

## SECTION 2 EARTHWORK AND PAVEMENTS

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## **SECTION 2 EARTHWORK AND PAVEMENTS**

### **SUBSECTION 1 EARTHWORK**

#### **1.0 EXCAVATION.**

1.1 DESCRIPTION. This section covers work consisting of excavation, disposal or compaction of all material not being removed under other items which are encountered within the limits of the work necessary for the construction of the project in accordance with these specifications and in conformity with the lines, grades and cross sections shown on the plans or established by the Engineer. All excavation will be classified as "unclassified excavation", "excess excavation" or "unsuitable material excavation" as hereafter described.

#### **1.2 MATERIALS**

1.2.1 UNCLASSIFIED EXCAVATION shall consist of all the work as described herein which is necessary for the preparation and construction of the project, embankments, subgrade, shoulders, parking, curb trenches, drainage ditches, channels, cross street and alley approaches, sidewalks, driveways, private entrances, etc. Unclassified excavation shall include the removal and satisfactory disposal of all trees, brush, stumps, posts, fences, weeds, rock, concrete, existing pavement, gravel or macadam, sidewalks, curbs, pipes, culverts, sewer manholes and inlets where required, and all other structures, materials or debris; the stripping and removing of the top soil or sod to be piled separately from other materials and later restored to its original place when backfilling is completed; the completion of all necessary backfilling, tamping, compacting, and refilling; the restoring of all streets, alleys, right-of-ways or other lands, either public or private, damaged or occupied by the Contractor in the performance of the contract, to as good of condition as they were prior to the beginning of the work.

1.2.2 EXCESS EXCAVATION shall consist of all excavation not designated for embankment or stockpiling on the project and is to be removed from the limits of the project.

1.2.3 UNSUITABLE MATERIAL EXCAVATION consists of the removal and disposal of soft, spongy material below the finished grade, either saturated or unsaturated which will not be suitable for foundation material regardless of moisture content, extending downward to firm earth. The Contractor shall not begin backfill operations until cross section of the excavation has been determined and approved by the Engineer.

1.3 EQUIPMENT. Excavating and grading equipment shall be approved types and designs, and shall be maintained in first class condition. Equipment used for disposing of excavated materials outside of the limits of the work shall be such as will avoid scattering or wasting material along the line of haul. The Contractor shall immediately clean up all material wasted or scattered.

#### **1.4 CONSTRUCTION METHODS.**

1.4.1 All grass or weeds or other vegetation shall be cut and properly disposed of in a satisfactory manner before the ground is broken for grading and excavation. All existing structures, such as manholes and sewer inlets, which are to remain in place shall be adjusted or rebuilt and care shall be taken not to damage existing structures during grading or construction operations.

1.4.2 After the site of the work has been properly cleared and cleaned, excavation and grading of the roadway shall proceed in conformity with the plans and the specifications. Rock, boulders or existing structures which are abandoned, shall be removed to a depth of not less than 36" below the original ground elevation.

1.4.3 Soft, spongy or other unsuitable material shall be removed to such a depth as may be necessary to permit the preparation of an acceptable subgrade. The determination of unsuitable material shall be made by the Engineer. All excavation below subgrade elevation shall be backfilled with approved select materials, placed in layers not exceeding 8-inches in thickness (loose measure). These layers shall be rolled or tamped, or both, to a density of 95% Standard Proctor at  $\pm 2\%$  of optimum moisture content (per ASTM D698-00a). This item will be used if unstable soil is encountered which cannot be stabilized by conventional dewatering operations.

1.4.4 Trenches shall be excavated to a depth not to exceed 2-1/2 feet below the pipe flowline until that depth or stable soil is reached. The area excavated will then be filled with crushed rock meeting either ASTM No. 57 gradation or the gradation of rock used for the underdrain cover aggregate. Payment will be by the cubic yard, which shall include both excavation and fill material. The Contractor and City Engineer will agree each day on the depth and linear feet of unsuitable material. Quantities will be computed based on the specified trench width as shown on the typical section. Care shall be taken not to disturb the ground below the required finish subgrade elevation except for necessary structures and where provision is made for uniformly scarifying or loosening the ground below subgrade.

1.4.5 Excavation outside the curb lines, or beyond the slab edges shall not be made wider than necessary for the setting of the forms or string lines. The finish grade, slopes and edges of the excavation on all parking, cross street or private driveway approaches, etc., shall be backfilled where necessary, using approved material thoroughly compacted in layers and dressed off uniformly in a neat and workmanlike manner. Slab edges shall be backfilled for a width of not less than 2 feet measured at the level of the top of slab. Ample provision will be made at all times for completely and readily draining the subgrade and all excavations.

1.5 STRUCTURES REMOVED AND SURPLUS EXCAVATED MATERIALS. All structures removed and surplus excavated materials are the property of the City. In general, all manhole frames and covers, sewer inlet frames and gratings, and all pipes, culverts, etc., salvaged from the work shall be hauled to and stored at the City facility designated in special provisions and approved by the Engineer. Gravel or Macadam surfacing material shall, as nearly as practicable, be removed separately from earth or other excavated materials, and when desired by the City for use on other streets, alleys, etc., shall be disposed of on sites designated or selected by the Engineer. In selecting locations for the disposal of surplus excavated materials the requirements for filling abutting or adjacent property shall be given priority in the order named. The disposal of all excavated materials other than as specifically mentioned above, shall be at the sites approved by the Engineer.

