SECTION 38 – CONCRETE REPAIR, REMOVAL AND REPLACEMENT

38-1 GENERAL

38-1.1 Description

This specification covers the repair of concrete pavement, constructed under Section 37 of these Specifications, which is found to be damaged or defective. Such pavement, under the terms of Section 37, is required to be removed and replaced at the cost of the Contractor. At the discretion of the Engineer, however, certain types of damage or defect may be repaired at the Contractor's expense, and, if the repair is found to be acceptable, the concrete pavement will be accepted, subject to any adjusted payment stipulations which may apply under Paragraph 501-8.1 of Section 37.

This following specification addresses these situations, and gives the requirements relative to effecting such repairs. In addition, this specification sets forth the requirements for full slab removal. No additional payment will be made for any repairs or slab replacement made under this section. The Engineer maintains the right to ultimately require complete removal and replacement of the defective slab should he find that the repairs undertaken are unacceptable. Nothing in this specification obligates the Engineer to accept the Contractor's request to attempt repair of damaged or defective pavement in lieu of full slab removal and replacement as required by Section 37, although such approval will not be withheld arbitrarily.

New pavement slabs that are broken or contain cracks shall be removed and replaced or repaired, as specified herein, at the Contractor's expense. Spalls along joints shall be repaired as specified. Removal of partial slabs is not permitted. The Engineer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be 4-inch diameter, shall be drilled by the Contractor, and shall be filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with epoxy resin, using approved procedures. Drilling of cores and refilling holes shall be at the Contractor's expense.

38-1.2 Identification. Prior to commencing repair work on the concrete pavement, the Contractor, in the company of the Engineer, shall inspect the concrete to identify defects and mark any areas that shall be repaired. Identification of defects approved for attempted repair shall be at the sole discretion of the Engineer.

38-2 MATERIALS

38-2.1 Elastomeric Concrete. Spall repair material shall be an elastomeric concrete consisting of a fluid base or binder with suitable reinforcing agents to provide a product which mixes in five minutes or less, flows readily, strongly, adheres to concrete, requires no external application of heat for curing and cures within one hour of application.

This material shall be "DelPatch™" as manufactured by the D.S. Brown Company, or approved equal.

A. Properties. The material-shall meet the properties in Table 1:

TABLE 1

Properties	Requirement	Test Method
Tensile Strength	600 psi, min	ASTM D 412 (Mod)
Elongation at break	25 %, min	ASTM D 412 (Mod)
Hardness, Type D Durometer	50 pts, min	ASTM D2240
Compression-Deflection Properties		
Stress (psi) 5% Deflection	800 min/1400 max	D 695
Resilience, 5% Deflection	95 min	D 695 (Mod)
Impact Ball Drop @ -20°F	>10 ft	D 3029 (Mod)
Adhesion to Concrete (psi)		
Dry Bond	400 min	
Wet Bond	250 min	

B. Application. Spall repair materials shall be weighed and mixed in accordance with the manufacturer's recommendations. The material shall be placed into the area to be repaired in layers up to finished grade within four minutes of the initial mixing. The material shall be allowed to cure two hours before opening to construction traffic.

[C. Manufacturer's Representative. A representative or agent of the manufacturer shall be present during the initial uses of this product to satisfy himself and the Engineer that it is being properly applied.]

38-2.2 High Molecular Weight Methylmethacrylate (HWHM). HWHM for filling hairline and low severity cracks shall be 4R by 3 M, T70X by Transpo, Pronto by SIKA, or approved equal.

38-2.3 Epoxy Resin. All epoxy resin used for crack repair shall conform to ASTM C 881, Type IV, of the various grades specified.

38-2.4 Other Materials. Unless otherwise specified herein, materials used for concrete pavement repair shall conform to the material requirements set forth in Section 37 of these Specifications, Portland Cement Concrete Pavements (FAA P-501).

