SECTION 02752

PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing Portland Cement Concrete Pavement.

1.2 RELATED SECTIONS

A. Section 00555: Prosecution and Progress

B. Section 01452: Profilograph and Pavement Smoothness

C. Section 03055: Portland Cement Concrete

D. Section 03152: Concrete Joint Control

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 03390: Concrete Curing

1.3 REFERENCES

A. AASHTO M 154: Air Entraining Mixtures for Concrete

B. AASHTO M 157: Ready-Mixed Concrete

C. AASHTO T 11: Materials Finer Than 75 Fm (No. 200) Sieve in Mineral Aggregates by Washing

D. AASHTO T 23: Making and Curing Concrete Test Specimens in the Field

E. AASHTO T 24: Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

F. AASHTO T 26: Quality of Water to be Used in Concrete

G. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

H. AASHTO T 97: Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

I. AASHTO T 119: Slump of Portland Cement Concrete

J. AASHTO T 121: Weight Per Cubic Foot, Yield, and Air Content (Gravimetric) of Concrete

K. AASHTO T 141: Sampling Fresh Concrete

L. AASHTO T 152: Air Content of Freshly Mixed Concrete by the Pressure Method

M. ASTM D 3405: Joint Sealant, Hot-Applied, for Concrete and Asphalt Pavements

N. Department of Labor Standards

O. UDOT Quality Management Plan

1.4 SUBMITTALS

A. Profilograph: Submit to the Engineer the day following testing, a copy of measured profile data and generated graphic reports containing a scaled reproduction of the measured profile with stationing, deviation information, and document points.

B. Concrete:
1. Refer to Section 03055.
2. Furnish the Engineer with mix design, trial batch gradation, and 28-day compressive strength test results from the trial batches before placing concrete.
3. Use the same materials and admixtures intended for production in the trial batches.
4. From the batch trial results, determine the cement content, aggregate ratio, and quantities of other mix components necessary to meet a design 28-day compressive strength of 5210 psi and a 7-day flexural strength of 490 psi.
5. The proportioning and mixing of the trial batches are subject to inspection.
6. Do not place pavement before obtaining written approval of the mix design.
7. Meet the approved trial batch proportions. Changes in the mix proportions require new trial batches.

1.5 PROJECT CONDITIONS/LIMITATIONS

A. **Seasonal:** Do not pave from October 15 to April 15. Submit cold weather concrete plan to the Engineer for written approval to pave outside these limits.

B. **Hot Weather and Cold Weather:** Refer to Section 03055.

C. **Night Operations:** Provide proper lighting from one-half hour after sunset to one-half hour before sunrise following Section 00555.

1.6 ACCEPTANCE - OVER LEAN OR UNTREATED BASE COURSE

A. Department will assess price adjustments for strength, thickness, and surface smoothness separately on the contract bid price.

B. Thickness acceptance is determined by core lengths located randomly one core per 12,000 ft^2 area.

C. Core lengths:
1. Engineer divides the pavement into consecutive areas not to exceed 12,000 ft^2.
2. Add a final area of less than 6,000 ft^2 to the previous section to make one section.
3. A final area of greater than 6,000 ft^2 will constitute a separate area.
4. Hand-placement areas will be considered separately. Take one core per placement area.

D. Engineer takes three measurements on each core and records to the nearest 1/16 in. Use the average to determine the acceptability and pay factors for deficient thickness areas using Table 1.

Table 1
Price Reductions for Deficient Thickness Over New Surfaces

Deficient Thickness (in inches)	Pay Factor
0 to 1/8	1.00
1/8 to 1/4	0.90
1/4 to 1/2	0.75
1/2 to 3/4	0.60

1. The Engineer may accept pavement deficient by more than 3/4 inch at 50 percent pay or require removal and replacement.

2. Make all corrections, including removal and replacement at no additional cost to the Department.

E. Engineer takes two additional cores for any deficient core (one on each side) where the thickness varies by 1/8 in. Locate the new core between the deficient core and each of the adjacent cores.

F. Deficient areas of slab thickness are defined by new cores plotted along with the original cores.

G. Engineer graphs the deficient areas with the following assumptions:
1. The graph represents the thickness of the pavement.
2. The thickness varies linearly along the pavement's length from core depth to core depth.
3. The pavement is a constant depth in the transverse direction.

1.7 ACCEPTANCE - OVER EXISTING SURFACES

A. Department will assess price adjustments for strength, thickness, and surface smoothness separately on the contract bid price.

