

# I N D E X

## DIVISION H

### CONCRETE PAVEMENT CONSTRUCTION SPECIFICATIONS

<u>PARA.</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
1.	General	H-1
2.	Materials	H-1
3.	Definitions	H-1
4.	Subgrade	H-2
5.	Construction Equipment	H-8
6.	Aggregates	H-13
7.	Concrete Requirements	H-14
8.	Opening to Traffic	H-30
9.	Final Grading and Clean-up	H-30
10.	Method of Measurement & Basis of Payment	H-30
	Measurement and Payment Schedule	H-31

## DIVISION H

### CONCRETE PAVEMENT CONSTRUCTION SPECIFICATIONS

1. GENERAL:

These specifications shall apply to the construction of concrete pavements with all necessary appurtenances.

2. MATERIALS:

2.01	Aggregates	Division E	Section 3
2.02	Cement	Division E	Section 6
2.03	Concrete	Division E	Section 7
2.04	Concrete Classification and Mix Requirements	Division E	Section 7.1
2.05	Concrete Admixtures	Division E	Section 7.2
2.06	Concrete Curing Materials	Division E	Section 7.3
2.07	Concrete Joint Materials	Division E	Section 7.4
2.08	Concrete Reinforcement	Division E	Section 7.5
2.09	Water	Division E	Section 16

3. DEFINITIONS:

Roadway: Roadway shall be considered as the portion of the highway within the limits of construction.

Embankment: Embankment shall be considered as a structure consisting of soil, granular material, shale, rock, or random material, constructed in layers to a predetermined elevation and cross section.

Subgrade: Subgrade shall be considered as the material, in cut or in fill, immediately under the pavement structure (pavement, base, and subbase) to such a depth as may affect the structural design of the pavement.

Subbase: Subbase shall be considered as selected material of planned thickness placed on the subgrade as a foundation for a base or surface course. Subbase is a part of the pavement structure.

Soil: Soil shall be considered to include all earth materials, organic or inorganic, which have resulted from natural processes such as weathering, decay, and chemical action in which more than 35 percent by weight of the grains or particles will pass a No. 200 sieve.

Granular Material: Granular material shall consist of natural or synthetic mineral aggregate such as broken or crushed rock, gravel, or sand which can be readily incorporated in an 8-inch layer, and in which at least 65 percent by weight of the grains or particles are retained on a No. 200 sieve.

Shale: Shale shall be considered as laminated material, formed by the consolidation in nature of soil, having a finely stratified structure.

Rock: Rock shall be considered as sandstone, limestone, glacial boulders, brick and old concrete which cannot readily be incorporated in an 8-inch layer.

Random Material: Random material shall consist of a mixture of previously defined materials suitable for use in embankment which can be readily incorporated in an 8-inch layer.

Optimum Moisture: Optimum moisture shall be considered as the water content at which the maximum density is produced in a soil by a given compactive effort (ASSHTO Designation: T-99).

4. SUBGRADE:

4.1 Description: This item shall consist of performing the following operations in accordance with the Plans, Proposal and the requirements hereinafter set forth: clearing, grubbing and scalping; preparing the embankment foundation; excavating for the roadway, slopes, ditches, approaches of driveways and intersecting highways; constructing embankment with the excavated material and material; preparing the subgrade; finishing shoulders, slopes and ditches.

The method of payment for excavation shall include payment for placing suitable excavated material in embankment, with no separate payment for embankment. No excavated material shall be wasted without permission, and all suitable material from excavation, or an equivalent volume of suitable material from other sources, shall be used for planned embankments to the extent of project requirements.

4.2 Preparation of Subgrade: The Contractor shall prepare the subgrade for all new pavement, and pavement widening in accordance with the provisions of this section. The entire subgrade shall be brought to a uniform condition of stability.

4.2.1 Compaction Requirements: Subgrade for all new pavements and pavement widening having a base width of 6 feet or more, except rock or shale subgrade in cuts, shall be compacted to the pertinent density shown in Table III for a depth of 6 inches below the surface of the subgrade. Subgrade under widening having a base width of less than 6 feet shall be compacted to a depth of 6 inches to the

density requirement shown in Table III. Subgrade under curb and gutter adjacent to the pavement shall be compacted to a depth of 12 inches to the density requirement shown in Table III, except that subgrade under curb and gutter adjacent to pavement widening less than 6 feet in width shall be compacted to a depth of 6 inches. When the depth of subgrade compaction is 12 inches, the subgrade shall be compacted for a distance of at least 18 inches outside the limits of the pavement surface or to the back of a curb and gutter adjacent to the pavement. When the depth of subgrade compaction is 6 inches, the subgrade shall be compacted to the outer edge of the pavement or base or to the back of a curb and gutter adjacent to the pavement. Payment for the compaction of subgrade for a depth of 6 inches shall be included in the unit price bid for excavation.

<b>TABLE III</b>	
<b>MAXIMUM LABORATORY DRY WEIGHT (Pounds per Cubic Foot)</b>	<b>MINIMUM SUBGRADE COMPACTION REQUIREMENTS (Percentage of Laboratory Maximum Dry Weight)**</b>
Less than 90.0	*
90.0 - 104.9*	100
105 - 119.9	98
120.0 - and more	95

\* Soils with a maximum dry weight of less than 100.0 pounds per cubic foot are considered unsuitable for use in the top 12-inch soil layer immediately below the surface of the subgrade and shall be replaced with suitable soil or granular material.

\*\* As determined utilizing an ASSHO Designation T99 Proctor or the Michigan Sand Cone, as appropriate.

4.2.2 Moisture Control: Except as noted below, the moisture content of all subgrade materials at the time of compaction shall not be greater than 2 percent over the optimum. The moisture content at the time of compaction and also at the time of placing pavement or subbase for any approved subgrade material which displays pronounced elasticity or deformation under construction equipment shall not exceed optimum.

Drying of wet soil shall be expedited by the use of plows, scarifiers, discs, harrows, power driven rotary type mixing machines, or by other approved methods when so ordered by the Engineer.

4.2.3 Drainage: The surface of the subgrade shall be maintained in a smooth condition to prevent ponding of water after rains, and ditches shall be constructed and maintained to insure the thorough drainage of the subgrade surface at all times.

4.2.4 Soft Subgrade: Where soft subgrade is encountered in cuts, due to no fault or neglect of the Contractor, in which satisfactory stability cannot be obtained by moisture control and compaction as provided for under 4.2.1 and 4.2.2 of this section, the unstable material shall be excavated to the depth required by the Engineer. The excavation thus required shall be measured and paid for at the Contract unit price bid for excavation. The excavation thus made shall be filled with suitable material from roadway excavation, other than that excavated from the soft subgrade area, if available from grading operations.

Where soft subgrade in cuts is due to the failure of the Contractor to maintain adequate surface drainage or is due to any other fault or neglect of the Contractor, the unstable condition shall be corrected as outlined above at no expense to the City.

4.2.5 Full Width New Pavement Construction: After the surface of the subgrade has been properly shaped, and before any pavement, base or subbase material is placed thereon, the subgrade and a portion of the berm for a distance of at least 18 inches outside the limits of the planned pavement shall be compacted with a roller as specified. When the rolling is completed, the surface of the subgrade shall conform to the grade and cross section of the overlying course within the tolerance set forth elsewhere and shall be so maintained until the overlying course is in place.

Where forms are required, before the setting of any forms, the area beneath the forms and 18 inches beyond the edges of the planned pavement shall be brought to not less than the required subgrade surface elevation and not more than 2 inches above it and properly compacted. Forms shall then be set in accordance with the requirements set forth in these specifications for the pavement or base course to be placed.