1.6 METHOD OF MEASUREMENT The quantities of unclassified excavation for which payment will be made shall be the quantities shown on the plans, provided the project is constructed essentially to the lines and grades shown on the plans. When the plans have been altered, the quantities involved shall be measured from the original plan cross sections. Additional original cross sections may be interpolated or determined by other approved methods at points where necessary to more accurately determine the quantities. When quantity is not specified by the plans, all accepted excavation and borrow shall be measured in its original position by cross sectioning the area excavated. Volume will be computed from the cross section measurements by the average end area method, or other approved methods. The Contractor and City Engineer will agree each day on the depth and linear feet of unsuitable material. Quantities will be computed based on the specified trench width as shown on the typical section. Unsuitable material excavation will be measure by the material removed. Replacement material will be measured and paid by the item used to replace the unsuitable material.

1.7 BASIS OF PAYMENT. Excavation will be paid for at the contract/unit price for the items classified for payment for:

UNCLASSIFIED EXCAVATION	C.Y.
UNSUITABLE MATERIAL EXCAVATION	C.Y.
EXCESS EXCAVATION	C.Y.

which shall be full compensation for all items of work specified and, for which no separate unit prices are included in the contract, including all labor, materials, tools, equipment and incidentals necessary to complete the work in accordance with the plans and specifications.

## 2.0 EMBANKMENT

2.1 DESCRIPTION. This section covers construction of roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes within or outside the right-of-way; the placing and compacting of approved material within roadway areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits and other depressions within the roadway area, in accordance with these specifications and in conformity with the lines, grades, thicknesses and typical cross sections shown on the plans or established by the Engineer. Only approved materials shall be used in the construction of embankments and backfills.

2.2 CONSTRUCTION METHODS. All grass, weeds, trees, stumps and existing structures shall be removed in a satisfactory manner from the entire area to be occupied by the embankment. All embankments shall be formed of good sound earth, gravel or other acceptable materials, and shall be built to sufficient heights and width that after full shrinkage, will conform to the lines, grades and cross sections shown on the plans, or called for in these specifications.

- Rocks may be placed in embankment provided they are not placed in piles, and provided no rock larger than 3-inches is placed nearer the finish grade than 12-inches. No sticks, weeds, trash or other vegetable matter, nor any other unsuitable materials shall be placed in embankments. Embankments shall not be constructed on or of frozen material. All excess or unsuitable excavated material, including rock and boulders larger than 8-inches in the largest dimension, that cannot be used in embankments shall become the property of the Contractor and disposed of by him to the satisfaction of the Engineer. Embankments constructed of material of which a large portion is rock of such a nature that, in the opinion of the Engineer, construction in 9-inch layers is not feasible shall be constructed in layers the depth of which shall not exceed the maximum size of the rock present in the material, and in no case shall the thickness of the layer exceed 24-inches. End dumping will be required. The rock shall be dumped near the end of the existing lift and pushed over the end. Compactive effort on the rock and rocky material shall consist of making multiple coverings of each layer with a tamping type roller or with a vibratory roller as approved by the Engineer.
- Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments of earth. The top 12-inches of embankment shall be constructed with approved materials, smoothed and placed in layers not exceeding 9-inches in loose thickness and compacted as specified for embankments.
- The surface layer of the roadbed shall not be wetted or compacted until final finish grade stakes have been set and all embankment material is in place. The surface layer of the entire embankment shall then be manipulated by scarifying and the moisture corrected as specified for embankments, after which the entire surface layer shall be compacted to not less than 95 percent of Standard Proctor Density. (Per ASTM D698-00a) Material in embankments shall be placed in layers not exceeding 9-inches in depth measured when loose, and extending the entire width and length of the embankment. Each succeeding layer shall be uniformly spread over the surface, then thoroughly compacted.

- Areas inaccessible to the roller shall be thoroughly hand tamped until the degree of compaction is equivalent to that of the rolled area. Hand tampers shall have a tamping surface not exceeding 25 in<sup>2</sup> , shall weigh not less than one pound per square inch, and shall be of a design approved by the Engineer. If the embankment can be deposited on only one side of abutments, wing walls, piers or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning of or excessive pressure against the structure.

2.3 METHOD OF MEASUREMENT. The quantities of embankment for which payment will be made shall be the quantities shown on the plans, provided the project is constructed to the lines and grades shown on the plans.

2.4 BASIS OF PAYMENT. Embankment will be paid for at the contract/unit price for the item classified for payment for:

EMBANKMENT                      CY

which shall be full compensation for all items of work specified and for which no separate unit prices are included in the contract, including all labor, materials, tools, equipment and incidentals necessary to complete the work in accordance with the plans and specifications.