B. Thickness acceptance of the finished pavement is determined from the graph of the deviations from the profile grade established by the plans or Engineer.

C. Engineer takes elevations at 100 ft intervals, and compares against the profile and graph to determine deficient thickness areas.

D. Price adjustments for pavement areas with deviations below thickness profile will be computed using Table 2.

Table 2
Price Reductions for Deficient Thickness over Existing Surfaces

Deviations Below Profile (in feet)	Pay Factor
0.0 to 0.02	1.00
0.02 to 0.04	.90
0.04 to 0.06	.60

1. The Engineer may accept pavement deficient by more than 3/4 inch at 50 percent pay or require removal and replacement.
2. Make all corrections, including removal and replacement at no additional cost to the Department.

E. The Engineer may accept pavement areas with deviations of more than 0.06 ft at 50 percent pay or require removal and replacement. Make all corrections, including removal and replacement, at no additional cost to the Department.

1.8 ACCEPTANCE - COMPRESSIVE STRENGTH (ACCEPTANCE/RETESTING)

A. Department will use Table 3 to determine price adjustments for concrete compressive strength.
   1. The price adjustment applies to the test lot represented by the strength test.
   2. The Engineer evaluates all concrete with a compressive strength of more than 400 PSI below specification to determine capability of the material to maintain the integrity of the structure for payment. This concrete may be accepted at 50 percent pay factor or required to be replaced.

Table 3
Pay Adjustments for Compressive Strength Based on 28 days

Psi below 4,000	Pay Factor
1 to 100	0.95
101 to 200	0.90
201 to 300	0.85
301 to 400	0.80

B. Hand-placement areas will be considered separately.

C. The Engineer notifies the Contractor within three calendar days of determining the 28-day compression if any strength test is below specifications. The Contractor may request referee testing in writing within 35 calendar days after placing concrete.
   1. An independent third party testing agency will conduct referee testing within 35 calendar days after placement at no additional cost to the Department.
   2. All testing laboratories must:
      a. Be certified by the Cement and Concrete Reference Laboratory.
      b. Use ACI accredited level one or level two inspectors.
      c. Be acceptable to both the Department and the Contractor.
   3. Obtain six pairs of cores at locations directed by the Engineer. Condition and wet test the cores as specified in AASHTO T 24.
   4. Engineer adjusts the core strengths to standard equivalent cylinder strength by dividing by a factor of 0.85. Each pair of adjusted core strengths will be averaged and considered as a single core test result.
   5. Basis of acceptance of the lot will be as follows:
      a. If any of the adjusted referee core test results are less than 4,000 psi, Engineer uses the lowest core test result or the original cylinder test value, whichever is lowest.
      b. If all the six adjusted referee core test results exceed 4,000 psi and the average is below 4,700 psi, Engineer uses the original cylinder test for the pay factor.

c. If all the six adjusted core test results exceed 4,000 psi and the average exceeds 4,700 psi, Department accepts lot at full pay.

D. Engineer and Contractor jointly determine alternate methods of acceptance for the lot represented by a specimen apparently damaged during the curing process or otherwise unacceptable.

E. Fill the core holes with concrete after coring making sure that the holes are cleaned and dry at the time they are filled.
1. Coat the sides of the holes with an epoxy resin adhesive from the Performance Data Products Listing (PDPL) maintained by the UDOT Research Division.
2. Consolidate the concrete by rodding or vibrating.
3. Strike off level with the pavement surface, texture, and treat with the specified curing-sealing compound.
4. Protect concrete in core holes from any damage for a minimum of 48 hrs.

1.9 SMOOTHNESS

A. Determine acceptance and correct in accordance with Section 01452.

PART 2 PRODUCTS

2.1 CONCRETE

A. Use AA(AE) concrete.

B. Refer to Section 03055.

2.2 AGGREGATE

A. Refer to Section 03055 for coarse, fine, and combined aggregates.

B. Separate and stockpile in two sizes coarse aggregate sizes 2 inch to No. 4 sieve, and 1½ inch to No. 4 sieve with the separation being made on the 1 inch and 3/4 inch respectively.

C. Use a No. 200 sieve to determine the material size in accordance with AASHTO T 11 and T 27.

2.3 WATER

A. Use water for washing aggregates, mixing concrete, and at the testing platform that, when compared with distilled water, does not change the setting time of Portland Cement more than 25 percent, or reduce the compressive strength of mortar more than 10 percent.

