PAVEMENT REPAIR

1.00 GENERAL

This work shall consist of repairing Portland Cement Concrete (PCC) pavement with Portland cement concrete (PCC), Asphaltic Concrete (AC), and/or hot-applied, flexible polymer modified concrete (FPMC) at the locations shown in the contract or as designated by the Engineer. The work shall include removing deteriorated concrete, disposing of the old concrete, preparation of the repair area, and furnishing, placing, finishing and curing of the PCC, FPMC, or Asphalt. This work includes full depth and partial depth repairs for pavement, curbs, joints, and cracks. Additional details are included in Lincoln Standard Plans (LSP).

Concrete pavement repairs are grouped into 3 types based on the surface area of the patch (see Table 1.0). If a pavement failure extends across more than one lane, each lane will be counted as a separate repair.

Table 1.00
PCC Pavement Repair Groups

Type	Size Square Yards (SY)
A	Less than 5
B	5 to 15
C	More than 15 to 45

Repair areas exceeding 45 SY in size and not of full panel width shall also be paid as a Type C concrete pavement repair. Dowel baskets for full depth concrete pavement repairs shall be installed at transverse joints. Repair areas greater than 45 SY in size and of full panel width shall be paid for and constructed per City of Lincoln Standard Specifications for PCC pavement. Dowel baskets for PCC pavement construction shall be installed when present in existing pavement.

Full depth concrete pavement repairs shall be a minimum of 4 feet in length and 4 feet in width. New curb shall be constructed as indicated on the plans or as directed by the City's Project Manager, to the same dimensions as the existing curb and measured and paid for in accordance with Chapter 4 of the current City of Lincoln Standard Specifications.

Full depth pavement repair shall be constructed on a prepared subgrade or foundation course as prescribed in the contract. The thickness of the new concrete pavement shall match the existing pavement thickness or as shown on the plans.

Removal of concrete for partial depth pavement repair shall be to the depth necessary to reach sound concrete. The minimum depth of removal shall be 1.5 inches for FPMC, 2 inches for asphalt, 3 inches for PCC, or as shown on the plans. The maximum depth of removal shall be 4 inches. The minimum width of removal shall be 2 feet for PCC pavement or joint repairs. The minimum width of removal shall be 1 foot for FPMC or asphalt pavement or joint repairs. The maximum mill width for crack repairs shall be 8 inches.

1.01 MATERIALS

A. CONCRETE

Repairs shall be made with Class L-3500 if the contract allows for lane closures, partial/full closure of drive access, or detours to accommodate the extended curing period. Repairs made with Class L-5500 or Class PR concrete shall be at approved locations as shown on the plans or as directed by the City's Construction Project Manager.

All concrete materials furnished by the Contractor shall conform to the requirements set forth in Chapter 3 of the current City of Lincoln Standard Specifications.

B. FLEXIBLE POLYMER MODIFIED CONCRETE

Partial depth concrete repairs constructed with flexible concrete material shall consist of hot-applied, polymer modified resin compounds containing mineral fillers, chopped fiberglass fibers, and graded aggregates. The repair material shall conform to the requirements of Table 1.01A.

TABLE 1.01A – FLEXIBLE POLMER MODIFIED CONCRETE.

Property	**Requirement**	**Test Method**
Color	Gray	Visual
Specific Gravity	1.8 – 2 g/cc	ASTM 2726
Flow	3mm max@60C@5hrs	ASTM D 5329, 0.5" thick specimen
Tensile Adhesion Elongation	20% min	ASTM D 5329, 0.75" thick specimen @ 2"/min
Resilience	50% Recovery	Tex-547-c
Flexibility	No Tear at Bend	ASTM D 3111, 1"dia.,0.4"thick,4" wide
Application Temperature	*	
Aggregate Settlement	3% Maximum	Tex-551-c
Maximum Heating Temp	*	

*As recommended by the manufacturer

The material shall be suitable for pavement repair depths up to 4 inches; it shall be durable when subjected to vehicle traffic for climate conditions normal to Nebraska. It shall set up and withstand traffic within one hour. It must be specifically designed for repair of concrete spalls or partial depth repairs. The material must be able to resist water and form a tight seal to the concrete.

The repair material is to be supplied in a powder form, factory blended and bagged in wholly-meltable type containers, and any of their components, shall be fully meltable and integrational with the polymer concrete material by the time the manufacturer's minimum application temperature is reached. Material that is shipped in boxes shall not have staples. Unused material left in machine must be able to be reheated and used at least twice with no effect in the material's performance.