38-3 TESTING AND QUALITY CONTROL

Unless otherwise specified herein, quality control testing and evaluation required for repair of concrete pavement shall conform to the testing requirements set forth in Section 37 of these Specifications, Portland Cement Concrete Pavements (FAA P-501). All costs for testing associated with effecting repairs under this section shall be borne solely by the Contractor.

38-4 REPAIR OF CRACKS

38-4.1 Cracks That Do Not Exceed 4 Inches in Depth. Except as otherwise specified below, cracks less than 4 inches deep (including plastic shrinkage cracks) shall be cleaned and then pressure injected with epoxy resin, Type IV, Grade 1, using procedures as approved. Care shall be taken to assure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the Engineer.

Where routing is specified, routing shall be done with a vertical spindle router or a concrete saw with a small diameter blade. Rotary impact routers shall not be used. Cracks shall be pressure-washed to remove all loose debris and cement mortar. Cracks shall be routed to a minimum width of 1/2-inch and 3/4-inch depth. When routing must be wider to match the crack width, the depth shall equal the width. When backer rod material is required, the depth shall be increased to accommodate the backer rod.

Guidelines for crack repair follow:

A. Low severity cracks. Isolated hairline cracks and cracks to 1/16 inch shall be filled with High Molecular Weight Methylmethacrylate (HMWM) filler. Application shall be in accordance with the manufacturer's recommendations. Low severity cracks with spalling shall be routed and sealed with epoxy resin.

B. Cracks from 1/16-inch to 1/8-inch wide shall be routed and sealed with epoxy resin.

C. Cracks over 1/8-inch in width shall require removal and replacement of the slab.

38-4.2 Cracks Greater than 4 Inches in Depth.

A. Slabs with Cracks through Interior Areas. Interior area is defined as that area more than 6 inches from any designed joint location. Slabs with any cracks greater than 4 inches deep that extend into the interior area, regardless of direction, shall be removed and replaced at the Contractor's expense.

B. Cracks Close to and Parallel to Joints. All cracks essentially parallel to original joints, extending deeper than 4 inches, and lying wholly within 6 inches on either side of the joint shall be treated as specified in the following subparagraphs. Any crack extending more than 6 inches from the joint shall be treated as specified above in subparagraph a, above, "Slabs With Cracks Through Interior Area."

Any cracks which do not extend 4 inches deep shall be treated as specified above in subparagraph 38-4.1.

(1) Cracks Greater Than 4-inches in Depth Present, Original Joint Not Opened. When the original uncracked joint has not opened, the crack shall be routed and sealed, and the original joint filled with epoxy resin as specified below. The crack shall be routed with an easily guided, wheel mounted, vertical shaft, powered rotary router designed so the routing spindle will caster as it moves along the crack. The reservoir for joint sealant in the crack shall be formed by routing to a depth of 3/4 inch, plus or minus 1/16 inch, and to a width of 1/2 inch, plus or minus 1/8 inch. Any equipment or procedure which causes raveling or spalling along the crack shall be modified or replaced to prevent such raveling or spalling.

The joint sealant shall be a liquid sealant as specified in Section 37. Installation of joint seal shall be as specified for sealing joints or as directed. If the joint sealant reservoir has been sawed out, the reservoir and as much of the lower saw cut as possible shall be filled with epoxy resin, Type IV, Grade 2, thoroughly tooled into the void using approved procedures. If only the original narrow saw cut has been made, it shall be cleaned and pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures. If filler type material has been used to form a weakened plane in the joint, it shall be completely sawed out and the saw cut pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures.

Where a parallel crack goes part way across paving lane and then intersects and follows the original joint which is cracked only for the remainder of the width, it shall be treated as specified above for a parallel crack, and the cracked original joint shall be prepared and sealed as originally designed.

(2) Cracks Greater Than 4-inches in Depth Present, Original Joint Also Cracked. At a joint, if there is any place in the lane width where a parallel crack and a cracked portion of the original joint overlap, the entire slab containing the crack shall be removed and replaced for the full lane width and length.