### 3.0 BORROW

3.1 DESCRIPTION. This section covers borrow which consists of required excavation, removal, and proper utilization of materials obtained from designated or approved sources. Compaction of embankments constructed from borrow, as provided herein, shall conform to the requirements of other relevant paragraphs of these specifications.

3.2 MATERIALS. Where shown on the plans, selected materials will be utilized in the formation of embankment or to improve the roadbed. Borrow material shall be suitable for the embankment purpose desired, as determined by the Engineer.

3.3 CONSTRUCTION METHODS. All suitable materials removed from the excavation shall be used, insofar as practicable, in the formation of embankments as required by the governing item for "Embankments", or shall otherwise be utilized as indicated on the plans or as directed, and the completed work shall conform to the established alignment, grades, and cross section. During construction, the borrow sources shall be kept drained, insofar as practicable, and the work shall be prosecuted in a neat and workmanlike manner. Payment will not be allowed for excavation for any material which is used for purposes other than those designated, except as provided in the other specifications. Site of the borrow operations shall be left in a suitable and neat condition so as to provide proper drainage where practical. Where indicated on the plans, the sides and/or ends of borrow pits shall be sloped to the dimensions indicated on the plans.

3.4 METHOD OF MEASUREMENT. Borrow will be measured in a compacted condition in its final position and the volume computed in cubic yards by the method of average end areas.

3.5 BASIS OF PAYMENT. Borrow will be paid for at the contract/unit price for the items classified for payment for:

BORROW                      CY

which shall be full compensation for all items of work specified and, for which no separate unit

prices are included in the contract, including all labor, materials, tools, equipment and incidentals necessary to complete the work in accordance with the plans and specifications.

#### 4.0 DEWATERING

4.1 DESCRIPTION. This section covers dewatering of trenches, pits, and all other excavation areas. The Contractor shall provide and maintain ample equipment with which to remove all water from every source that enters excavations for structures and pipelines. Dewatering operations shall ensure dry excavations and preservation of the elevations of excavation bottoms shown on the drawings. Surface drainage shall not be allowed to enter excavated areas. Where areas to be excavated are located under water surfaces or near banks of flowing streams or other bodies of water, the Contractor may adopt and carry out any method of dewatering he may deem feasible for the performance of excavation work and for protection of the work thereafter, provided that method and equipment to be used results in completed work which complies with the specifications and is acceptable to the Engineer. In such cases, the excavation areas shall be effectively protected from water damage during the excavation period and until all contemplated construction work therein has been completed. Prior to beginning excavation for pipes and structures, which are to be constructed at or below the ground water table, groundwater levels shall be lowered and maintained at a level at least 2 feet below the bottom of trench or such structures until construction and backfilling operations have been completed. The Contractor shall be responsible for damage to structures caused by hydrostatic displacement during construction operations.

#### 4.2 CONSTRUCTION METHODS

4.2.1 Bailing, Sump or Trench Pumping. For trench or structural excavations, and for small quantities of water, a sump or trench pump may be used to pump excess water from the low end of the excavations. When, as determined by the Engineer, soil conditions are such that dewatering may readily be accomplished by ordinary bailing and use of trench pumps, well systems shall not be used.

4.2.2 Well Systems. When required, the Contractor may utilize the following methods of dewatering:

- Deep Pumped Wells Method. In locations where the water table is deep, pumped filtered wells may be used for lowering the water level or for controlling artesian pressures in aquifers beneath excavations.
- Well Points Method. Well points are small-diameter wells with one or more slotted or screened sections of pipe attached to riser pipes that are connected through swing joints to header pipes. Where a single row of well points is not enough to lower the water level adequately, then 2 or more rows of well points shall be used as directed by the Engineer.
- Vacuum Method. Soils that are too fine-grained for gravity drainage may be dewatered by application of a vacuum to filters surrounding well points.
- Electroosmosis Method. Dewatering of soils by electroosmosis may be achieved by installing a line of metal well points serving as negative electrodes to attract water and allow it to be removed by suction and a line of rods serving as cathodes.
- When requested by the Engineer, the Contractor shall submit to the Engineer for review and approval the proposed dewatering method, well and pump layout, depth of penetration and points of discharge.

#### 4.3 METHOD OF MEASUREMENT

- Dewatering trenches using a well system shall be measured as the length of trench dewatered plus 20 feet from each end well, or 40 feet for one well.
- Dewatering of excavations using a well system shall be measured as the length of the perimeter of the structure such as clarifiers or basins.
- Dewatering for pits and/or shafts excavated for construction operations such as those needed for trenchless construction methods shall be measured per length of pit along the line.
- All dewatering performed using bailing and trench or sump pumping shall be considered incidental work and NOT be paid for directly, but shall be included in the cost of other items.

4.4 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:

DEWATERING	LF
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Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

#### 5.0 TRENCH EXCAVATION AND BACKFILL

5.1 DESCRIPTION. This section covers trench excavation for pipelines and consists of excavation necessary for construction of all underground work and all appurtenant facilities, including site preparation, placement of embedment material, backfilling, and compaction of pipe trenches and around structures and disposal of waste materials, all of which shall conform to the applicable provisions of these specifications. Trench excavation shall be made in open-cut and true to the lines and grades shown on the plans or established by the Engineer.