A manufacturer's recommended primer agent shall be used to coat the vertical and horizontal repair surface promoting adhesion and preventing moisture intrusion.

Bulking aggregate shall be as supplied by the manufacturer or shall be a hard, durable, clean, crushed rock meeting the gradation requirements of Table 1.01B and approved by the City's Project Manager.

TABLE 1.01B – BULKING AGGREGATE

Sieve	% Passing
1"	100%
¾"	90-100%
3/8"	0-15%
No.200	0.5% maximum

Surface aggregate shall be as supplied by the manufacturer or shall be a hard, durable, clean, crushed rock meeting the gradation requirements of Table 1.01C and approved by the City's Project Manager.

TABLE 1.01C – SURFACE AGGREGATE

Sieve	% Passing
No. 4	100%
No. 10	0-10%
No. 200	0.5% maximum

C. ACCEPTANCE REQUIREMENTS

All materials used for concrete pavement repairs and joint repairs, otherwise not listed here shall conform to those requirements in the contract and or Lincoln Standard Specifications.

Flexible polymer modified concrete material and materials used in conjunction with it for repairs shall be accepted based on manufacturer's certification of compliance letters.

1.02 EQUIPMENT

A. CONCRETE EQUIPMENT

A mobile mixer conforming to the requirements set forth in Chapter 3 of the current City of Lincoln Standard Specifications may be used.

Adequate hand tools shall be provided, including an internal vibrator. Internal vibrators and hand tools shall meet the concrete placement requirements of Chapter 4 of the current City of Lincoln Standard Specifications.

Screeds, either mechanical or hand operated, shall be used to finish the concrete except for small patches and integral curb repair. The screeds shall be either a vibrating or roller type screed

specifically designed for striking off concrete and in conformance with the concrete placement requirements of Chapter 4 of the current City of Lincoln Standard Specifications.

Drills for dowels or tie bars, shall be capable of drilling the appropriate sized hole parallel to the surface of the concrete and the longitudinal centerline within 1/8 inch.

B. FLEXIBLE POLYMER MODIFIED CONCRETE EQUIPMENT

Repair material must be melted in an appropriate indirectly heated mixing unit with horizontal shaft and full sweep agitation to uniformly mix the product and with an effective product delivery system. The temperature of material shall be controlled with an electronically controlled thermostat.

The repair site shall be milled with an approved milling machine to the specified width and depth. Pot holes or spalls shall be milled, saw cut and/or removed with a 15 lb. maximum chipping hammer.

A hot compressed air lance shall be used to clean and dry the repair surfaces when moisture is present. The hot air lance shall be capable of producing temperatures in excess of 2500° F and flow rates of 185 cfm.

Adequate hand tools shall be provided.

C. ACCEPTANCE REQUIREMENTS

All equipment used for pavement repairs and joint repairs, otherwise not listed here shall conform to those requirements in the contract and or Lincoln Standard Specifications.

1.03 CONSTRUCTION METHODS

A. REMOVALS GENERAL REQUIREMENTS

The Contractor shall remove the concrete pavement and curbs, if applicable, without damaging the adjacent concrete pavement and curbs. Repair of any damage caused by the operation is at the Contractor's expense.

The Contractor shall remove and dispose of all old pavement, reinforcing steel, and all other materials. The repair section shall be removed with minimum disturbance of the underlying foundation course. Any loosened foundation course material shall be removed and replaced with concrete.

If reinforcing fabric is encountered, it shall not be replaced.

The Contractor shall cut around the perimeter of the repair area as shown in the plans. All repairs shall be cut so the edges are parallel or perpendicular to the traveled way. Saw over-cuts shall be kept to a minimum.

The Contractor shall use hand or pneumatic tools to remove the concrete pavement. If the patch is full depth Type C, then a drop hammer may be used to remove the pavement.

When tie bars in longitudinal joints are damaged during concrete removal, they shall be replaced by the Contractor at no additional cost to the City with No. 5 reinforcing bars that are 18 inches in length. The new tie bars shall be installed into holes drilled in the existing concrete and secured in place with a non-shrink grout or epoxy on the Nebraska Department of Roads (NDOR) Approved Products List.

B. PREPARATION

1. General

The repair sections shall be removed to the lines designated in the plans and or by the City's Project Manager, including reinforcement that interferes with the operations. The wheel-type cutter shall be operated to produce minimum disturbance of the foundation course material, with no encroachment of the cut into the concrete of the adjoining lane. The Contractor shall uniformly moisten and compact the subgrade or foundation course to the satisfaction of the Engineer.

A bond breaker shall be used as shown in the contract.