B. Limit the maximum concentration of sulfate as SO_4 to 3000 ppm.

C. Potable water may be used without testing.

D. Conform to AASHTO T 26.

2.4 ADMIXTURES

A. Air-entraining Agents
   1. Select from the Accepted Products Listing maintained by the UDOT Research Division.
   2. When concrete is central-mixed and transported in non-agitating haul units, incorporate synthetic/non-visol resin air entraining admixtures.
   3. When central-mixed with agitating haul units or transit mixed, conform to the material standard found in AASHTO M 154.
      a. Thoroughly mix all entraining agents before use.
      b. Constantly agitate any agent that settles during batching.

2.5 POZZOLAN

A. Refer to Section 03055.

2.6 CONCRETE CURING COMPOUND

A. Refer to Section 03390.

2.7 EXPANSION JOINT MATERIALS

A. Refer to Section 03152.

2.8 JOINT SEALERS

A. Unless specified otherwise, provide pre-approved hot applied joint sealant for transverse-sawed, longitudinal-sawed, and all contact joints following Section 03152.

B. Select sealers and joint material from the Accepted Products Listing maintained by UDOT Research Division.

2.9 STEEL REINFORCEMENT

A. Tie Bar: Grade 60, deformed reinforcing steel epoxy-coated following Section 03211.

B. Dowel Bars: Grade 60, smooth steel rod, epoxy- coated, following Section 03211.

2.10 CONCRETE COLORANT FOR STATION MARKERS

A. Brick Red 160 or Tile Red A-28 surface, dry-shake type concrete colorant.

2.11 BATCH PLANT

A. Meet the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

B. Equip batch plant with a numerical printout device that makes a continuous, permanent, and accurate record of:

1. The weights of all individual ingredients including water and cement added after initial batching.
2. The time of day for each batch shown in hours and minutes.
3. Date and daily accumulated totals.
4. Commercial batch plants that are not dedicated to the project are exempt from the daily accumulated total requirement.

C. Give the Engineer a copy of the record at the end of each production day.

D. If the printout device malfunctions, finish the shift following the initial malfunction. Then stop operations until the device is fully operational.

E. Have the beams scales, and water meters on the batching plant checked, certified, and sealed by the Utah Department of Agriculture, Division of Weights and Measures annually and each time the plant or weighing device is moved.

2.12 TESTING PLATFORM

A. Provide a stable, 40 ft by 8 ft testing platform with a canopy when concrete is hauled in dump trucks.
   1. Provide a lockable 8 ft by 10 ft by 8 ft storage room at one end.
   2. Locate the platform within 250 ft of the batch plant.
   3. Platform height must equal the concrete haul truck bed height.
   4. Platform must meet the Department of Labor standards outlined in Safety and Health Regulations for Construction.
   5. Provide adequate railing, and stairs with a handrail.
   6. Provide 110 V electrical power and pressurized water.
   7. Maintain suitable lights and outlets and a communication system with the batch plant control room.

2.13 VEHICLES FOR HAULING

A. Haul vehicles are limited to the legal axle load.

B. Present certified scale axle weights for each unit in terms of yardage to be hauled.

C. Permissible to use:
   1. End dump trucks with essentially watertight beds and endgates, and rounded corners.
   2. Agitator trucks with open tops.
   3. Transit mixers that conform to the standard found in AASHTO M 157.

D. Do not use bottom or belly dump units.

2.14 CYLINDER STORAGE DEVICE

A. Use a device that maintains a temperature of 60 degrees F to 80 degrees F and is equipped with an automatic 7-day temperature recorder. The recorder's accuracy must be within 2 degrees and have a permanent recording feature.

B. Use device or devices with the capacity to accommodate the required test cylinders and beams for a minimum of two day's operation. Stop placing concrete if capacity is lacking.

C. Make the storage devices available on the job site at least 48 hours before placement.

D. Submit written procedures explaining operation and required monitoring or care of the device for approval.

E. A 24-hour test run may be required.

2.15 SLIP FORM PAVER

A. Self-propelled machine with no fluid leaks, equipped with automatic line and grade control capability.

B. Capable of:
   1. Spreading the dumped concrete uniformly across the grade by an auger or a traveling strike-off device.
   2. Vibrating, tamping, striking-off, and shaping the concrete to the desired line grade and thickness in one continuous pass.