#### 5.2 CONSTRUCTION METHODS

5.2.1 Excavation in Advance of Construction. The length of trench excavated approximately to grade shall not exceed 150 feet and no trench excavation whatsoever shall be made farther than 300 feet in advance of completed backfill.

5.2.2 Trench Widths. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, joining, and embedment. Stipulated minimum trench widths are not minimum average widths, but are minimum widths that shall be required. Stipulated maximum trench widths shall not be exceeded. Trench width shall be the width of the trench excavation measured from bank to bank at the top of the pipe. For rigid pipes, when the maximum trench width is exceeded, the Contractor shall be required to provide a higher strength pipe or higher bedding classification, singly or in combination as directed by the Engineer at his own expense. Any additional foundation material and/or embedment material required due to over-excavation, beyond the maximum trench width shall be at the Contractor's expense. Minimum and maximum permissible trench widths shall be as shown in table below.



Pipe Nominal Size (Inches)	Minimum Trench Width (Feet)	Maximum Trench Width (Feet)
12	3.00	5.00
16	3.25	5.00
18	3.25	5.00
21	3.75	5.25
24	4.00	6.00
30	4.50	6.75
36	5.25	9.00
42	6.25	9.50
48	7.00	10.00
54	8.00	10.50
60	9.00	11.00
64	9.75	11.50
66	9.75	11.50
72	10.50	12.00
78	10.50	12.50
84	11.00	13.00
90	11.50	13.50

5.2.3 Trenches Requiring Sheet piling and Shoring. Where trenches are excavated in soil of such nature as to require sheet piling and shoring to assure proper installation, safety of the workmen, and avoid damage to any adjacent structures or other objects, the Contractor shall provide the necessary sheet piling and shoring. Where possible, shields designed to be portable and moved along as work progresses may be used. The contract pay widths shown in the above shall apply to all trenches with or without sheet piling or shoring, except where a bid price has been solicited and provided in the Contract and where the Engineer shall thereafter direct.

5.2.4 Trenches With Stepped Sides. Where the work is located in open areas, if the right-of-way is of sufficient width and soil conditions are suitable, the Contractor may at his option, upon approval of the Engineer, excavate trenches with sloping or stepped sides provided that no additional compensation for excavation and backfilling will be allowed for work performed outside the maximum trench widths designated in the above Table.

5.2.5 Trenches at Tunnels. Where the water line is in a tunnel, the trench excavation shall be measured to the faces of the tunnel.

5.2.6 Excavation for Valve Vaults and Other Waterline Structures. When structural excavation is listed as a separate pay item, excavation for valve boxes and other waterline structures shall be computed in cubic yards using dimensions of the net prescribed area outside trench width excavation where the length of trench is measured through or partially through structures. When structural excavation is not listed as a pay item, cost shall be included in the cost of other items.

- When exterior forms with or without sheet piling and shoring are used, the excavation shall be computed for a width 5 feet greater than the exterior dimension of the structure.
- Excavation shall be considered a part of the trenchless work per linear foot, and shall not be paid for separately unless such excavation is listed as a pay item in the bid documents.
- Any sheet piling, shoring, bracing or sheet piling left in place, in conformity with the plans and specifications or as directed by the Engineer, shall be paid for separately.

### 5.3 PERFORMANCE REQUIREMENTS.

5.3.1 General Excavation. Excavation shall be made in open-cut from the surface of the ground and shall be made no larger than necessary to permit proper construction of the work in accordance with the plans and specifications. The entire foundation area in the bottom of all excavations shall be firm, stable and of uniform density as nearly as practical, and unless necessary, materials shall not be disturbed below grade. Where trenches are excavated in soft, unsuitable materials, or rock, trench bottom may be stabilized as directed by the Engineer.

5.3.2 Deep or Unstable Excavations. Where depth of trenching and other excavations are greater than 12 feet and when not provided for in the plans, an Engineer shall be retained by the Contractor to design bank protection as per OSHA rules and regulations. The bank protection design, signed and sealed by a Professional Engineer licensed in the State of Oklahoma, shall be submitted to the City Engineer for approval.

5.3.3 Sheet piling, Shoring, Bracing and Sheet Piling. The sides of all excavations shall be sufficiently sheeted, shored and braced so as to prevent slides, cave-ins, settlement or movement of the banks. In wet, saturated or flowing ground where it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling of approved design and type shall be used. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressures exerted and maintain the walls of the excavation properly in place and protect all persons or property from injury or damage. When excavations are made adjacent to existing buildings or other structures, or in paved streets or alleys, particular care shall be taken to adequately sheet, shore, and brace the sides of the excavation to prevent any undermining of or settlement beneath the structures or the pavement. Underpinning of adjacent structures, when necessary, shall be done in an approved manner. The foundation material that is undermined shall be replaced and compacted in accordance with the requirements of this section. Sheet piling, shoring, and bracing shall not be left in place unless otherwise shown on the plans or authorized by the Engineer. The removal of sheeting, shoring and bracing shall be done in such a manner as not to endanger or damage either the new structure or any existing structure or property, either private or public, and so as to avoid cave-ins or sliding of the banks. If for any reason the Contractor, with the approval of the Engineer, leaves in place any sheeting, shoring or bracing, no payment will be allowed for such material left in place unless it is classified as a contract pay item. All holes or voids left by the removal of sheeting, shoring or bracing shall be satisfactorily filled and compacted in accordance with the requirements of this section.