Where the repair area is not bordered by existing concrete pavement, a form shall be used as the pavement edge to provide the same surface elevation and edge alignment as the existing pavement. The form shall be supported or braced in position to prevent movement during the placement and finishing of the concrete. Forms for concrete pavement repair shall conform to the requirements of Chapter 5 of the current City of Lincoln Standard Specifications.

2. Preparation Full Depth With Dowels or Tie Bars

Removal shall extend across the existing joint a minimum of 2 feet into the adjacent panel in doweled concrete.

Dowel bars or tie bars shall be anchored into the faces of the existing concrete as designated in the contract.

The dowel bar holes shall be drilled at the same plane ± 1/8 inch and at the spacing shown in the contract.

The tie bar holes can be drilled independently.

The drilled holes shall be thoroughly cleaned with compressed air to remove all dust, dirt, loose material and moisture.

After cleaning and prior to dowel or tie bar insertion, an application of grout or Type IV, Grade 3 epoxy shall be made at the back of the hole. The grout or epoxy shall be from NDOR Approved Products List. Twist the dowel or tie bar one full turn during insertion to completely surround it with the grout or epoxy. The furnishing and installation of dowel and tie bars will not be paid for directly but shall be considered subsidiary to the concrete pavement or joint repair work being performed.

For the new matching transverse joints on repairs that span existing joints, the dowel baskets shall be placed parallel to the joint, and the dowel bars shall be parallel to centerline.

3. Preparation Partial Depth

For partial depth repairs, the Contractor shall cut and chip the pavement edges with a 15 pound (6.8 kg) maximum chipping hammer to form reasonably neat vertical surfaces.

The Contractor shall use a diamond blade to cut around the perimeter of the repair area.

Material shall be removed from the repair area to a depth and width necessary to provide sound pavement that will allow proper bonding and support of the repair material. The Contractor may use an approved milling machine capable of removing material to the horizontal and vertical dimensions needed. Otherwise, hand or pneumatic tools shall be used to remove the concrete pavement.

All surfaces, including the bottom, of the partial depth concrete repairs shall be free from loose concrete, sand, and other debris and shall be maintained in a dry and clean condition. Use a hot compressed air lance to clean and dry the repair surfaces for application of flexible polymer modified concrete.

All surfaces shall be cleaned and dry before the bonding agent is applied. The bonding agent shall be a Type IV, Grade 2 Epoxy Adhesive on the NDOR Approved Products List.

The primer agent for flexible polymer modified concrete material utilized in partial depth repairs shall be as recommended by the manufacturer. Apply the primer agent to vertical and horizontal repair surfaces and allow to dry. The repair material shall be installed the same day the primer is applied. Do not use an open flame to dry the primer.

All preparation of partial depth pavement repairs, otherwise not provided above shall conform to those requirements in the contract and or Lincoln Standard Specifications.

C. PLACING AND FINISHING

1. Concrete

The Contractor shall furnish and place the concrete. The concrete shall be handled and consolidated so there will be no separation of the aggregate and the mortar.

An internal vibrator shall be used to consolidate the concrete.

A vibrating screed shall be used on a full depth concrete repair that is a full panel width and two or more panels in length, to finish the concrete to the final elevation.

The concrete shall be floated with a magnesium bull float and then given a drag finish with wet burlap, carpet, or canvas in a direction parallel to the traffic flow. If the surface is not to receive an overlay or smoothness grinding, it shall be finished to match the existing surface.

2. Flexible Polymer Modified Concrete

Mix and heat the repair material to a temperature as recommended by the manufacturer. Placement of the material at a temperature outside of the specified or manufacturer recommended temperature range may require removal and replacement of flexible polymer modified concrete material or concrete at the expense of the Contractor. All material heated in excess of the manufacturers maximum heating temperature for more than one hour shall be rejected.

If bulking or surface aggregate contains surface moisture, dry the aggregate by heating, aerating or other method approved by the City's Project Manager before placement in repair material.

The heated repair material shall be placed in lifts with dry bulking aggregate at a rate between 20 to 30 percent of the repair volume, not to exceed 30 percent of the entire repair volume. One lift of heated repair material and bulking aggregate shall be defined as the placement of repair material followed by bulking aggregate uniformly spread over entire repair area and then enclosed by repair material. The bulking aggregate shall be installed such that 50 percent of the bulking aggregate is encapsulated by the lower layer of repair material and the remaining 50 percent will be enclosed in the top layer of repair material.