For portland cement concrete construction, a subgrade machine meeting the approval of the Engineer shall be used to bring the surface of the subgrade or subbase, when provided, to its required shape. A test for elevation shall then be made by use of a templet

riding on the side forms ahead of the paving operation and, if necessary, material shall be removed or added as required to bring the surface of the subgrade or subbase to the correct elevation. The subgrade or subbase shall then be rolled and again tested with the templet.

- 4.2.6 Pavement or Base Widening Construction: Where the work performed under this item includes the construction of a subgrade for the widening of an existing pavement or pavement base, it shall include the cutting, truing and trimming of the old pavement base to the neat line indicated by the Engineer.

Where the old pavement is of bituminous or macadam type construction, the Contractor shall, under the direction of the Engineer, excavate channels at frequent intervals in the shoulders and locate the outside edges of sound base. With this information the Engineer shall stake out the neat edge of line upon which cutting and trimming is to be done.

The Contractor shall use such suitable equipment and methods of cutting this edge, prior to the removal of any old pavement material, as will not in any manner disturb or injure the pavement or base to be salvaged. Power chisels shall be used wherever the type and density of material requires. Damage done to those areas designated for salvaging by the Contractor's equipment or methods shall be repaired and restored at the Contractor's expense.

The old pavement materials resulting from this cutting and trimming operation shall be disposed of at a location to be designated by the Engineer, at no extra cost to the City unless beyond the specified free haul distance of 2 miles, in which case it shall be paid for at the unit prices for overhaul.

The subgrade shall be constructed and compacted as described elsewhere under this section using a three-wheeled or tandem roller where possible. The subgrade for widening areas, gutter or curb and gutter sections which are inaccessible to a roller shall be compacted with either a trench roller or a mechanical tamping devise in accordance with the compaction requirements of this section.

- 4.3 Method of Measurement: The quantities to be paid for shall be as follows: The number of cubic yards of material in the original position, acceptably excavated as herein described, is measured by the method of average end areas. Excavation outside plan lines shall not be included in measurement for payment. The plan quantities as adjusted for changes, errors and deviations in excess of allowable tolerances, as determined by check

measurements or final cross sections, will be the method of measurement for earthwork.

The number of cubic yards of embankment in the completed position, acceptably excavated as herein described, is measured by the method of average end areas. Excavation outside plan lines shall not be included in measurement for payment. The plan quantities as adjusted for changes, errors and deviations in excess of allowable tolerances, as determined by check measurements or final cross sections, will be the method of measurement for earthwork. The number of cubic yards of embankment in the completed position, acceptably placed as herein described, is measured by the method of average end areas. Embankment outside plan lines shall not be included in measurement for payment. The plan quantities as adjusted for changes, errors and deviations in excess of allowable tolerances, as determined by check measurements of final cross sections, will be the method of measurement for earthwork.

- 4.4 Conditioning of Subgrade or Subbase: Ruts or depressions shall be filled as they develop with suitable subgrade or subbase material (not with concrete or concrete aggregates) and thoroughly compacted to the proper cross section by tamping with a hand tamp. A multiple pin templet weighing not less than 50 pounds per foot and conforming to the dimensions and requirements shown on the plans shall be provided and operated on the forms immediately in advance of the placing of concrete upon the subgrade or subbase. This templet shall be provided with adjustable steel pins or teeth, set to the correct crown and contour of the subgrade or subbase. The adjustment of pins and the operation of the templet shall be such as will provide an accurate retest of the subgrade or subbase before placing the concrete thereon. All excess material shall be removed, and if the subgrade or subbase is found to be below the true elevation, the depressions shall be filled with approved subgrade or subbase material and thoroughly compacted to the proper cross section by tamping with a hand tamp.

The pin templet shall be maintained in accurate adjustment at all times by the Contractor and shall be checked daily by the Engineer or Inspector.

The work described under the foregoing paragraphs does not contemplate a regular subgrading operation as described under Section III, but rather a final accurate check of the subgrade or subbase.

On all widening construction of less than 10 feet in width, the subgrade or subbase testing or checking operation may be performed by other hand operated templets or scratch boards in lieu of the above procedure.

- 4.5 Disposal: All excavated material not required or allowed for refilling or in

embankments shall be removed and deposited at such locations as are specified, or, if no such locations are specified, the Contractor shall find suitable dumping places for all such material. No material shall be deposited on private property until written consent of the owner or owners thereof has been filed with the Engineer. All costs of disposal of surplus excavated material shall be included in the prices bid for excavation or items requiring excavation.

Excavated material shall be disposed of and all dumps shall be leveled by the Contractor in the following order of preference:

- 4.5.1 Along the site of the work to fill requirements of the work, material for this purpose shall be of the same type or better than the existing material where fill is required or where necessary to replace as backfill.
- 4.5.2 On private property facing the site of the project.
- 4.5.3 On any City-owned property in or outside of the City's limits.
- 4.5.4 Adjacent to the work upon the request of property owners upon property within a two-mile haul and as directed by the Engineer.
- 4.5.5 Non-adjacent to the work beyond the two-mile haul and as directed by the Engineer.
- 4.5.6 Any balance remaining after the above requirements are filled shall be disposed of by the Contractor to his best advantage with no overhaul compensation.

The contractor shall be entitled to "overhaul" under the terms of this Contract for his compensation for hauling beyond the two-mile limit upon orders of the Engineer.

All free haul and "overhaul" shall be made by written orders of the Engineer on order blanks having a number sequence.

- 4.6 Salvage: In the case of structures, the service of which is permanently abandoned, the Engineer will designate which of the materials are to be salvaged and which are to be abandoned. The Contractor shall remove and deliver to a designated point of storage, materials ordered to be salvaged and unless otherwise specified, no additional compensation will be allowed for this removal and hauling. He shall allow owners of privately-owned structures reasonable facilities for salvaging their property. Structures designed as abandoned and not mentioned in plans or

specifications to be salvaged shall become the property of the Contractor and shall be removed from the work without additional compensation. The Contractor shall not move nor disturb the structures in any way without the approval of the Engineer.

5. CONSTRUCTION EQUIPMENT:

All equipment necessary for the proper preparation of the subgrade, subbase, mixing concrete, the laying, finishing and curing of the pavement shall be on the project in first-class working condition and must have been inspected and approved by the Engineer before concreting will be permitted to begin.

An approved spreader will be required when the width of pavement being placed in one operation is 12 or more feet and the square yardage exceeds 10,000.

The Contractor shall provide equipment of such capacity that the paver and finishing operations will operate continuously or at a constant rate of production insofar as feasible. In the event that any piece of equipment does not have sufficient capacity to keep pace with the other operations, the Engineer may limit the size of batch or otherwise limit the rate of production to prevent poor workmanship, overloading the equipment, or frequent delays.

5.1 Weighing Devices: The measurement and batching of fine and coarse aggregates shall be by weight at a central plant unless otherwise permitted by the Engineer. Measurement of bulk cement shall be by weight. The equipment used for weighing aggregate shall consist of a bin with suspended scales and measuring hoppers.

Scales shall be of either beam or springless dial type and shall be suitable for supporting the hopper or hoppers. They shall be set accurately in substantial mountings which will insure a permanent spacing of the knife edges under all conditions of loading and use. They shall be so designed and maintained that they will at all times be accurate to within four-tenths (.4) of one (1) percent throughout the entire weight range. The value of the minimum gradations on any scale shall not be greater than five (5) pounds. The weighing beam or dial shall be so placed that it will be in full view of the operator during the operation of the gate which delivers the material to the hopper. Scales shall be protected from air currents that may effect the accuracy of weighing.