5.3.4 Pumping, Dewatering and Draining. The Contractor shall remove immediately any surface or seepage water or water from sewers, drains, creeks, or other sources which may accumulate during the excavation and construction work by doing the necessary pumping, dewatering or draining by ditch or other means. The Contractor shall have available at all times sufficient equipment in proper working order for doing the work herein required. All water removed from excavations shall be disposed of in an approved manner so as not to create unsanitary conditions nor to cause injury to persons or damage to the work in progress or to other property, either public or private, nor to interfere unduly with the use of streets, alleys, or of private drives and entrances.

5.3.5 Disposal of Excavated Materials. Excavated materials, so far as needed and of a suitable character, shall be piled adjacent to the work to be used for backfilling as required. Excavated materials unsuitable for backfilling or in excess of that required for backfilling shall be disposed of in an approved manner at locations designated or approved by the Engineer. Desirable topsoil, sod, etc., shall be carefully piled separately from other excavated materials so that it can be replaced to its original position when required. Excavated materials shall be handled at all times in such a manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of the work.

5.4 BACKFILLING. Backfill is that portion of the total trench volume down to but not including the pipe embedment material. The backfill shall be only material approved by the Engineer consisting of loose earth, free of clods, stones, organic matter, debris or other objectionable materials.

5.4.1 All backfilling shall be done in such a manner as not to disturb or injure the pipe or structures over or against which it is being placed. Any pipe or structure injured, damaged or moved from its proper line or grade during backfilling operations shall be opened up and repaired and then re- backfilled as herein specified. The placing of backfill material shall not begin until approval for so doing has been given by the Engineer, but backfilling around structures or portions of structures shall be done immediately. The top surface or slopes of all backfill shall be neatly graded off where select topsoil, sod or other material is removed and piled separately; such material shall be carefully replaced in a manner satisfactory to the Engineer. The top 12 inches of backfill material shall be of equal or better quality than the original topsoil that was removed.

5.4.2 Compaction Requirements. All backfill shall be placed and compacted in 8-inch lifts for hand-tamped equipment and 18-inch lifts for self-propelled or power-driven equipment to the following minimum percent of Standard Proctor Density or Relative Density as determined by ASTM D-698, "Tests for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures". Cohesive backfill material shall reach the indicated compaction levels at plus or minus ( $\pm$ ) 3% of optimum moisture content. The lift thickness shall be reduced, if necessary, to meet the compaction requirements specified herein.

Location	Percent Compaction
Under Traffic Areas or Improved Existing Surfaces	95
Urban and Residential Areas	90
Undeveloped and Other Areas	85

5.4.3 Compaction Methods. Compaction methods may vary depending on the material or as approved by the Engineer.

- Cohesive Materials. Compaction of cohesive materials may be obtained by use of impact type equipment. In confined areas, pneumatic tampers and engine driven rammers may also be used. In relatively narrow trenches, self-propelled rammers may be used. In wide trenches, sheepfoot rollers may be used.
- Cohesionless Materials. Cohesionless materials are granular materials classified as non-plastic. In general, vibratory equipment may be used for proper compaction. In confined areas, vibratory plates may be used. For wider trenches, vibratory rollers may be used.
- Flooding (Jetting). Compaction by flooding the trench shall not be approved except in rare instances and only in undeveloped areas. If approved by the City Engineer, no additional compensation shall be allowed the Contractor for settling the backfill by flooding. The cost of such work shall be absorbed in the unit bid price for trench excavation and backfill or other pay units the Contractor may elect.

5.4.4 Testing of Backfill. All backfill shall be subject to testing by an approved laboratory for compliance of the compaction requirements when so directed by the City Engineer. Upon completion of backfill, the Contractor shall replace all surface materials and shall restore paving, curbing, sidewalks, gutters, shrubbery, fences, sod, and other surfaces disturbed to a condition equal to or better than that before the work began, furnishing all labor, tools, equipment, materials and incidentals thereto as provided elsewhere in these specifications.

5.5 METHOD OF MEASUREMENT. General Bid prices for "Trench Excavation and Backfill" and "Structural Excavation" shall be full compensation for all labor, materials, tools, equipment and incidentals necessary to complete the work in accordance with the plans and these specifications.