One lift shall fill approximately 1.5 to 2 inches of a repair depth. The repair material shall always be at least ¾ inch thick at the bottom of the repair. Install additional repair

material and bulking aggregate in 1.5 to 2 inch lifts until the repair is level with the existing pavement. Each lift shall cool to 200° F prior to placing the next lift. The final ½ inch of the repair shall consist of only flexible polymer modified concrete material (no bulking stone) for optimum flexibility of repair.

Dress the surface of the repair with surface aggregate. Perform this operation while the repair is still hot. The finished surface shall be within ¼ inch of existing pavement. At the discretion of the Engineer, repair areas with depressions greater than ¼ inch may be repaired by reapplying the heated repair material with surface aggregate. Do not use air lance or open flame to heat the existing surface material of the depression area.

Sweep the area and remove all debris from the site.

3. Asphaltic Concrete

The Contractor shall furnish and place the asphaltic concrete conforming to those requirements in the contract and or Lincoln Standard Specifications.

D. JOINTS

The Contractor shall create joints in full depth repairs as shown in the contract.

When pavement and joint repairs will not be overlaid, all saw cuts, transverse joints, and longitudinal joints shall be thoroughly cleaned with compressed air to remove all dust, dirt, loose material and moisture, and sealed with hot pour joint sealant.

Random cracks which develop in the new concrete repair that will not be overlaid with asphaltic concrete shall be routed and sealed.

Joints shall not be sealed until after any corrective work or Diamond Grinding and Texturing Concrete Pavement is completed. Formed joint wells that are destroyed shall be re-constructed, and joints of insufficient depth shall be deepened prior to sealing.

E. CURING AND PROTECTION

1. General Concrete

The Contractor shall apply curing compound to all concrete pavement repairs. The cure compound shall be applied immediately after each patch is completed.

When pavement and joint repairs are overlaid with asphaltic concrete, the curing method shall be with tack coat. An approved asphalt emulsion or bituminous based compound may be used with approval of the City's Project Manager.

White pigmented curing compound shall be used when the repair will be the wearing surface. The application rate shall be 1 Gallons per 200 Square Feet.

2. Class L-3500 Concrete

Class L-3500 concrete pavement repairs shall not be opened to traffic until the compressive strength reaches 3,000 psi as determined by the Maturity Method or cylinders, at the discretion of the City's Project Manager. The maturity curve will be developed by the City of Lincoln Testing Lab. Concrete shall not be placed when ambient air temperature is expected to drop below 40°F (4°C) during the cure period.

3. Class PR and Class L-5500 Concrete

Class PR and Class L-5500 concrete pavement repairs shall be covered with polyethylene film and then insulation board or insulated blankets immediately after the curing compound has been applied. The insulation board and insulated blankets shall have an R-value (thermal resistance) equal to or greater than 5 ft²-hr-°F/BTU [1.0 m² (°C/W)]. Insulation and polyethylene film shall be maintained until concrete reaches opening strength.

Class PR and Class L-5500 concrete pavement repairs shall not be opened to traffic until the compressive strength reaches 3000 psi. This will be determined by use of Maturity Method or cylinders, at the discretion of the City's Project Manager. The maturity curve will be developed by the City of Lincoln Testing Lab.

Table 1.03A is a guide to the minimum time the PR concrete will reach a compressive strength of 3,000 psi.

TABLE 1.03A – CLASS PR (With Calcium Chloride)

Minimum Ambient Air Temperature	(Hours)
41°– 60°) F (5° - 16°C)	12
(61° – 80°) F (16°-27° C)	8
Above (80°) F (27° C)	4

Concrete shall not be placed when ambient air temperatures are expected to drop below 40 °F (4° C) during the cure period.

Class PR Concrete with calcium chloride added will be used for all concrete repairs if the repaired areas must be opened to traffic within 24 hours. Calcium chloride may be excluded from the concrete mix provided the minimum required strength can be attained within the allotted time.

Class L-5500 Concrete will be used for all concrete repairs if the repaired areas must be opened to traffic within 24 to 48 hours provided the minimum required strength can be

attained within the allotted time. Non-chloride accelerators may be used to accomplish this with prior approval by the City's Project Manager.

Concrete placed shall be paid for per the concrete mix approved. However, concrete which does not make the minimum required strength for opening to traffic within 24 hours for Class PR or within 48 hours for Class L-5500 shall be paid for as Class L-3500 unless approved otherwise by the Engineer.

4. Flexible Polymer Modified Concrete

Do not allow traffic over the material until after it has cooled to the point that it does not permanently deform under pressure, as recommended by the manufacturer or as directed. As a guide, allow on hour of cure time from final placement of repair material and surface aggregate for a 2 inch partial repair depth. Allow an additional ½ hour of cure time for each inch of repair depth exceeding 2 inches.

