the Contractor’s skilled personnel have attended a short competency or product knowledge course by the Supplier on site or at their premises.

18.2 MORTAR REPAIR

(a) Preparation is important;
(b) Edges must be neatly saw-cut at least 10 mm;
(c) Substrate must be sound and wet;
(d) Not all systems require a primer;
(e) If primed the primer should not have exceeded its pot-life;
(f) Mortar application thicknesses are limited and material may require scratch coats;
(g) Mixing should be done by mechanical tools or mixers;
(h) Dosing of material, water or polymers is critical and should be done exactly with measuring devices, beakers or measuring jugs are examples;
(i) Material that has exceeded its pot-life or mixing life, should be discarded and a fresh batch mixed;
(j) Polymer modified mixes do not require curing as they form curing membranes;
(k) Hot weather, cold weather and wind can affect application, Supplier can advise;
(l) Attend a supplier’s training session for some insight into the process;
(m) Mortar repairs should be worked as little as possible. Excessive wood and steel trowel floating to obtain aesthetic look are bad because it draws water from the mix to the surface and increases the water cement ratio on the surface skin. This will result in crocodile cracking before the end of the defects period. Work as little as possible.

18.3 GROUT REPAIRS

(a) Grout is simpler than patch repair and more suited for larger repairs;
(b) Preparation is standard as in mortar repair;
(c) Mixing and water calibration very important. Pumping of grout is good as it extends mixing;
(d) Repair contractors do not always have a structural awareness of how far they can demolish columns, slabs or beam. Method statements on structural elements must define demolition limits to maintain structural stability;

(e) Soffits, underwater work and foundations need extra care and experience. Soffit repairs require methods to avoid air entrapment;

(f) Grouts give high early strengths. Some more than others and some proprietary grouts pump better than others. Different equipment will vary effect slightly.

(g) SANS 1200 does not have a specified procedure for testing grout cubes. RE should agree indicative methods of testing with supplier and contractor – 100 mm x 100 mm x 100 mm cube moulds are one practical method. Drop in indicative strengths are often caused by excessive water content. Water dosing accuracy is critical;

(h) Quality Assurance plan of contractor should record batch numbers. Shelf life of product should not be exceeded. Supplier product failures are very rare. Problems usually occur in incorrect product selection or incorrect application. In Africa the human element plays a big role and applicators tend to get complacent. As in mortars the manufacturer plays an important role in ensuring the correct product is correctly applied with random checks;

(i) Splitting of kits are not recommended but can be done if carefully managed and measured.

18.4 COATINGS

(a) Coatings are basically pure chemistry developed over years by the supplier’s chemists. The window of latitude is limited as is wind, temperature, moisture content and application method. If correctly applied there will be no problem;

(b) Coatings fall into various categories and may depending on the designer and supplier consist of two differing products for one coating system. In civil engineering a coating has a primary function of protection and secondary of aesthetics. Do not try and work coatings once applied. Their chemistry starts quickly and should not be disturbed;

(c) Coatings are generally Cementitious, Epoxy, Polyurethane, Silicones or Acrylics. Preparation involves one of water jetting, sand blasting, wire brushing, flail scabbler and in limited cases no preparation. Trial sections with supplier and manufacturer helps establish a baseline and develop a method statement. Coatings have developed to a point where very few require curing with water;

(d) Overnight freezing can affect the day’s coating. Wind-chill factors or excessive wind can cause damage. Heat from adjacent machinery or excessively hot day temperatures can cause damage. The supplier is best to advise and in some circumstances can do a minor adjustment to their batch process.

(e) Coatings such as epoxy and polyurethane that go onto steel need to be applied away from dew point. Coatings that are trowel applied need a higher level of skill than block brush applications. Generally coatings are thin. Spread is important. Ten percent variation on a five hundred micron coating is close to the contractor’s profit or can be below the client or manufacturer’s specification. More risk exists in coatings than repair material for the client and contractor. The most practical method is to mark out the coverage for an area a kit size can cover then the applicator is to apply the material evenly. Kit sizes should be selected for the area to be covered. Large kits can be split but must be measured with science not the eye. On steel stripe coats edges are very important. Sloping, vertical and soffits require more skill. Complex structures need attention to even coverage;

(f) Mechanical equipment does sometimes get used to apply coatings but is sophisticated, is expensive to purchase and maintain. Operators are often not freely available. Blockages often result in addition of water or thinners to assist application which destroys the product’s
operational characteristics. Supplier monitoring of equipment applied product should occur on a regular basis.

18.5 MEASUREMENT & PAYMENT

(a) Keep an accurate check of product used. The theoretical coverage is a good correlation to actual measured if there is very little wastage;

(b) Agree and sign off quantities regularly. Do frequent checks initially to establish a credible system and don’t leave it to month end;

(c) Quiz the contractor on his programme and resources to check stock levels, especially if some distance from supply. Try not to store too much material on site when in summer at elevated temperatures or rainy season. As a general rule two months’ stock on site is rule of thumb, depending on geographic location.

18.6 ACCESS

(a) Some repair projects are called access projects. This occurs when the cost of access or complexity exceed the repair product value. If rope access is used the product and method of preparation and application should match the circumstances. Mixing and storage of product should not overload the system or create conditions where artisans cut corners because they run out of water or primer, or access must be removed for road or rail operation;

(b) Most access is priced as a lump sum. Serious problems and claims occur if the quantity of repair or coating increase considerably resulting in more access or longer access. Unresolved issues like this create discord. It is important an RE continually establishes the facts of the matter, contractual progress and site circumstances and communicate these to his engineer and client. Contractual issues are best resolved early and not at the end of the project when facts can become a little cloudy. Fairness from all parties must prevail.
Photo 18.2: View of spalled concrete before repairs

Photo 18.3: Saw cutting around repair area
Photo 18.4: View of reinforcing coated with zinc rich primer

Photo 18.5: Removing damaged concrete
Photo 18.6: Removing damaged concrete

Photo 18.7: Applying protective coating
Photo 18.8: Removal of damaged concrete

Photo 18.9: Access scaffold
Photo 18.10: Preparation of repair area

Photo 18.11: Preparation of steel railing before painting