5.5.1 Trench Excavation and Backfill. The Contractor shall be paid for "Trench Excavation and Backfill" on a linear foot basis for depths from 0' to 10 feet, 0 to 15 feet, 0 to 20 feet, 0 to 25 feet, and 0 to 30 feet. The price established shall be full compensation for trench excavation and backfill, and shall include all necessary sheeting, shoring, bracing and incidental dewatering, pumping, draining, and disposition of any surplus excavated material not needed unless otherwise provided. For the purpose of determining pay quantities, trenches shall be measured through valve boxes and similar structures, based on the applicable width of trench for size of line under consideration unless otherwise designated. Should size of waterline change at a valve or other structure, the appropriate width of trench for each size shall apply, with the consideration for the purpose of ascertaining pay quantity, that the change of size takes place at the centerline of the valve or structure.

5.5.2 Structural Excavation. When classified as a pay item, "Structural Excavation" shall be paid for on a cubic yard basis. The price established shall be full compensation for all necessary dewatering, sheeting, shoring, excavation and backfilling and disposal of surplus material. When not classified as a pay item, it shall be included in the cost of other items.

5.6 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:

TRENCH EXCAVATION AND BACKFILL – 0 TO 10 FEET	LF
TRENCH EXCAVATION AND BACKFILL – 0 TO 15 FEET	LF
TRENCH EXCAVATION AND BACKFILL – 0 TO 20 FEET	LF
TRENCH EXCAVATION AND BACKFILL – 0 TO 25 FEET	LF
TRENCH EXCAVATION AND BACKFILL – 0 TO 30 FEET	LF
STRUCTURAL EXCAVATION	CY

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications. In the absence of this Pay Item in a contract, the cost shall be considered incidental and no additional compensation shall be made for this work and the cost of same shall be included in the other pay items.

6.0 CRUSHED ROCK FOUNDATION

6.1 DESCRIPTION. This section covers proper treatment of unsuitable and soft foundation materials. A crushed stone mat shall be provided for waterline support where directed by the Engineer. Stone shall be hand or mechanically tamped to obtain a firm support.

6.2 MATERIALS. Gravel containing rounded aggregates shall not be acceptable for this work. The aggregates for crushed rock pipe foundation shall be a uniformly graded crusher run material meeting the following gradation requirements:

Nominal Sieve Sizes	Percentage Passing
2 inch	100%
½ inch	< 30%

6.3 CONSTRUCTION METHODS. The crushed stone mat shall be 6 to 12-inches thick and shall be hand or mechanically tamped to obtain a firm support.

6.4 METHOD OF MEASUREMENT. Measurement for "Crushed Rock Foundation" shall be per cubic yard or ton. The price established shall be full compensation for furnishing and placing of all materials, labor, tools, equipment, and any incidentals necessary to complete this item of work.

6.5 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:

CRUSHED ROCK FOUNDATION	CY
CRUSHED ROCK FOUNDATION	TON

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

7.0 LEAN MIX CONCRETE FOUNDATION

7.1 DESCRIPTION. This section covers proper treatment of unsuitable foundation materials. A concrete mat shall be used for soil stabilization as a pipe support where directed by the Engineer.

7.2 MATERIALS. The concrete mat shall be constructed using 1-part Portland cement to 12-parts of sand mix. A 6-inch stabilizing mat shall be prepared by blending equal proportions of concrete mix and soil. The mat shall be placed at proper elevation to permit installation.

7.3 CONSTRUCTION METHODS. A 6-inch stabilizing mat shall be prepared by blending equal proportions of concrete mix and soil. Place mat at proper elevation to permit installation.

7.4 METHOD OF MEASUREMENT. The unit price for "Lean Mix Concrete Foundation" shall be based on the volume of concrete used and not the volume of the finished concrete soil mat. The price established shall be full compensation for furnishing and placing of all materials, labor, tools, equipment, and incidentals necessary to complete this item of work.

7.5 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:

LEAN MIX CONCRETE FOUNDATION	CY
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Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

8.0 EMBEDMENT MATERIAL

8.1 DESCRIPTION. This section covers furnishing and placement of material for embedment of both rigid and flexible pipes. The embedment is that material to be placed from a minimum of 6-inches below bottom of the pipe to the springline (half pipe diameter) or to a minimum of 6-inches above top of pipe for rigid and flexible pipes, respectively. The remaining material to be placed over the embedment is considered backfill.

8.2 MATERIALS. General - Embedment material shall meet the requirements ASTM C-33 No. 67 and gradations shown below:

Nominal Sieve Sizes	No. 67
1 inch	100%
¾ inch	90 to 100 %
½ inch	.....
3/8 inch	20 to 55%

No. 4	0 to 10%
No. 8	0 to 5%
No. 200	.....

8.3 CONSTRUCTION METHODS. All embedment material shall be placed and compacted in 6-inch lifts to 95% of Standard Proctor Density or Relative Density as determined by ASTM D698, "Tests For Moisture-Density Relations of Soil-Aggregate Mixtures. All embedment material shall be tested by an approved laboratory for compliance of compaction requirements. Following acceptance of compaction, the Contractor may proceed with placing remaining backfill.

8.4 METHOD OF MEASUREMENT. The unit price for "Embedment Material" shall be based on the volume or tonnage of material used. Contractor shall submit material delivery tickets and shall be verified by the Engineer. The price established shall be full compensation for furnishing and placing of all materials, labor, tools, equipment, and incidentals necessary to complete this item of work.