Separate hoppers shall be provided for weighing fine and coarse aggregate and shall be of suitable size and tight enough to hold the aggregates without leakage, and shall be supported entirely upon the scales, and shall be free otherwise. Suitable provisions shall be made for the removal of overload from the hopper by the operator while he operates the bin gates.

Equipment for weighing bulk cement shall be approved by the Engineer before work is started. The equipment shall be so designed and constructed that no cement will be wasted in transferring it from the weighing device to the batch boxes. Scales for weighing cement shall conform to all the requirements for accuracy specified for scales for weighing aggregates. Cement shall be fully protected from contamination or damage during handling.

A certificate of scale accuracy will be required prior to starting work.

- 5.2 Mixer: The mixer shall be of the batch type, of an approved design and with a minimum capacity of not less than one cubic yard.

The speed of the mixer drum in revolutions per minute shall conform to the rating of the manufacturer. No mixer designed to operate at a rate of less than fourteen (14) revolutions per minute shall be employed to produce the concrete.

The mixer shall be equipped with an approved batch meter and an attachment for automatically timing each batch of concrete so that all the materials will be mixed together for the minimum time required. The timing device shall automatically lock the discharge lever during the full time of mixing and release it at the end of the mixing period. This device shall be equipped with a bell adjusted to ring each time the lock is released.

The manufacturer's guaranteed capacity, in cubic feet, of the mixing drum shall be shown on the mixer and no batch shall be mixed which produces a volume of concrete in excess of the guaranteed capacity.

The mixer shall be provided with a water measuring device which will consistently measure the water going into the mixer drum to within one (1) percent of the total amount for each batch.

The mixer shall not be operated unless the water measuring device is functioning properly, nor when leaking valves pass unmeasured water into the drum. The water measuring equipment shall be so arranged that the measurement will not be affected by variations of pressure in the water supply line and will be uniformly accurate under all construction conditions encountered. Unless the water is weighed, the measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The volume of the auxiliary tank shall be at least equal to that of the measuring tank. The amount of water used in each batch shall be shown on an indicator of water which is accurately calibrated and easily read. The gradations of the water measuring device shall be in increments not larger than one (1) gallon. The measuring tank shall have an outside tap so that the calibrations on the indicator and the water in the tank may be checked.

All equipment required for testing the water tank shall be furnished by the Contractor.

Pick-up and throw-over blades in the drum of the mixer which are worn down three-fourths (3/4) inch or more in depth shall be replaced with new blades.

- 5.3 Subgrade Planer: A steel shod subgrade planer shall be provided to be drawn behind the paver by two (2) rigid connections, one attached to each side of the paver, and supported by two (2) flanged wheels or shoes on either end. If the paver is not operating on the subgrade, the planer shall be drawn by tractor or other approved means. The steel shod template shall be adjustable to fit the shape of the bottom of the pavement and shall have adequate connections to a rigid frame to maintain the crown. The planer shall be of sufficient weight to plane off all high spots encountered.
- 5.4 Rollers: All compaction and rolling equipment shall be self-propelled steel wheel or pneumatic tired rollers weighing not less than eight (8) tons.
- 5.5 Forms and Form Setting: The side forms shall be of steel, of an approved section, shall be straight and of a depth equal to the thickness of the pavement at the edge, except forms of greater depth than the specified pavement edge thickness will be permitted provided that the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of one inch of thickness per foot of width. Any additional cost caused by this tapering shall be included in the bid price for this item. The base of forms shall have a width of not less than 8 inches. Built-up forms designed for a thinner pavement will not be permitted unless the lifts are of steel, rigidly secured to the original form and the resulting unit correct in lines, dimensions and workmanship. Wood lifts will not be permitted.

All forms shall be set with exactness to the required grade and alignment and be supported on thoroughly compacted material for finishing of concrete. They shall not at any time show a variation of more than 1/8 inch in a 10-foot length from the true plane of top of forms. In the setting of side forms they shall be tested for grade and smoothness by the Contractor, using a 10-foot straight edge furnished for this purpose, and variations from the above requirements shall be eliminated by the resetting of forms. The forms shall be set and of such base area, cross section and strength and so secured that they will not spring or settle over 1/8 inch in 10 feet under the impact or vibration of the finishing machine. Shimming with loose earth pebbles, etc., will not be permitted. If a form does not have satisfactory bearing for its full length, it shall be removed, the bearing area of subgrade or subbase reshaped and compacted, and the form replaced. The use of bent or damaged side forms or forms with damaged joint locks or pin pockets shall not be permitted. All forms shall be cleaned and oiled each

time they are used. During the construction when the temperature is below 50° F., the forms shall not be removed in less than 48 hours.

Stone or concrete of adjacent lanes may be used in lieu of forms for supporting finishing equipment provided that proper protection is afforded concrete or stone from damage and further provided that the surface of the concrete or stone carrying the finishing equipment does not vary more than 1/8 inch in a 10-foot length.

When the concrete placed under this item is to later serve as a support for a finishing machine in the placing of an adjacent surface course, the alignment of such supporting edges shall be such that the distance between edges will nowhere vary more than 1/2 inch from that specified.

The Contractor shall set and maintain sufficient forms and shall otherwise so conduct his operations that the final minor corrections and compaction of subgrade or subbase, together with checking and approval of forms, will not in any way interfere with operations at the concreting site. While the amount of completed and accepted forms required in advance of the paving operation will vary with different organization and equipment, this amount shall in no case be less than 500 feet (each side).

- 5.6 Wood Forms: Wooden forms may be used only when specifically provided for on the plans or when, in the opinion of the Engineer, special conditions are encountered for which wooden forms are particularly suited, except that their use is herein approved for all curves having radii of less than one hundred fifty (150) feet. All forms to be used on curves shall be subject to approval of the Engineer. Wooden forms shall be dressed on one side and equal in depth to the edge thickness of the work prescribed. The forms when used on tangents shall have a minimum length of ten (10) feet. Forms shall be held by stakes set at intervals such that the forms are firmly held to the grade elevation and alignment shown on the plans or as set by the Engineer. Two (2) stakes shall be placed at each joint. Forms shall be firmly nailed or secured to the side stakes, and securely braced at any point where necessary such that no movement will result from pressure of the concrete or the weight or thrust of machinery operating on the forms.
- 5.7 Bulkheads: Bulkheads for construction joints shall be of good grade lumber not less than three (3) inches nominal thickness, shaped to conform to the cross section of the pavement and with provisions for the installation of hook bolts and an approved keyway.
- 5.8 Portland Cement Concrete Finishing Machines: Regular finishing machines for finishing Portland Cement concrete pavement without vibration shall be mechanical, self-propelled spreading and finishing machines of approved types, and shall be capable of compacting and finishing the concrete as

hereinafter required. If a machine has two screeds, they shall be independently operated. If a machine has only one screed, the screed shall be not less than 18 inches in width and shall be equipped with compensating springs to minimize the effect of the momentum of the screed on the side forms. The number of driving wheels, power of the motor, and weight of the finishing machine shall be so coordinated as to prevent slippage. Any machine which causes displacement of the side forms from the line or grade to which they have been properly set or causes undue delay due to mechanical difficulties shall be removed from the work and replaced by a machine meeting these specifications in a manner satisfactory to the Engineer.

