Chapter 9
Repairs and Final Finishing

9-1. Tolerances

a. Specifications. The specifications should list the proper procedures and timing for repairs which become necessary for the architectural concrete. Trial repairs should be required on the field mockup prior to attempting them on the production of architectural concrete. It should be clear in the specifications that repair procedures must be approved prior to actual use. Tolerances of an acceptable appearance can be determined by a review of the field mockup.

b. Mockup. Although the main purpose of a field mockup is to determine the effectiveness of the contractor's proposed materials and procedures to produce the desired architectural appearance, the mockup should also be used to determine whether his methods, materials, and personnel will result in non-contrasting repairs. If the mockup is sized properly to include all of the contractor's procedures and formwork details, opportunities will be available to test the contractor's repair methods.

9-2. Finishing Methods

a. As-cast surfaces. Depending on the designer and the specifications, an as-cast surface may be left without any additional work or, to improve uniformity of appearance, sack rubbing may be required. For architectural concretes the sacking mix should be formulated and tested on the job site mockup for color uniformity. It is important that an entire exposed surface or structural member such as a pier, column, or wall be done at one time to ensure a uniform appearance. A typical mixture for sack rubbing consists of one part cement to two parts by volume of well-graded sand passing a 600-μm (No. 30) sieve with sufficient water to produce a grout having the consistency of thick paint. Some white cement should be included to prevent the appearance of dark spots. The surface should be wet to prevent absorption of water from the grout. The temperature of the air adjacent to the surface should not be less than 10° C (50° F) for 24 hr prior to and 48 hr after application of the sack-rubbed finish. The mortar should be applied with clean burlap in a uniform coat so as to fill all holes and depressions. Excess mortar should be scraped off with a trowel. When the surface is firm and dry enough to stay within the holes, the surface is rubbed vigorously with dry burlap. Curing is required for the next 48 hr. No visible film of mortar should remain. All areas should be completed the same day. Any remaining streaks or dark spots can be fine-honed carefully so that the surface texture is not altered.

b. Form tie holes. Tie holes can be left visible as part of the architectural pattern, partially filled, or completely filled. Even though tie holes are left unfilled, sufficient grout must be inserted to protect the remaining metal portion from rusting. Precast colored or gray plugs are available to fill tieholes. If the concrete surface is to be textured by sandblasting or bush hammering, or is to be tooled, filling of tieholes should be delayed until completion of treatment in order to determine what texture and color are to be matched and to prevent the material from being removed during texturing. Tie holes should be filled with a wood rod having a rough end. The use of a steel rod or piece of reinforcing steel tends to polish the tamped material so that it does not bond to the last layer. Subsequent shrinkage may loosen these partial plugs enough to fall out. The mixture for the tieholes should not contain any epoxy or acrylic, as both tend to darken the patch permanently. In some cases, the epoxy has been affected by the sunlight and discolored.

9-3. Defect Repair

a. As-cast surfaces. Defects in surfaces having a permanent as-cast finish should be repaired as soon as forms are removed, as this allows the concrete and the repaired defect to age together and be uniform in color. Repairs to edges of rustication, broken ribs, or other projections may require replacement of small portions of forming. One part of portland cement containing a portion of white cement, which is needed for a resultant color match with the original concrete after drying, to 2-1/2 parts of fine sand has been used successfully for repairs. If the concrete has a colored admixture, it should be added to the patching compound in an amount to match existing concrete. The proposed mixture should be used on the field mockup to determine color

matching effects of aging. The mix water may contain 30-percent acrylic to assist bonding if no significant color contrast occurs. Use only enough mix water to be able to place the repair material. Too much water or acrylic will cause crazing. To assist bonding, the in-place concrete may be painted with acrylic just prior to application of the repair material. Mixtures containing acrylics should be mixed no longer than 2 min to prevent excessive generation of air. Acrylic mixtures or patching materials should be placed on acrylic-covered surfaces within 20 min, as acrylics tend to glaze after that time. Curing of the repair should start immediately after completion. Convenient methods are application of a curing membrane that is compatible with specified sealers or sealants, or taping over a sheet of polyethylene to retain the moisture. In either case, the repair should not be allowed to dry out prior to application of the cure. Repair containing acrylic should be allowed to dry out after 72 hr of moist cure. To eliminate feather edges, all repairs should have a minimum depth of 6.3 mm (1/4 in.) at the edges. Upon completion, the repair should match the overall texture of the as-cast surface.