8.5 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:

EMBEDMENT MATERIAL	CY
EMBEDMENT MATERIAL	TON

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications. In the absence of this Pay Item in a contract, the cost shall be considered incidental and no additional compensation shall be made for this work and the cost of same shall be included in the other pay items.

9.0 CONCRETE CRADLES.

9.1 DESCRIPTION. This section covers concrete cradle, Bedding Class "A", ASCE Manual No. 60, to be constructed as called for on the plans or as directed by the Engineer. Cradle shall be constructed beneath rigid pipes, to increase load bearing capacity of pipe-soil embedment system, either plain or reinforced, in accordance with the "Standard Details for Plain and Reinforced Concrete Cradle".

9.2 MATERIALS. Before cradle is constructed, the subgrade shall be prepared and properly shaped at the required grade. All concrete shall be placed in a dry trench. Where concrete is placed in a wet trench, the work shall be done strictly as directed or approved by the Engineer.

9.3 CONSTRUCTION METHODS. The pipes shall be firmly bedded in the concrete to proper grade. The concrete shall be so placed as not to damage the joints or disrupt any pipes. Backfilling shall be done in a careful manner and at such time after the concrete is placed as not to damage the concrete in any way.

9.4 METHOD OF MEASUREMENT. Payment for "Concrete Cradle" shall be made at the unit price bid per cubic yard of concrete for each type. Quantity shall be computed based on the neat lines for concrete cradle (Plain, Type I Reinforcement, or Type II Reinforcement) as shown on the plans. The price established shall be full compensation for all materials, including concrete and steel reinforcement (if required), labor, tools, equipment and incidentals necessary to complete the work.

9.5 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:

CONCRETE CRADLE PLAIN	CY
CONCRETE CRADLE TYPE I REINFORCEMENT	CY
CONCRETE CRADLE TYPE II REINFORCEMENT	CY

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

## 10.0 CONCRETE ARCHES

10.1 DESCRIPTION. This section covers concrete arch, Bedding Class "A", ASCE Manual No. 60, to be constructed where shown on the plans or as directed by the Engineer. Concrete arch shall be constructed over top of rigid pipes, to increase load bearing capacity of pipe-soil system, either plain or reinforced, in accordance with the "Standard Detail for Concrete Arch".

10.2 CONSTRUCTION METHODS. Before arch is constructed, the embedment material shall be placed and compacted to the pipe springline (one-half pipe diameter) as specified elsewhere in these specifications. The top of the embedment material shall be then prepared for placement of the concrete arch. All concrete shall be placed in a dry trench. Concrete shall be so placed as not to damage the joints or disrupt any pipes.

10.3 METHOD OF MEASUREMENT. Payment for "Concrete Arch" shall be made at the unit price bid per cubic yard of concrete for each type. Quantity shall be computed based on the neat lines for concrete arch (Plain or Type I Reinforcement, or Type II Reinforcement). The price established shall be full compensation for all materials, including concrete and steel reinforcement, labor, tools, equipment, and incidentals necessary to complete the work.

10.4 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:

CONCRETE ARCHES PLAIN	CY
CONCRETE ARCHES TYPE I REINFORCEMENT	CY
CONCRETE ARCHES TYPE II REINFORCEMENT	CY

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

## 11.0 EMBEDMENT PLUGS

11.1 DESCRIPTION. This section covers construction of embedment plugs, for control of groundwater flow, where called for on the plans or as directed by the Engineer. The minimum length of embedment plugs shall be 10 feet and shall extend 6-inches below the bottom and above top of pipe. Placement and materials shall be in accordance with the Standard Detail for Embedment Plugs.

11.2 MATERIALS. Two types of embedment plugs may be used, at the Contractor's option. Clay Plugs used for embedment and backfill material shall be select clay material separated from excavated materials and shall be approved by the Engineer prior to placement. This material shall be free of clods, clumps, debris, organic material, and stones. All clay plug material shall be compacted to a minimum of 90% of Standard Proctor Density (ASTM D698) at plus or minus ( $\pm$ ) 3% of optimum moisture content. Flowable fill plugs shall consist of a Portland Cement grout having a minimum 28-day compressive strength of 500 psi.

11.3 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:

EMBEDMENT PLUGS (TYPE)

EA

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

12.0 SUBGRADE

12.1 DESCRIPTION. This section will cover the compaction of earthwork by rolling or tamping or any combination of these methods in the construction of embankments in accordance with relevant paragraphs of these specifications.

12.2 CONSTRUCTION METHODS. After the subgrade material has been accepted by the Engineer it shall be compacted to a minimum density of 95% of ASTM D698-00a Standard Proctor Density and shall be maintained at  $\pm 2$  percent of optimum moisture content during the compaction process. The degree of compaction shall be determined by Field Density tests taken as provided under "Testing".

12.2.1 The Contractor is responsible for the condition of the subgrade until the pavement is in place and any portion which becomes damaged or unstable due to having become wetted or from freezing, or for any other reason, shall be corrected prior to the placing of the pavement. The finished surface shall conform to the cross sections shown on the plans and shall be smooth and unyielding.