5. Asphaltic Concrete

All curing and protection of asphaltic concrete shall conform to those requirements in the contract and or Lincoln Standard Specifications.

F. SMOOTHNESS

1. Concrete

The pavement elevation of repair areas shall be corrected in a manner that eliminates dips or bumps. Dips and bumps are defined as having a 1/8 inch or greater deviation using an approved 10 foot straightedge. If the repair will be the wearing surface, the correction shall be diamond grinding or replacement as directed by the City's Project Manager. The condition of the adjacent pavement shall be considered when evaluating the 1/8 inch deviation requirement.

2. Flexible Polymer Modified Concrete

Any repairs that are rejected, at the discretion of the City's Project Manager, due to unsatisfactory or improper workmanship including repairs with surface profiles that vary from the existing roadway profile by more than ¼ inch or failures due to damage by the operation or public traffic, if opened to traffic prior to approval, shall be removed and replaced at no expense to the City.

3. Asphaltic Concrete

The smoothness of repairs shall conform to those requirements in the contract and or Lincoln Standard Specifications.

1.04 BASIS OF PAYMENT

A. GENERAL

Concrete pavement repairs that adjoin full depth repair areas of varying widths in the same traffic lane which are situated such that the removals of the areas may be accomplished concurrently, shall be considered as a single repair. The total area of the adjoining areas shall be combined to determine the repair type as shown in Table 1.00.

A concrete pavement joint repair shall be considered any repair that extends across the joint and is 9 feet or less in length. Joint repairs that the final measurement is in excess of 9 feet in length will be paid for as the appropriate pavement repair item, as determined by Table 1.00.

Acceptance of PR concrete shall be based on the concrete attaining 4000 psi within 28 days from date of placement. This may be determined either by the maturity method or test cylinders.

The 28-day compressive strength of each day's production will be determined from cylinder strength tests for L-3500 and L-5500 concrete. If the 28 day strength fails, the Contractor has the option to take 3 core samples, representative of the concrete in question, at no additional cost to the City. The average compressive strength of these cores will be used to determine the actual 28-day compressive strength. Cores must be taken within 35 days from the date the concrete was poured. The Engineer shall select the site where the cores will be taken and take possession of them immediately after removal from the pavement. The cores shall be delivered to the City Lab for testing. At the discretion of the Engineer, any concrete represented by cores or cylinders which do not meet the required strength, shall be removed and replaced at no cost to the City or paid for at 50% of the contract unit price.

The sealing of all random cracks or joints will not be measured and paid for directly but shall be considered subsidiary to the joint or pavement repair work being performed.

Payment is full compensation for all work prescribed in this Section.

B. CONCRETE PAVEMENT JOINT REPAIR

CONCRETE PAVEMENT JOINT REPAIR completed in conformance the Plans and Lincoln Standard Specifications and accepted by the City’s Project Manager, shall be measured and paid for at the contract unit price bid per cubic yard.

C. CONCRETE PAVEMENT REPAIR, TYPE ___, FULL DEPTH

Full depth Portland Cement Concrete (PCC) pavement repair, Types A, B, and C, as determined by Table 1.00, constructed in conformance with the Plans and the Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per cubic yard for CONCRETE PAVEMENT REPAIR, TYPE ___, FULL DEPTH.

D. CONCRETE PAVEMENT REPAIR, TYPE ___, PARTIAL DEPTH PCC

Partial depth Portland Cement Concrete (PCC) pavement repair, Types A, B, and C, as determined by Table 1.00, constructed in conformance with the Plans and the Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per cubic yard or per cubic feet for CONCRETE PAVEMENT REPAIR, TYPE ___, PARTIAL DEPTH PCC.

E. CONCRETE PAVEMENT REPAIR, TYPE ___, PARTIAL DEPTH FPMC

Partial depth flexible, polymer modified concrete (FPMC) pavement repair, Types A, B, and C, as determined by Table 1.00, constructed in conformance with the Plans and the Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per cubic yard or per cubic feet for CONCRETE PAVEMENT REPAIR, TYPE ___, PARTIAL DEPTH FPMC.

F. CONCRETE PAVEMENT REPAIR, TYPE ___, PARTIAL DEPTH ASPHALT, TYPE 3

Partial depth Asphaltic Concrete pavement repair, Types A, B, and C, as determined by Table 1.00, constructed in conformance with the Plans and the Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per cubic yard or per cubic feet for CONCRETE PAVEMENT REPAIR, TYPE ___, PARTIAL DEPTH ASPHALT, TYPE ___.