- 5.9 Strike-Off: An approved strike-off shall be used to level the concrete before placing the pavement reinforcement or tie-bars when tie-bar chairs are not used. It shall be adjustable and shall be supported by two flanged wheels on each end which rest on forms.

Along previously constructed pavement, curb, or curb and gutter, special rails shall be provided adjacent to the existing pavement, curb, or curb and gutter, on which the strike-off shall ride. The strike-off shall have sufficient weight and rigidity to retain its shape under working conditions and to properly strike-off the concrete.

- 5.10 Floats: Floats for finishing the pavement transversely and longitudinally shall be a minimum of ten (10) feet in length and of the box or channel type, made of metal or wood. The floating face shall be at least 6 inches in width and have a plane surface. It shall be of light construction, rigid, free from warp, suitably braced and provided with handles such that float shall assure a smooth plane surface on the finished pavement.
- 5.11 Foot Bridges: At least one (1) portable foot bridge of rigid type and so constructed that at no time will any part of the foot bridge come in contact with the surface of the pavement, shall be provided by the Contractor to assist in finishing the pavement properly.
- 5.12 Joint Installation: All joints except expansion joints shall be saw cut to a depth of 1/4 of the slab thickness or 2" minimum depth and subsequently filled with MDOT approved hot poured joint sealant. All transverse joints shall extend through the curbs and must be continuous across the pavement. Contraction joints shall be saw cut as soon as possible after placing concrete.
- 5.13 Concrete Saw: A concrete saw shall be provided to do the work which is adequately powered, self-propelled, and constructed to cut hardened concrete rapidly with a water-cooled diamond edge or abrasive saw blade to a depth of at least 2 inches. The minimum width of saw blade shall be

1/8 inch.

- 5.14 Miscellaneous Equipment: The Contractor shall furnish all other equipment, small tools, straight edges, and all supplies which are necessary to the proper prosecution and completion of the work.

6. AGGREGATES:

- 6.1 Samples and Sources: The following standard requirements for materials shall apply to all work pertaining to the Contract unless otherwise distinctly specified. The Contractor shall advise the Engineer, prior to placing any order for aggregates, of the proposed source or sources of supply of such aggregates. The Engineer may require the Contractor to submit fifty (50) pound samples of all aggregates proposed for use. If the Engineer finds such samples fulfill the requirements of these specifications for aggregates, similar material shall be considered acceptable. Acceptance of samples shall not be construed as a guarantee of acceptance of all materials from the same source, and it shall be understood that any aggregates which do not meet with the requirements of these specifications will be rejected. Upon receiving notification of the proposed source or sources of aggregate supply, the Engineer may elect to investigate and test the aggregate supply at the source; in which case he shall notify the Contractor as to acceptability or non-acceptability, of the proposed aggregates. The Engineer shall notify the Contractor, after agreement upon a source or sources of aggregate supply, whether routine tests of aggregates during construction will be made at the source or at the point of receipt.

- 6.2 Handling, Storage and Protection of Material: Batching of aggregate from bins from which the water has not been thoroughly drained, also from bins where the aggregates comes directly from the washer will not be permitted. If materials are stockpiled, such piles shall be built up on layers not to exceed three (3) feet in height, and each layer shall be completely in place before beginning the next. Coning or building up of stockpiles by depositing materials in one place or any other method of handling materials which causes objectionable segregation will not be permitted.

Each stockpile shall be placed on concrete, sheet metal, wood plant platforms or other satisfactory foundations and so arranged that the different aggregates do not become mixed.

Mixing stone and gravel, or fine aggregates from different sources in one storage pile, or alternating batches of different aggregates will not be permitted.

If the materials become mixed with earth or other foreign matter between the time of loading at the plant and the time of charging the mixer, they shall

be thoroughly cleaned, as directed by the Engineer. If not so cleaned they will be rejected.

7. CONCRETE REQUIREMENTS:

The Contractor shall be responsible for the quality of the concrete. The concrete mixture shall be designed on the basis of the use of non-air-entrained Portland cement Type 1, with an approved air entraining agent to meet the following requirements:

Minimum 28-Day Compressive Strength	3,500 p.s.i
Modulus of Rupture: 7 Days 14 Days 28 Days	550 p.s.i. 600 p.s.i. 650 p.s.i.
Minimum Cement Content	1.375 bbls. (6 sacks per cubic yard)
Entrained Air	5% - 7%
Slump: Machine Finishing Hand Finishing	1½" - 3" not more than 3½"
Water-Cement Ratio	6 Gallons per sack max.

Approximate proportions by volume (dry loose measure) 1:2:3-3/4

The grade of coarse aggregate shall be specified in the proposal and plans.

7.1 Mixing:

7.1.1 General: No mixer shall be employed in the work which does not meet the approval of the Engineer. The batch, consisting of cement, fine aggregate and coarse aggregate, shall be fed into the mixer simultaneously and in such manner that the flow of each is about the same. The batch shall be so charged into the mixer that some of the water will enter in advance of cement and aggregates, and all water shall be in the drum within the first fifteen (15) seconds of mixing. The entire contents of the drum shall be discharged before any materials for the succeeding batch are placed therein. The mixer or mixers shall be cleaned at suitable intervals while in use.

7.1.2 Paver Mixer: All of the materials for each batch of concrete, including the water, shall be mixed not less than 1-1/4 minutes after all of the materials are in the drum, and during this period the drum

shall revolve at the speed for which it is designed, but shall not make less than 14 nor more than 20 revolutions per minute. If a thorough mixing of the concrete, in the opinion of the Engineer, is not affected by this process, a sufficient number of additional revolutions at the same rate shall be given until a thorough mixing of each batch of concrete is secured.

No material for a batch of concrete shall be placed in the drum of the mixer until all the previous batch has been discharged therefrom. Water shall be added at the time the materials are being run into the mixer. The inside of the drum shall be kept free from hardened concrete.

The use of mixers having a chute delivery will not be permitted except for placing narrow widening or filler strips. In all such cases, the arrangement of chutes, baffle plates, etc., shall be such as will insure the placing of fresh concrete without segregation.

7.1.3 Central Mixing: Central mixed concrete may be employed in the work when authorized by the Engineer, provided there is no segregation of material when the concrete is deposited on the subgrade. Central mixed concrete shall be mixed in a stationary mixer or paver operated as a stationary mixer. The central mixing of concrete shall be done at the site approved by the Engineer. Concrete mixed in a stationary mixer shall be completely mixed before being discharged into the hauling equipment. The mixing time for mixers having a capacity of one cubic yard or less shall be not less than one minute. For mixers of greater capacities, this minimum shall be increased 15 seconds for each additional capacity of one cubic yard or fraction thereof. Mixing time shall be measured from the time all cement and aggregates are in the drum. The mixer shall be charged in accordance with provisions given under "Mixing-General". The amount of concrete mixed at one time shall not exceed the rated capacity of the mixer as recommended by the manufacturer and stamped in metal on the mixer.

7.1.4 Transit Mixing: Transit mixed concrete is ready mixed concrete which has been mixed in a truck mixer. The mixing equipment shall be capable of combining the aggregates, cement and water within the specified time into a thoroughly mixed and uniform mass, and of discharging the mixture without segregation. Truck mixers shall be of the revolving drum or the pugmill revolving blade type and shall be water-tight. Each mixer shall be equipped with a tank for carrying the mixing water. The water measuring equipment shall be readily adjustable, shall be graduated in increments not larger than one gallon, and shall be accurate within a range of error of not over one

percent. The water shall be measured and placed in the tank at the proportioning plant unless the tank is equipped with a locking device which will automatically prevent the discharge of the mixer prior to receiving the required number of drum revolutions, or shall have a counter mounted on the mixer which will permit reading of the counter at the proportioning plant and at the point of delivery.