C. Under normal operating conditions, do not place wheeled or tracked power equipment in front of the paver redistributing the concrete.

D. Vibrator minimum requirements:
   1. Eccentric Diameter: 1-7/8 inch
   2. Frequency: 9500 vibrations per minute minimum.
   3. Spacing: 18 inch maximum mounted longitudinally.

E. Operate the vibrators horizontally at the midpoint of the concrete slab and mounted so they maintain this position.

F. Run the vibrators parallel to the direction of the paving.

G. Check each vibrator for operation daily.
   1. Shutdown paving operations immediately if any indication of malfunction occurs.
   2. Resume operations only after repairing or replacing the vibrator.

H. Trailing forms: long enough to leave a smooth, straight, vertical edge.

I. The vibrating and tamping elements: stop when the forward movement of the paver stops.

2.16 FINISHING EQUIPMENT REQUIREMENTS

A. Machine float that may be attached to the paver.

B. Burlap drag.

C. Transverse tining machine (single use) and a comb equipped with steel tines randomly spaced (3/4 in ± 1/8 inch).

D. Curing-sealing compound application machine (single use) with a fully atomizing type power spray and a wind protection hood.

E. Dual-use tining and curing machine may be used when placement rate is 100 yds^3/h or less.

2.17 PAVEMENT SURFACE ROUGHNESS TESTING DEVICE - PROFILOGRAPH

A. Refer to Section 01452.

PART 3 EXECUTION

3.1 PREPARATION

A. The profilograph must be on the project site before beginning paving operations.

B. Aggregate Stockpiles
   1. Prepare site by clearing, grubbing, smoothing, and compacting.
   2. Construct stockpile platforms to prevent intrusion of subgrade materials into aggregates.
   3. Provide adequate drainage for the stockpile site.
   4. Construct either individual stockpiles containing materials for a single day of paving, or elongated stockpiles (maximum 25 ft in height, 30 ft top width) with material identified.
      a. Build stockpiles a minimum of two working days before use.
      b. Acceptance of stockpiles is in daily increments only and a maximum of 30 calendar days before use.
      c. May construct standby stockpiles to prevent or avoid delays. Cover until needed.
   5. Construct by distributing over entire base in layers not to exceed 5 ft.
      a. Do not dump or spill over sides.
      b. Equip conveyors with rock ladder or tremie.
      c. Maximum drop from rock ladder or tremie is 10 ft.
   6. Restrict conical piles to a 10 ft maximum height before distribution.
   7. Supply loader and operator to assist in sampling for testing.

3.2 APPLICATION - FORMED PAVING OPTION

A. Construct pavement between metal side forms conforming to the guidelines in this Section.

B. Do not allow springing to occur under the weight of paving and finishing equipment.

C. Forms:
1. Keep free from warps, bends, kinks, and keep equal in depth to the specified pavement edge.
2. Maintain deviation of the forms within 1/8 in from a plane in the top surface or within 1/4 in from a plane surface on the inside face.
3. Set at a distance equal to a day's maximum run.
4. Firmly stake side forms using steel dowels placed on each side of every joint, and spaced not more than 5 ft apart.
5. Tightly join form sections by an interlocking joint free of vertical and horizontal movement.
6. Stop paving operation if the side forms do not meet line and grade, or if side forms are loose.
7. Keep side forms in place for at least 12 hours after the concrete has been placed. Clean and oil forms after each use.
8. Remove the side forms without damage to the edge of the pavement. Immediately fill any honeycomb areas at once with mortar composed of one part Portland Cement, two parts sand, and sufficient water to form a thick paste.
9. Protect the edges of the pavement with curing-sealing compound after the form removal.

D. Vibrators:
1. Attach vibrators to the concrete finishing machine in front of the strikeoff auger and mount as transverse moving or longitudinal fixed at 18 inch maximum spacing to clear tie bars.
2. Vibrator minimum requirements:
   a. Eccentric Diameter: 1-7/8 inch.
   b. Frequency: 9500 vibrations per minute.
3. Use hand-operated vibrators on a regular pattern not to exceed 12 inches in each direction for irregular areas where required.

3.3 LINE AND GRADE CONTROL

A. Establish the necessary stakes for grade control over existing surfaces, and provide the elevation control benchmarks.

B. Use previously established stakes for grade control on the underlying course or courses of lean concrete or asphalt base course.