38-5 PARTIAL DEPTH SPALL REPAIR OF PAVEMENT

Spall repair shall consist of sawing concrete behind the spalled area, removing concrete pavement to expose sound pavement throughout the repair area, preparing and installing repair material, and completion of the sawn joint.

38-5.1 Establishing Repair Boundaries. The limits of the unsound concrete shall be determined by sounding with a steel rod. The rod shall be dropped from a height of 4 to 6 inches. The sounding will produce a dull sound in areas of delaminated concrete. A sharp ringing sound will be heard when there is sound concrete. The repair boundary which shall be outside the unsound concrete, a minimum of three inches into sound concrete. Concrete to be removed shall be sawcut in a rectangular pattern, square to the slab edges, with rounded corners.

38-5.2 Cutting the Repair Limits. Corners of repair limits shall be drilled to a minimum depth of 2 inches using 4-inch or larger diameter core drills. Diamond blade sawcuts shall then be made along the tangents of these cores, square to the slab edges, to establish the removal area. The depth of sawcut shall be a minimum of 2 inches. When the boundaries of multiple partial depth repairs areas are closer than 24 inches, the repair areas shall be combined as one repair. Where repairs abut previously sealed joints, a sawcut of minimum depth shall be made along the joint face to remove old joint sealant and to make a clean vertical face at the joint.

38-5.3 Removal of Existing Concrete. Existing concrete within the boundaries of the repair shall be removed by chipping with pneumatic tools. Pavement breakers or hydraulic rams shall not be used. Concrete will be removed to the depth of the sawcut or to at least ½ inch beyond sound concrete, whichever is deeper. The depth of total removal shall be at least 3 inches. Sounding within the limits of the repair will ensure that all damaged and unsound concrete has been removed. When the depth of the unsound concrete exceeds one-half of the slab depth, the slab will be removed and replaced. Under no circumstances will a partial depth repair be allowed to rest on a dowel bar.

38-5.4 Preparation of Cavity

The cavity thus formed shall be thoroughly cleaned with high pressure water jets supplemented with compressed air to remove all loose material. The concrete surface preparation and patch installation shall be accomplished in accordance with the material manufacturer's recommendations. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens

38-5.5 Placement of Filler. An insert or other bond-breaking medium shall be used to prevent bond at the joint face and to shape a reservoir for the joint sealant. The cavity shall be filled with elastomeric concrete, except that any spall less than 0.1 cu. ft. shall be repaired with epoxy resin mortar or a Grade III epoxy resin. Elastomeric concrete shall be proportioned, mixed, placed, consolidated, and cured as directed by the manufacturer and approved by the Engineer. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions and mixing and placing procedures as recommended by the manufacturer and approved by the Engineer. The epoxy resin materials shall be placed in the cavity in layers not over 2 inches thick. The time interval between placement of additional layers shall be such that the temperature of the epoxy resin material does not exceed 140°F (60°C) at any time during hardening. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens.

38-6 FULL DEPTH REPAIRS

Full depth slab repairs will not be allowed. Where spall repair extends more than one-half the slab depth, the entire slab shall be removed and replaced at the Contractor's expense.

38-7 REMOVAL AND REPLACEMENT OF FULL SLABS

Where it is necessary to remove full slabs, unless there are keys or dowels present, all edges of the slab shall be cut full depth with a concrete saw. All saw cuts shall be perpendicular to the slab surface. If keys, dowels, or tie bars are present along any edges, these edges shall be sawed full depth 24 inches from the edge if only keys are present, or just beyond the end of the dowels or tie bars if they are present. These joints shall then be carefully sawed on the joint line to within 1 inch of the depth of the dowel or key.