- 7.1.5 The revolution counter shall be turned back to zero before each charging of the mixer. The size of the batch shall not exceed the maximum guaranteed capacity of the mixer when used as truck mixed as stated by the manufacturer and stamped in metal on the mixer. Each batch of the standard strength concrete or high-early-strength concrete shall be mixed not less than 70, nor more than 100 revolutions of the mixer at the rate of rotation specified by the manufacturer as mixing speed. Additional mixing, if any, shall be done at a slower speed specified by the manufacturer for agitation.

The truck mixers or agitators shall be dispatched from the proportioning plant such that a uniform rate of delivery is maintained during the pour, and the interval between batches shall in no case exceed 20 minutes. The concrete shall be delivered to the site of the work and discharged within a period of one (1) hour after the introduction of the mixing water with the dry materials, or within a period of one and one-half (1-1/2) hours after the cement has been placed in contact with the aggregates.

The Contractor shall provide at least one spare truck mixer or agitator for standby service during concreting operations, which shall be equipped and ready to operate immediately in case of need.

All ready mix equipment shall be kept properly manned until notification is given by the Contractor, with approval of the Engineer, that sufficient concrete has been furnished to complete the pour. A satisfactory means of communication shall be provided by the Contractor from the site of the work to the proportioning plant which shall be available at all times to the Engineer during concrete operations. The costs for this facility shall be considered as incidental to the work and the Contractor will not be allowed any additional compensation for the same.

The Contractor shall provide and use a ticket system for recording the transportation of batches from the proportioning plant to the site of the work. The tickets shall be issued to the truck operator at the proportioning plant for each load. Each ticket shall bear the amount of water added to the mix and the time the truck left the proportioning plant. Loads which do not carry such tickets and loads which do not

arrive in satisfactory condition within the time limits specified shall not be used in the work.

7.1.6 Right of City to Require Portable Batch Type Mixer: The City reserves the right to require the Contractor to discontinue the use of ready mixed concrete and use a portable mixer of the batch type operated at the site of the work if, in the opinion of the Engineer, the use of ready mixed concrete does not produce satisfactory work, and no claim will be considered on account of such change.

7.1.7 General: In the transporting of proportioned aggregates or of ready mixed concrete to the project, the gross weight which will be permitted on the subgrade or subbase shall not exceed 550 pounds per inch of width of tire, except by written permission of the Engineer. The gross weight shall include the weight of the vehicle plus the load thereon.

Retempering of concrete which has partially hardened (i.e., re-mixing with or without the addition of water) will not be permitted.

7.2 Transportation of Materials: When the materials are transported from the proportioning plant to the mixer in batch boxes, containers, or vehicle bodies, such containers or vehicle bodies shall be of sufficient size to hold a batch of maximum size with a safety margin. Partitions intended to separate batches shall be adequate and effective in preventing material leaking or spilling from one compartment into another while in transit or when being dumped. The entire batch shall be discharged into the mixer skip. Trucks which do not discharge one complete batch into the skip, without spillage from other batches in the truck shall be replaced with satisfactory batch trucks. Cement shall be transported to the mixer in the following ways:

- (1) In the original container;
- (2) In waterproof compartments or containers for each batch;
- (3) Or in the same compartment with the aggregate.

In all cases, cement which has been in contact with aggregates for more than 1-1/2 hours before it is used shall be rejected.

When cement is transported in the original container, it shall be suitably protected from rain while it is in transit, and it shall not be dumped into the batch at a greater distance from the mixer than 1,000 feet. Tarpaulins or other approved means shall be provided on all hauling equipment for use in case of high winds or rains to prevent loss of cement after dumping.

When the cement is transported in the same compartment with the

aggregates, it shall be placed between the fine and coarse aggregates.

### 7.3 Placing:

7.3.1 The subgrade or subbase shall be sprinkled at such times and in such manner as directed by the Engineer so that it will be in a thoroughly moistened condition (but not muddy) when the concrete is deposited thereon. If deemed necessary by the Engineer, the subgrade or subbase shall be sprinkled the evening prior to the placing of concrete. Extra care shall be exercised after moistening to maintain and protect a correct and unmarked subgrade or subbase surface.

The concrete shall be deposited in such a manner as to require as little rehandling as possible and so that irregularities in composition are corrected. The concrete shall be struck off as soon as placed so that a uniform layer of concrete is produced with a thickness approximately 1 inch greater than that required for the finished pavement. Rakes shall not be used for handling concrete.

In order to prevent the introduction into the concrete of earth and other foreign materials, the "muckers" or men, whose duties require them to work in the concrete shall, in general, confine their movements to the area already covered with fresh concrete. Whenever it becomes necessary for these men to step out of the concrete, their footwear shall be washed or otherwise thoroughly cleaned before returning to the concrete. Repeated carelessness in regard to this detail will be deemed sufficient cause for removing such workmen.

During the operation of striking off the concrete a uniform ridge of concrete at least 4 inches but not more than 10 inches in depth shall be maintained ahead of the strike-off for its entire length. The tops of the forms and the surface of the finishing machine wheels shall be kept clean.

After the first operation of the finishing machine, additional concrete shall be added to all low places and porous spots and the concrete restruck. In any restriking a uniform head of concrete shall be maintained ahead of the strike-off for its entire length. Porous spots shall not be eliminated by tamping or grouting.

The crown and elevation of the strike-off and screeds must be such that a finished pavement having the required crown and thickness will be secured. After adjustment of the screed for proper crown and pavement section has been completed, the height of the middle

ordinate shall not be increased more than 10 percent when supported at the center than when supported at its ends.

In conjunction with the placing and spreading, the concrete shall be thoroughly spaded or internally vibrated along all transverse joints, forms, bulkheads, center joints and steel as is required.

The surface of the pavement shall be tested by the Contractor before the final finish, with an approved standard straight edge, 10 feet in length, and a templet cut to the cross sections shown on the plans. Irregularities so detected which exceed 1/8 inch shall be corrected immediately. Special attention must be given to the concrete adjacent to transverse joints to insure that the edges thereof are not above the grade specified, or the adjacent concrete below grade. All depressions or projections discovered shall be corrected before any initial set shall develop in the concrete.

As soon as the concrete is sufficiently hardened, the edges of the pavement, the construction and expansion joints shall be carefully finished with an edging tool so that the radius shown on the plans is obtained. The tools, special accessories for cutting impressed joints, methods and workmanship shall be such as will produce a joint whose edges are of the same quality of concrete as the other portions of the pavement. Methods and workmanship which make use of excess mortar or grout in this area shall be eliminated. Unnecessary tool marks shall be eliminated during construction and the edges left smooth and true to line.

Whenever the placing of the concrete is stopped or suspended for any reason, for a period of 30 minutes or longer, a suitable bulkhead shall be placed so as to produce a vertical joint which is perpendicular to the centerline and to the surface of the pavement. When the placing of the concrete is resumed, the bulkhead shall be removed and new concrete placed and spaded evenly and solidly against the face of the previously deposited concrete. Any concrete in excess of the amount needed to complete a given section, or that has been deposited outside the forms, shall not be used in the work.

After removal of the forms, all honeycombed edges shall be immediately filled with 1-2 mortar. Any areas such as intersections, turnouts, driveways and approach slabs that are impracticable to be constructed with a finishing machine may be finished in accordance with Section 7.3.2.