C. Equip machinery with a control system that automatically controls concrete placement to the specified longitudinal grades.

D. Control systems:
   1. Must be automatically actuated from an independent line and grade control reference using a system of mechanical sensors or sensor-directed devices.
   2. Use sensors that maintain the equipment at the proper transverse slope and elevation to obtain the required thickness and surface.
   3. Furnish, place, and maintain supports, wire devices, and materials as required to provide continuous line and grade reference controls for the placing machine, etc.

3.4 BATCHING MATERIALS

A. As specified for weighing and batching materials. Conform to AASHTO M 157.

B. Batch mixer: Conform to the standard, and operate at the drum speed recommended by the manufacturer.
   1. Do not lose bulk cement and fly ash when transporting into the mixer.
   2. Introduce cement before fly ash.
   3. Add admixtures to the mix water separately and at different times.
   4. Conduct mixing efficiency tests at the beginning of placing concrete, and evaluate as specified in AASHTO M 157, Annex A-1.
   5. Maintain a mixing time of 80 seconds at manufacturer recommended mixing speed after all materials are in the drum. If necessary, increase mixing time in 10 second increments until the mixer efficiency evaluation is passed.
   6. Correct poor mixing efficiency at no additional cost to the Department.
   7. Replace mixing blades when they are worn down 1 inch or more below the original height.
   8. Do not allow buildup of cement or mortar on the mixer drums and blades.

C. Centrally mixed materials:
   1. Base mixing time on the results of the mixer efficiency evaluation, and do not mix less than 80 seconds.
   2. Mix materials for a minimum of 30 seconds after the last addition of water or cement is made after initial batching.

D. Transit mixed materials:
   1. Add a minimum of 30 revolutions at mixing speed when water is introduced after initial batching. Follow AASHTO M 157.
   2. Do not add water to retemper the concrete.
   3. Do not add water to the mix after acceptance testing.

3.5 PLACING CONCRETE

A. Keep the base surface moistened 500 ft in front of the paver without allowing areas of standing water to occur.

B. Place material according to Section 01452 and Section 02752 of Measurement and Payment, Price Reductions for Deficient Thickness, in the Bid Book.

C. Place the concrete to the full width of the pavement in a single operation.

D. Vibrate, screed, and mechanically tamp the spread concrete.

E. Discharge and place the mixed concrete with a lay down machine within the time frame listed below after introducing the mixing water to the cement and aggregates. Reject concrete not placed within the following time period.
   1. Non-agitating Haul Equipment: 35 minutes.
   2. Agitating Haul Equipment: 75 minutes.

F. Deposit the concrete so rehandling is not required.

G. Thoroughly vibrate against and along the faces of the forms.

H. Use shovels or other approved tools for any necessary hand spreading. Do not use rakes.

I. Do not add water to the pavement surface behind the final screed on the paver.

J. Spray water directly on the final burlap drag only in the quantity necessary to keep the burlap wet.

K. Do not add water to the surface for finishing. If water is added, paving operations may be shut down or the concrete rejected.

L. Concrete may be placed in an adjoining longitudinal section three days after initial placement.

M. Provide protection for initial surface.

3.6 HANDLING AND PLACING REINFORCING STEEL

A. Properly store all steel received.

B. Keep tie bars clean, free from damage, and free from distortion.

C. Place tie bars in the middle third of the slab, as shown on the plans.
   1. Refer to PV series Standard Drawings.
   2. Place normal to direction of paving and parallel to the slab surface.
   3. Hold tie bars, as shown in the plans.
   4. Place by using automatic bar inserters, support on chairs, through forms, or drilled and epoxied in. Manual insertion is not permitted.

D. When load transfer dowel bars are required, place bars in the middle third of the slab depth, parallel to the centerline and surface of the slab. Limit deviations from parallel to 1/4 inch in the length of the dowel bar.

3.7 FINISHING

A. Finish the surface smooth and true to grade by machine float immediately after placing concrete. Finish at a rate equal to the progress of the paving operation.

B. If preliminary finishing is delayed more than 30 minutes after initial screeding, shut down the mixing operation until the situation is resolved.

C. Texture the pavement by burlap drag and transverse tining.
   1. Use at least three plies of wet burlap and drag parallel to the centerline without tearing.
   2. Complete the drag finish with one pass.
   3. Form depressions in the plastic concrete surface with the tining comb:
      a. Randomly spaced (3/4 inch " 1/8 inch).
      b. 3/32 inch to 5/32 inch in deep normal to centerline.
      c. Do not tear or remove excess mortar in the tining process.
   4. Do not tine Urban Highways with design speeds less than 40 mph.