The main slab shall be further divided by sawing full depth, at appropriate locations, and each piece lifted out and removed. Suitable equipment shall be used to provide a truly vertical lift, and approved safe lifting devices used for attachment to the slabs. The narrow strips along keyed or doweled edges shall be carefully broken up and removed using light, hand-held jackhammers, 30 pounds or less, or other approved similar equipment. Care shall be taken to prevent damage to the dowels, tie bars, or keys or to concrete to remain in place. The joint face below keys or dowels shall be suitably trimmed so that there is not abrupt offset in any direction greater than 1/2 inch and no gradual offset greater than 1 inch when tested in a horizontal direction with a 12 foot straightedge. No mechanical impact breakers, other than the above hand-held equipment shall be used for any removal of slabs. If underbreak between 1-1/2 and 4 inches deep occurs at any point along any edge, the area shall be repaired as directed before replacing the removed slab. Procedures directed will be similar to those specified for surface spalls, modified as necessary. If underbreak over 4 inches deep occurs, the entire slab containing the underbreak shall be removed and replaced.

Where there are no dowels, tie bars, or keys on an edge, or where they have been damaged, dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete using procedures as specified. Original damaged dowels or tie bars shall be cut off flush with the joint face. Protruding portions of dowels shall be painted and lightly oiled. All four edges of the new slab shall contain dowels. Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material (unless it is stabilized) shall be recompacted and shaped as specified in the appropriate section of these Specifications. The surfaces of all four joint faces shall be cleaned of all loose material and contaminants and coated with a double application of membrane forming curing compound as bond breaker.

If sawcutting extends into joints between existing slabs to remain, the existing joint treatment (expansion material and sealant) shall be restored. If sawcuts extend into the concrete of existing slabs that are otherwise intended to remain, these slabs shall be completely replaced by the Contractor, at no cost to the Owner.

When a slab is replaced, new dowels shall be installed on joints as detailed for the original construction. On doweled joints with existing slabs, the new dowels will be offset horizontally from the original positions. The holes drilled in adjacent slabs for the new dowels shall be at the midpoints between the halves of the dowels remaining from the original construction. The spacing of new dowels from the slab corners shall be determined by the Engineer.

Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material shall be recompacted and shaped as specified in the appropriate section of these specifications, and the surfaces of all four joint faces shall be cleaned of all loose material and contaminants and coated with a double application of membrane forming curing compound as bond breaker. Care shall be taken to prevent any curing compound from contacting dowels. The resulting joints around the new slab shall be prepared and scaled as specified for original construction.

38-8 REPAIR AND CORRECTION OF SURFACE DEFICIENCIES

38-8.1 High Areas. High areas of concrete surfaces shall be reduced either by rubbing the freshly finished concrete with carborundum brick or by grinding of the hardened concrete. Grinding will not be done until the concrete is at least 36 hours old. High areas in subgrade or base course shall be trimmed and the area scarified and compacted.

38-8.2 Thickness Deficiency. When the measurements of the concrete surface are deficient by more than ½ inch, the deficient layer will be removed and replaced.

38-9 REPAIR OF CONCRETE QUALITY DEFICIENCY

38-9.1 Slump and Air Content. See Section 37 of these Specifications.

38-9.2 Strength Deficiency. See Section 37 of these Specifications.

38-9.3 Smoothness. See Section 37 of these Specifications.

38-10 ACCEPTANCE

If the Engineer considers the repairs to be unacceptable under any criteria described herein, or that the repaired slab is not of commensurate quality to that of concrete pavement in Section 37 of these specifications, the Engineer may require complete removal and replacement of the slab at the Contractor's sole expense.

38-11 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

No measurement for payment will be made for any repairs effected under this Specification. If the Engineer elects to accept the repaired pavement, it will be measured and paid under Section 37. Nothing in this specification obligates the Engineer to accept the Contractor's request to repair damage or deficiencies in place of full slab removal and replacement, however. See

Section 38-12 for penalty assessment which will apply to each repaired spall or slab requiring repair under this section.

Full slab removal, as part of demolition operations, will be measured and paid under Section 14 of these specifications.

38-12 PENALTY

Any deficiencies that must be corrected during construction will result in future maintenance costs that will be borne by the Engineer. Therefore, the Contractor will be assessed a penalty of Five Hundred ($500) dollars for each spall repaired, over and above the cost to repair the spall. This penalty will be deducted by the Engineer from the funds otherwise due the Contractor.

END OF SECTION 38