7.3.2 Hand Finishing: When specifically permitted by the plans or specifications, the concrete may be finished by means of a hand-

operated strike-off or templet approved by the Engineer. The strike-off or templet shall meet the rigidity requirements of Section 7.3.1. This striking templet shall be operated forward with a combined longitudinal and transverse motion, and shall be so manipulated that neither end will be raised off the side forms.

All other details of the finishing operations shall be as provided under Section 7.3.1.

- 7.4 Overruns and Underruns: The Contractor when ordering concrete should add to the estimated quantity in determining concrete requirements to compensate for irregularities in the subgrade and variations beyond his control. No additional compensation will be granted for overruns in concrete. It shall be the Contractor's responsibility to prevent underruns in concrete, and his attention is hereby directed to the paragraphs of this specification dealing with deficient strength and deficient thickness, and the penalties included therein.
- 7.5 Cold Weather Concreting: Except by specific written authorization, concrete shall cease when the descending air temperature in the shade and away from artificial heat fall below 40° F. It shall not be resumed until the ascending air temperature in the shade and away from artificial heat rises to 35° F.

When concreting is permitted during cold weather, the temperature of the mixed concrete shall be not less than 60° F., nor more than 85° F., at the time of placing in the forms. The aggregates or water, or both, may be heated. The aggregates may be heated by steam or dry heat prior to being placed in the mixer. The water shall not be hotter than 170° F. Aggregates shall not be used which are hotter than 150° F. In no case shall concrete be deposited on a frozen subgrade nor shall frozen materials be charged into the mixer at any time. The heating of the water and the aggregates shall be controlled so that there will not be any large difference in temperature from batch to batch.

The temperature of the concrete at the time of placing on the subgrade shall not be less than 60° F., nor more than 85° F.

Chemical admixtures shall not be used without written permission of the Engineer except where expressly authorized. Calcium chloride shall not be used as a preventive of freezing of concrete. When authorized by the Engineer, the use of calcium chloride to accelerate the hardening of the concrete will be permitted. The amount used shall be not more than 2% by weight of the cement. When its use is permitted, the calcium chloride shall be employed so as to conform to Article 7.01.10b of the Michigan State Highway Department Specifications for Road and Bridge Construction

(1976).

- 7.6 Cold Weather Protection: When concrete is being placed in cold weather and temperature may be expected below 35° F., there shall be provided along the line of the work a sufficient amount of clean, dry straw or hay to cover at least 1,500 square yards of pavement and as much more as may be necessary for the complete protection of the pavement. At any time, when the air temperature may be expected to reach the freezing point during the day or night within seven (7) days of the placing of the concrete, the loose dry material so provided shall be spread over the concrete to a depth of not less than 12 inches to cover the work. Such protection shall remain in place and be maintained for at least seven (7) days or until the concrete has developed a modulus of rupture of not less than 575 pounds per square inch, as determined by test beams placed adjacent to the pavement and cured by the same method and materials as used for curing the pavement, or until the pavement has attained at least 70 percent of its designed strength of concrete at various temperatures, Table 7.01-4 of the Michigan Department of Transportation Standard Specifications for Construction (Current Edition). Concrete injured by frost action shall be removed and replaced at the Contractor's expense.
- 7.7 Curbs: Integral curbs shall be constructed immediately following the checking of the surface for smoothness with the 10 foot straightedge. The concrete shall be deposited and thoroughly spaded and compacted to form a homogeneous mass with the pavement slab. It shall be shaped to the cross-section shown on the plans and given a finish comparable to that of the pavement.
- 7.8 Burlap Drag: As soon as all excess moisture has disappeared and while it is still possible to produce a uniform surface of gritty texture, the pavement shall be finished by dragging a seamless strip of damp burlap, not less than 5 feet nor more than 6 feet in width, over the full width of the pavement. The strip shall be 4 feet longer than the width of the slab under construction and shall be renewed as often as necessary to obtain the required texture of the surface. The drag shall be laid on the surface of the pavement and dragged forward in the direction in which the pavement is being laid. Immediately after the edges of the slab and all joints are finished with an edging tool to the radius or radii shown on the plans, the pavement shall be given a final finish by dragging a damp burlap drag over the full width of the pavement for a second time.
- 7.9 Surface Requirements: The pavement shall be checked with a 10 foot straightedge not later than 9:00 a.m. of the day following the placing of the concrete, to locate irregularities in the pavement. The straightedge shall be placed parallel to the centerline so as to bridge any depressions and touch all high spots. All high spots indicated by a variation exceeding 1/8 inch

from the straightedge will be plainly marked and shall be removed or reduced by rubbing with a carborundum brick and water. Rubbing shall be discontinued as soon as contact with coarse aggregate is made. Should it be impossible to remove the high spots in the above manner due to disturbing the coarse aggregate, such spots shall be removed by an approved surface grinding machine before acceptance of the pavement.

The final surface of the concrete pavement shall have a uniform gritty texture free from excessive harshness and true to the grades and cross-sections shown on the plans. The Engineer may require changes in the final finishing procedure of belting, brooming, or burlap drag as required to produce the desired final surface texture.

- 7.10 Removal of Forms: Forms shall not be removed from freshly placed concrete until it has set for at least 12 hours. After the form pins have been removed, the forms shall be carefully removed so that no damage will be done to the edge of the pavement. After the forms have been removed, the ends of all joints shall be cleaned and all honeycombed areas pointed. The space back of the curb shall be filled with suitable earth backfill, free from concrete, wood or any trash or other debris, and flushed with water except where honeycomb areas are to be pointed. If the backfill is not flushed with water, it shall be protected with wetted hay or straw or an approved curing agent.
- 7.11 Curing: Curing operations shall immediately follow the final finishing operations.

Failure to provide sufficient curing material to maintain the protection required, or failure to provide proper curing methods or operations or lack of sufficient equipment to take care of both curing and other construction requirements, shall be considered sufficient cause for the immediate suspension of the concreting operations, and the Contractor shall not resume concreting until the conditions objected to are corrected to the satisfaction of the Engineer.

- 7.11.1 Wetted Fabric or Mats: When wetted fabrics are used for the curing operation, the pavement shall be covered with a double layer of fabric left in place which shall be left on the pavement and kept thoroughly saturated with water both day and night for a period of not less than six (6) days, unless otherwise directed by the Engineer. In lieu of the covering of fabrics, the concrete may be covered with other woven material or mats approved by the Engineer. Such covering shall be capable of preventing the evaporation of mixing water and controlling variations of the temperature of the concrete to a degree at least equal to that of wetted fabrics.

7.11.2 White Membrane Curing: After finishing operations have been completed and immediately after the free water has left the surface, the surface of the slab shall be completely coated and sealed with a uniform layer of white membranous curing compound. The compound shall be applied in one or two applications as directed by the Engineer. When the compound is applied in two increments, the second application shall follow the first application within thirty (30) minutes. The compound shall be applied in a continuous uniform film by means of an automatic self-propelled, pressure sprayer equipment at the rate directed by the Engineer, but not less than one gallon per 200 square feet of surface. The equipment shall provide adequate stirring of the compound during application. The equipment for applying the compound must be approved by the Engineer before work is started. Should the method of applying the compound not produce a uniform film, its use shall be discontinued, and the curing shall be done by one of the other approved methods specified herein.