D. Mark station numbers every 500 ft and date of placement 25 ft from start and finish of a day's placement on the outside edge of the concrete pavement:
   1. After texturing and before curing-sealing.
   2. Use a "brand" with changeable numbers a minimum of 3 inches high.
   3. Smooth an area approximately 9 inch by 18 inch with a float, color with concrete colorant, and press the "brand" approximately 1/4 inch into the concrete to form the appropriate station number.

3.8 CURING

A. Refer to Section 03390.

3.9 FIELD QUALITY CONTROL

A. Engineer random samples all concrete.

B. Compliance with the mix design is determined by inspecting the batching procedures.
   1. The Department furnishes the molds and machines for testing.
   2. Furnish material, internal vibrators and storage devices following this Section, Part 2, article, Cylinder Storage Device for making and curing the test specimens as per AASHTO T 23.
   3. Maintain cylinders at a temperature range of 60 degrees F to 80 degrees F for the initial curing period of not less than 24 hours.
   4. Cure concrete cylinders and flexure beams in the field a minimum of 24 hours before moving.
   5. Maintain storage devices.

C. Engineer samples materials centrally mixed with non-agitating haul units at the batch plant platform in accordance with AASHTO T 141.
   1. One set of strength tests represents 2650 yds^2 of pavement.
   2. Hand-placed areas are considered separately for strength and thickness.
   3. Run each truckload of concrete past the platform for inspection. The Engineer may test any or all truckloads.
   4. Perform correlation testing to determine the loss of entrained air from the platform to the finished in-place pavement.
      a. Perform air test on concrete at the platform, and again from the same load in the finished pavement. Record any change in the air content.
      b. Make necessary adjustments at the platform to achieve adequate air-entrainment in the finished pavement.
      c. Perform two tests, one in the morning and one in the afternoon, for each day of paving operations.

D. Engineer samples and tests materials centrally mixed with agitating haul units or transit mixed at placement location. One set of strength tests represents 725 yds^2 of pavement or one day's placement whichever is smaller (a lot).

E. Engineer tests air and slump in accordance with AASHTO T 152, and T 119 on the first three loads at startup and after any shutdown of more than one hour.
   1. Slow the batching operation to allow completion of each air and slump test before the next batch is made. Communicate test results to the batch plant operator and make necessary corrections.
   2. Engineer takes random samples during the day. Any samples taken that differ from air or slump test requirements require the testing and acceptance of three consecutive loads before full operation resumes.
   3. Engineer verifies samples that are out of specifications by conducting an additional test on the same load. When the second test is within specifications, Engineer conducts a third test as the deciding factor.

F. Yield tests: Engineer takes in conjunction with an air test at least one per day in accordance with AASHTO T 121.

G. Compressive Strength: Engineer conducts a strength test consisting of one set of three cylinders made at the platform or point of placement. Conform to AASHTO T 23.

H. Flexural Strength: Engineer casts two beams for each day concrete is placed.
   1. Conform to AASHTO T 23 and T 97.
   2. Beams used to determine when a pavement can be opened for traffic shall be cured in the field at the site of the represented pavement.

3.10 PROTECTION

A. Protect pavement against all damage and marring.

B. Keep Contractor hauling equipment and traffic off the pavement until at least ten days after concrete placement as per AASHTO T 97, or until 100 percent of the minimum flexural strength has been achieved.
   1. Use barricades to prevent traffic from using the pavement.
   2. Construct crossings to bridge the concrete as approved by the Engineer when necessary at no additional cost to the Department.

C. Protect from rain and hail damage.
   1. Cease operation when rain is threatening.
   2. Remove, replace, or repair any pavement damaged by rain or hail as directed at no additional cost to the Department.

3.11 JOINTS

A. Construct contact joints, sawed joints, or transverse expansion joints as shown on the plans.

B. Keep the faces of all joints at right angles to the top surface of the pavement with all longitudinal joints parallel to the centerline and coinciding with the traffic lane lines.

C. Place fresh concrete against previously cured concrete at planned locations to form contact joints.
   1. When used, retain transverse contact joint forms in place until paving operations resume.
   2. Join concrete on both sides of all longitudinal and transverse contact joints with tie bars as shown in contract plans.
   3. Maintain the tie bars in their proper position during concrete placement.
   4. Saw and seal all contact joints to the dimensions shown on the plans.