b. Exposed aggregate surfaces. Minor repairs of surfaces having exposed aggregates should not be done until the aggregate is exposed. Once the aggregate is exposed, repairs can be matched to the resulting color and texture. An acrylic can be used for bonding the new repair material to the in-place concrete. Checking the color match of the repair mixture will determine whether it can be used integrally in the mixture. Major repairs requiring replacement with the actual concrete should be done as soon as possible after the forms are removed, in order that the new and old concrete can age together for uniform strength and color. All proposed repair mixtures and methods should be tried on the field mockup prior to the final surface.

c. Needle gun. A tool new to concrete repair is the needle gun, which is normally used for scabbing steel plate. The needle gun has a number of metal rods with chisel points. It can be used to remove the contrast associated with the dark lines caused by form leakage and the dark streaks from mortar splattered on the form face both of which are too hard to remove by sandblasting. Judicious use and continuous replacement of rods to maintain sharpness will make the needle gun an effective tool. A typical needle gun used for repair of textured architectural concrete surfaces can be found in Figure 9-1.

9-4. Stain Removal

Stains are difficult to remove from concrete without some effect on the surface texture, as some of the material has usually been absorbed into the concrete. Prevention is the best possible insurance. Care not to allow iron or steel to rest against or on completed concrete will prevent rust staining. Once present, a rust stain may be removed by soaking for 10 min, accompanied by brushing periodically, with a solution containing 30 ml (1 oz) of sodium citrate per 180 ml (6 oz) of water. This is followed by applying crystals of sodium hyposulfite and covering the area with a paste of fuller's earth and water. The material is removed after drying for 10 min and flushing the area well with clean water. The process may have to be repeated. For many of the stains caused by other materials such as food, there are commercial cleansers. Efflorescence and calcium carbonate deposits may be removed from the concrete with mild solutions of muriatic acid. The surface should be thoroughly flushed with water to remove the acid, as delayed or incomplete removal may etch the concrete. It is difficult to use acid on vertical surfaces due to nonuniform application and running. A last resort is to use a light sandblast if the resulting texture can be accepted. A trial on an area not visible to the public will provide an example for determination. Generally, sandblasting cannot be limited to a small area, as the difference in texture will contrast.

9-5. Protective Coatings

a. Clear coatings. Generally, clear coatings are not necessary unless used to protect a textured surface against weathering and freeze-thaw in severe or ocean climates, graffiti, staining from spillage in eating areas, or to prevent color changes due to airborne pollutants. Many coatings are proprietary and should be tested on the field mockup for yellowing, chalking, and effect on concrete color and texture. Generically, they include silicones, acrylics, acrylic methacrylates, urethanes, polyurethanes, and epoxies. Silicones have a life of 1-3 years and an affinity for hydrocarbon contaminants. The acrylics and methacrylates have had good success

Figure 9-1. Needle gun

and last over 10 years. The heavier-bodied type of sealers dry to a glossy finish which will dull with time. The urethanes, polyurethanes, and epoxies have not been as successful as clear coatings due to decomposition by the infrared rays of the sun. In areas where the coating is subjected to large sudden temperature changes, the epoxies having much larger thermal coefficients and tensile strengths will pull themselves loose from the concrete.

b. Opaque coatings. Opaque coatings should not be used for architectural concrete except as a last resort to correct errors in architectural concrete construction which cannot be corrected in any other fashion. Use of this material cannot disguise bulging and misalignments. Some coatings are not long-lasting and require continuous maintenance. They are not recommended for use with architectural concrete.