If the compound is too thick for satisfactory application during cold weather, the material may be warmed in a water bath at temperatures not over 100° F. Thinning with solvents will not be permitted. If rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, the Contractor will be required to apply a new coat of material to the affected areas equal in curing value to that specified for the original cost. The treated surface shall be protected by the Contractor from injury for a period of at least seven (7) days. Placing forms or form pins on the coated surface will not be permitted, and any damage to the coating resulting from forms being carried across the pavements shall be immediately corrected by application of a second coating with a hand sprayer. All traffic, either foot or otherwise, will be considered injurious to the film of the applied compound. A minimum of foot traffic will be permitted on the dried film as necessary to properly carry on the work, including the removal of any high spots, provided any damage to the film is immediately repaired by the application of a second coat of the compound. Walking on any portion of the surface will not be permitted while it is still sticky. Immediately after the forms have been removed and after all honeycombed areas have been jointed, the entire area of the side of the slab shall be coated with the curing compound at the rate specified for the pavement surface.

The Contractor shall provide on the project sufficient burlap or

cotton coverings for the protection of the pavement in case of rain or breakdown of the spray equipment. If hair cracking develops before the curing compound can be applied, the procedure as specified herein shall be modified in that preliminary curing with wetted burlap or cotton coverings, as specified under the general requirements for curing, shall be performed before the curing compound is applied.

The Contractor shall assume all liabilities for and protect the City from all claims and any damages arising from the use of materials or processes described herein.

## 7.12 Joints:

7.12.1 General joints consist of transverse joints and longitudinal joints. Longitudinal joints shall consist of contraction joints, keyed thickened-edge joints, and construction joints. Transverse joints shall consist of expansion joints, contraction joints, keyed thickened-edge joints, and construction joints. The detail of construction of these joints appear on the general details.

All joints shall be constructed true to line with their faces perpendicular to the surface of the pavement. Transverse joints shall be constructed at right angles to the center line of the pavement unless otherwise required, and shall not vary more than 1/4 inch from a true line. Longitudinal joints shall be constructed along or parallel to the center line of the pavement, unless otherwise required, and shall not vary more than 1/4 inch from their designated position.

The surface of the pavement adjacent to all joints shall be finished to a true surface and edged to the specified radius. The surface across joints shall be tested with a 10 foot straightedge as the joints are finished, and any irregularities shall be corrected before the concrete has hardened.

When the pavement is laid in partial width slabs, transverse joints in the succeeding slabs shall be placed in line with the like joints in the first slab. In the case of widening the existing pavements, transverse joints shall be placed in line with like joints in the existing pavement, and as otherwise shown on the plans.

Keyways shall be accurately formed with templates of wood or metal and the gauge or thickness of material in the template shall be such that the full keyway, as specified, is formed.

- 7.12.2 Contraction Joints: Longitudinal contraction joints shall be sawcut at the position designated on each lane and running parallel to the center line of the pavement unless otherwise provided. The position of these joints shall be as shown on the plans.

Transverse contraction joints shall be sawcut at the position designated on the plans or standard concrete paving details and shall be generally constructed every fifteen (15) feet on center. At intersections, they shall follow the pattern as shown on the general details.

- 7.12.3 Expansion Joints: Expansion joints shall be placed through the pavement according to the spacing position shown on the plans. The filler shall be cut to the crown and shape of the slab cross-section and shall extend the full depth of the joint. After installation, the top shall not be less than 1/2 inch and not more than 3/4 inch below the finished surface. The premolded joint filler shall be furnished in lengths not less than ten (10) feet except where the pour width is less than ten (10) feet. Where more than one (1) section is allowed and used in a joint, the sections shall be securely laced or clipped together. During installation, the joints shall be held in place by an approved installing device which shall be securely staked. The top edge of the filler shall be protected while the concrete is being placed by a metal channel cap of at least ten (10) gauge material having flanges not less than 1-1/2 inches in depth. A channel cap shall be shaped to the proposed crown of the full width of the filler. The cap may be designed as part of the installing device.

Where load transfer joints are specified, they shall be equipped with dowel bars spaced and arranged in positions indicated on the plans or on standard details. The dowel bars shall be held accurately in place by an approved method so as to be perpendicular to the plans of the cross-section of the pavement and parallel to the center line at a distance from the surface equal to one-half the thickness of the slab. Each dowel shall be held firmly so that its final position, after concreting operations, shall not vary more than 1/4 inch from its designated line and grade. One end of each dowel bar shall be free to move in the slab as the concrete contracts and expands. To accomplish this, not less than two-thirds of the length of each dowel shall be thoroughly coated with a liquid asphalt, RC-250. The liquid asphalt coating shall be sufficiently dry before using the dowels so that it will not be removed by handling and placing of the dowels in the joint. The bars shall be installed so that the alternate bar on each side of the joint shall be the coated end.

- 7.12.4 Keyed Thickened-Edge Joints: Transverse keyed thickened-edge joints shall be constructed on the center of the pavement slab and shall be constructed at locations as are shown on the general details or directed by the Engineer. Keyed thickened-edge joints shall be formed by

placing the concrete on each side of the joint in separate pours through the use of keyways attached to the forms.

7.12.5 Construction Joints: Construction joints shall normally be keyed thickened-edge joints. Construction joints shall be provided for partial width pours when it is desired to cease pouring, and at all other locations where pouring activities cease for more than thirty (30) minutes. In the event the construction joint falls at the location of a proposed expansion joint, the expansion joint shall be installed.

7.12.6 Joint Sealer: Sealing material for filling all types of pavement joints shall be hot-poured rubber asphalt joint sealing compound.

Equipment shall be available for filling and sealing the joints on each section of pavement before opening it to traffic.

The heater equipment shall be of the indirect heating or double-boiler type with a built-in agitator and equipped with an indicator thermometer to measure the temperature of the melted compound. Direct heating will not be permitted. Any sealing material heated in excess of the safe heating temperature shall not be used in the work.

All specified joints and the surface of the pavement for at least one inch on each side of the joint shall be thoroughly cleaned of all extraneous matter and dried, where necessary, before pouring the joint filler. The cleaning shall be done by sandblasting or other methods approved by the Engineer that will be equally effective in cleaning the concrete. The sand or dust present after the sandblasting or cleaning shall be removed by a jet of compressed air supplied at a working pressure of not less than 90 p.s.i. Hand tools shall be used, when necessary, to remove stones and other foreign materials from the joint groove.

Immediately after the joints have been cleaned with the compressed air jets, the joints shall be sealed with hot-poured rubber-asphalt type compound. The surface shall be dry at the time of sealing. Sealing compound shall not be placed when the temperature in the shade is less than 50° F., except with approval of the Engineer. The joint material shall be resilient, adhesive, non-extruding and capable of sealing joints in the concrete pavement against the infiltration of moisture throughout repeated cycles of contraction and expansion and will not be picked up by traffic during summer temperatures.

Immediately following the sawing of longitudinal contraction joints, the slurry resulting from the sawing operation shall be completely removed from the joint and the immediate area by flushing with a jet of water under pressure. The joint shall then be blown out with a jet of

compressed air to remove the flushing water. After the sawed joint is dry, it shall be cleaned out with a jet of compressed air with a working pressure of 90 p.s.i. and then sealed with one application of hot-poured rubber-asphalt type compound. The groove shall be filled until the sealer overlaps the pavement surface about 1/8 inch. The sealing compound shall be applied with pressure equipment with a nozzle extending into the groove so as to completely fill the groove with sealing compound.