D. Longitudinal contact joints:
   1. Construct with tie bars to the dimensions shown on the plans.
   2. Do not allow the finished surface across longitudinal contact joints to deviate from a straight line by more than 1/8 inch in 10 ft when tested with a straight edge.
   3. Shut down operations until specified tolerances are achieved if the edge slump requirements are not satisfied within 200 ft longitudinally of the start of a contact joint.
   4. If the edge slump exceeds the specified 1/8 inch in 10 ft, repair the edge by the following procedures before placing adjacent concrete:
      a. Saw off the slumped edge to the full thickness with a diamond saw.
      b. Drill holes in the sawed edge and epoxy in new tie bars.
      c. Use No. 8 by 24 inch epoxy-coated tie bars. Place midpoint in the slab at 12 inches on center embedded 12 inches into the slab.
   5. Straighten bent tie bars and re-coat with epoxy paint at the bend point before placing concrete in the adjacent lane.

E. Use power driven saws to construct sawed joints. Maintain a minimum of two working power saws and one working standby power saw during concreting operations.
   1. Single cut all transverse and longitudinal joints (1/8 inch wide) to one third the depth of the design pavement thickness (T/3).
   2. Saw initial or “control” transverse contraction joints at 50 ft intervals or less to control cracking.
      a. Begin sawing immediately after the concrete has sufficiently hardened and before uncontrolled cracking occurs.
      b. Conduct continuous sawing operations during both day and night regardless of weather conditions.
      c. Provide lighting during nighttime sawing.

3. Immediately flush all joints with water after sawing and wash cuttings from road surface.
4. Thoroughly clean joints of all loose debris, cement powder, etc., with a jet of water at 2000 psi minimum pressure.
5. Keep the transverse joints clean and dry before placing moisture resistant backer rod and/or sealant.
    a. Clean the joint with air at a minimum of 100 psi just before placing the backer rod.
    b. Equip air compressors with operating oil and water traps.
6. Unless specified otherwise, install hot-pour joint sealant (ASTM D 3405) the full depth of the saw cut.
7. Fill the longitudinal joints evenly 1/8 inch ± below the pavement surface.
8. Do not permit hauling equipment or traffic on the pavement before all sawed joints are sealed.
9. Match joints in adjacent lanes to form a continuous line across the pavement width including the concrete shoulders.

F. Make night and transverse contact joints normal to the centerline without keyways on the vertical face.
1. Use No. 10 by18 inch epoxy-coated tie bars placed midpoint in the slab at 12 inches on center and embedded 9 inches on each side.
2. Form joints with tie bars placed through the form or saw joints with tie bars drilled and epoxied or as approved.

G. Form transverse expansion joints at structure approaches as shown on the plans by using a joint filler strip and joint sealer.
1. Firmly support the filler strip by metal holder and end supports that remain in place after completing the pavement.
2. Secure the metal holder and end supports to prevent movement of the filler strip away from the position indicated on the plans when placing and vibrating the concrete.
3. Extend the joint filler the full width of the concrete being placed less 1/4 inch on each end.
4. Remove any concrete that flows around the ends of the joint filler.

3.12 DEFECTIVE PAVEMENT PANELS

A. A panel is that area of pavement within the traffic lane bounded by two transverse joints.

B. Engineer determines defective panels within 21 calendar days after placement.

C. Repair or replace defective pavement panels before acceptance for smoothness at no additional cost to the Department.

D. Remove and replace panels within the traffic lane when multiple full depth cracks separate the panel into three or more parts including the adjacent shoulder.

E. Remove and replace portions of panels within the traffic lane and the adjacent shoulder with any full depth transverse crack within 4 ft or less of a transverse sawed joint. Use methods that do not disturb adjacent panels.

F. Drill and epoxy tie bars as well as dowel bars into existing pavement. Coat dowel bars with a release agent on the free end.

G. Groove to a 1 inch depth by 3/8 inch width and seal any random full depth cracks that open 1/64 inch or more at the surface in 21 calendar days after placement. Silicone sealant required.

H. Leave tight random cracks less than 1/64 inch wide undisturbed.

I. Any core taken for determining full-depth crack is at no additional cost to the Department when the core verifies full-depth cracking.

END OF SECTION