- 7.13 Requirements for Thickness: Thickness of concrete at any point, determined by the measurement of cores cut as hereinafter specified, shall not be more than 1/2 inch less than the specified thickness, nor shall the average thickness of the concrete, determined as hereinafter specified, be more than 1/10 inch less than the specified thickness. Deduction for deficiency in thickness shall be made in accordance with the following table:

DEFICIENCY IN THICKNESS DETERMINED AS DESCRIBED IN THIS SECTION	PROPORTIONAL PART OF CONTRACT PRICE ALLOWED
0.00" to 0.10"	100%
0.11" to 0.50"	Ratio $\frac{\text{(Average Thickness)}}{\text{(Specified Thickness)}}$
Greater than 0.50"	None

The entire payment shall be considered a unit for the purpose of coring.

One core shall be taken at random for every 2000 square yards of pavement or major fraction thereof, however, a minimum of three cores shall be taken from any pavement cored. Should any core show a deficiency in thickness of more than 1/2 inch, additional cores shall be cut 5 feet, measured longitudinally, on each side of the location of the core deficient in thickness. If both these additional cores are within the 1/2 inch tolerance, no further special borings for this particular zone of deficiency shall be made. If either or both of the cores are outside the 1/2 inch tolerance, special borings shall be continued 50 feet and 100 feet, measured longitudinally, from the thickness, and thence at 100 foot intervals longitudinally until pavement thickness within the 1/2 inch tolerance is found in both directions of the end of the pavement is reached, thus establishing the boundaries of the zone of deficiency, but in no case shall additional cores be cut beyond the locations of any boring in that lane at which the pavement thickness has been found to be within the 1/2 inch tolerance.

When any core shows a deficiency of more than 1/2 inch, the length of the adjacent pavement for which payment shall be withheld, shall be the sum of the distances measured parallel to the center line, from the location at which the core originally found to be deficient in thickness was cut, to the nearest boring in each direction longitudinally which produced a core within the 1/2 inch tolerance. Deductions shall be only for the separately poured lane from which the cores were cut to determine thickness.

All thickness measurements which are more than 1/2 inch greater than the specified thickness shall be regarded as the specified thickness plus 1/2 inch.

The average thickness of concrete pavement shall be the mean thickness in inches of the core taken from the pavement with the provision that wherever a total deduction occurs, the mean thickness of the cores limiting the zone of deficiency shall be used in lieu of the original core (in the zone) in the average thickness calculation. The other cores within a zone of deficiency shall be disregarded in the calculation.

Any widening less than five (5) feet in width or any pavement of less than 2000 square yards in area shall not be cored unless requested by the Engineer.

All core holes shall be filled by the Contractor with concrete of the same proportions and materials used in the pavement.

- 7.14 Deficient Strength: If the average results from the test cylinders are deficient in required compressive unit strength at the 28 day compressive test, it will be sufficient reason for rejecting the concrete pavement strip.

If any one cylinder is deficient in required compressive unit strength, core samples may be cut from the finished pavement by the City at the expense of the Contractor. These cores will be taken along the centerline of the pavement strip at distances of twenty (20) feet in each direction from the location at which the deficient cylinder specimen was taken.

If the average results from the test cylinder are deficient in the required compressive unit strength by less than 15%, the City may allow such pavement to remain in place and allow in compensation therefore a certain adjusted unit price according to the following schedule:

PERCENTAGE BELOW SPECIFIED COMPRESSIVE UNIT STRENGTH	ADJUSTED UNIT PRICE PERCENTAGE OF CONTRACT UNIT PRICE
0.00% to 5%	90%
5.01% to 10%	80%
10.01% to 15%	70%

Any portion of the pavement strip where the test results indicate a deficiency of more than 15% of the specified compressive unit strength shall be removed by the Contractor within the limits of the nearest transverse joints. Any such removal shall be done at the expense of the Contractor. All such removal work shall be replaced with concrete meeting the required specifications for strength, width, thickness, and cross section as shown on the plans or as stated within these specifications.

7.15 Deficient Thickness and Strength: Any portion of the pavement strip where the test results indicate deficiencies in both the specified 28 day compressive unit strength and the specified thickness shall be removed by the Contractor within the limits of the nearest transverse contraction joints. Any such removal shall be replaced with concrete meeting the required specifications for strength, width, thickness, and cross section as shown on the plans or as stated within these specifications, at no additional compensation to the Contractor.

7.16 Deficient Width: The Contractor will be paid for the amount of concrete actually in place, as specified thereafter. In the event this concrete is deficient in required width in any area by more than two (2) percent, the Engineer may require that this area be removed and replaced at the correct width and the Contractor shall bear all expense for performing the replacement. If, in the opinion of the Engineer, additional concrete may be placed to produce the required width, without resulting in poor strength or bearing qualities, this procedure may be allowed.

An area (for replacement purposes) shall be considered to be that portion of pavement lying between the nearest longitudinal and transverse joints. It will normally be twenty (20) feet longitudinally (between contraction joints) and one lane width transversely.

7.17 Tests: Standard test cores, beams and cylinders shall be taken by the Engineer whenever necessary during the course of the work. Such test specimens shall be tested or examined in accordance with A.S.T.M. testing methods and requirements. The testing shall be done by a testing

laboratory designated by the City and at the expense of the City. The transporting of the test specimens to laboratory will be done by the City at no cost to the Contractor.

The results of the tests shall be considered as determining the quality and sufficiency of the work.

In the case of concrete core cuts taken to check or further verify the strength of concrete shown to be deficient in strength by test cylinders (as in Section 7.14 above), or in the case of core cuts taken to determine thickness (as in Section 7.13 above), all expenses so incurred shall be charged to the Contractor, irregardless of the results of the core tests.

8. OPENING TO TRAFFIC:

The pavement shall be closed to all traffic, including vehicles of the Contractor, for a period of ten days after the concrete is placed or longer if, in the opinion of the Engineer, the weather conditions make it desirable to extend this time. In any event, no pavement shall be opened to traffic until the concrete shall have reached a modulus of rupture of 575 pounds per square inch.

9. FINAL GRADING AND CLEAN-UP:

Prior to final payment, and as a condition thereto, the Contractor shall complete all grading and shaping of the right-of-way to the cross section shown on the plans. Any earth or other foreign material accumulated on the concrete during this operation shall be immediately removed. All catch basins, manholes, and other similar structures located within the right-of-way shall be thoroughly cleaned regardless of their condition prior to construction. Immediately after final grading and clean-up is completed, the Contractor shall notify the Engineer who will then inspect the work and, if satisfactory, issue a written notice to that effect.

10. METHOD OF MEASUREMENT AND BASIS OF PAYMENT:

Each item will be measured and paid for as specified in the schedule below. There will be no payment allowed for any unit of work not specifically mentioned in the proposal as a bid item. Any such unit of work not mentioned in the proposal as a bid item, but necessary to the job, shall be considered incidental to the construction of the concrete pavement.

## MEASUREMENT AND PAYMENT SCHEDULE

ITEM IN PROPOSAL	METHOD OF MEASUREMENT	BASIS OF PAYMENT
		The Contract Unit Price bid in the proposal shall be payment in full for all labor, material, and equipment necessary to do the following according to the Plans and Specifications.
Concrete Pavement	By the area in square yards (SYD) actually constructed within the limits as shown on the Plans or as directed by the Engineer. No deduction will be made for the area occupied by manholes, catch basins, inlets and other similar structures. When integral curb and gutter is specified, the area for payment shall include the integral curb and gutter without additional remuneration.	Construct the pavement completely to specified thickness and cross section including excavation, or fill, adjustment of all structures within the right-of-way, complete placement of concrete, finishing, curing, construction of curb drops, joints, protection of the work, and opening to traffic unless any of the above items are included as Bid Items.