12.2.2 When the moisture content of the subgrade soil does not fall within the required Moisture Range, the subgrade shall be reworked to bring the moisture content into compliance with the specifications.

12.3 TESTING. A standard proctor test as prescribed in this Section will be made of each type of soil on samples of the subgrade after the street is rough graded. Testing to be performed by a laboratory approved by the City. The maximum number of satisfactory tests ordered by the Engineer for a private development and the applicable method of test will be that shown on the schedule below:

TEST SCHEDULE

Description	Test Method	Quantity Represented by One Test
Soil Classification		4800 SY of Subgrade or Select Soil
1) Preparation Of Soil Mechanical Analysis	ASTM D421	
2) Mechanical Analysis Of Soils		
3) Liquid Limit Of Soils	ASTM D4318	
4) Plastic Limit And Plastic Index	ASTM D4318	
5) Soil Classification	ASTM D2487	
Standard Proctor Density	ASTM D698	4800 SY of Subgrade
Field Density		
1) Subgrade	ASTM D1556	2400 SY of Subgrade or Select Soil or
2) Trench under Paving	ASTM D2922	400 LF of Trench or at any transverse
CBR 1 per Class of Soil	ASTM D3017	crossing.
	ASTM D1883	

Notes. Standard Density as determined by the Standard Proctor test shall be the density to which the Field Density is referred for comparison or percentage for each type of soil used in the work. Optimum Moisture Content shall be the moisture content corresponding to the Maximum Density of the Standard Compaction curve. Field Density shall be the density of the compacted subgrade determined by the Field Density test. Moisture Content shall be the actual moisture content of the soil in the compacted embankment at the time of testing or at the time the grade is to be covered.



12.4 METHOD OF MEASUREMENT. The quantities of compaction for which payment will be made shall be in the quantities shown on the plans provided the project is constructed to the lines and grades shown on the plans. Any allowance for additional quantities shall first be approved by the Engineer.

12.5 BASIS OF PAYMENT. The amount of completed and accepted work shall be paid for at the contract unit prices bid per square yard.

SUBGRADE SY

Payment shall be full compensation for all materials, equipment, tools, labor and incidentals necessary to complete the work.

13.0 NATURAL SOIL BASE

13.1 DESCRIPTION. This section will cover approved soil material of the thickness shown on the plans constructed as the subgrade to provide a foundation for the pavement. It shall be constructed in accordance with these specifications to the lines and grades shown on the plans. Natural soil base will be used only for residential streets.

13.2 MATERIALS. The subgrade material to be used for this work shall have a Liquid Limit of 35 or less, a Plasticity Index less than 12 and 15% to 49% by weight passing the No. 200 sieve. These soils shall have a minimum California Bearing Rating (CBR) value of 15 at 0.1 inch penetration.

13.3 CONSTRUCTION METHODS. The subgrade shall be scarified or otherwise processed to permit uniform dispersion of moisture to the specified depth. Areas of the subgrade through rock cuts that cannot be scarified or otherwise processed shall be undercut not less than 6-inches and backfilled with specified soil or aggregate.

13.4 METHOD OF MEASUREMENT. Subgrade shall be plan quantity by the square yard in place as called for on the plans.

13.5 BASIS OF PAYMENT. This item measured as provided for above will be paid for at the contract unit price bid per square yard for natural soil base in place and accepted:

NATURAL SOIL BASE SY

Payment shall be full compensation for all materials, equipment, tools, labor and incidentals necessary to complete the work.

14.0 SUBGRADE STABILIZATION

14.1 DESCRIPTION. This work shall consist of furnishing, placing and compacting one or more courses of a mixture of soil, a stabilization additive and water in accordance with these Specifications and in reasonably close conformity with the lines, grades, thickness, and typical cross sections shown on the Plans or established by the Engineer for the purpose of increasing the shear strength of subgrade soil. Stabilization additives for the purposes of this specification will be defined as cementitious additive (Portland Cement, fly ash, cement kiln dust, or lime.

14.2 MATERIALS. Any cementitious additives shall be stored in a suitable, weather-tight building or compartment which will protect it from dampness and permit easy access for proper inspection and identification of each shipment. Do not mix cementitious additives from different

sources in storage. Cementitious additives shall not be used if for any reason it has become partially set or if it contains hard lumps or cakes. The lime shall be stored in a suitable, weather-tight building or compartment, which will protect it from dampness and permit access for inspection and identification of each shipment. Lime shall not be used if for any reason it has become partially set or if it contains hard lumps or cakes. Do not mix limes from different sources in storage, even though they have been tested. By-product lime from approved sources may be used in lieu of quick lime.

14.3 CONSTRUCTION METHODS. The primary requirement of these Specifications is to secure a completed course of stabilized material containing a uniform mixture of soil, stabilization additive, and water, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses.

14.3.1 It shall be the responsibility of the Contractor to regulate the sequence of this work, to use the prescribed amount of stabilization additive, to maintain the work, and to rework the courses as necessary to meet the above requirements.

- Weather. Stabilization additives shall not be applied unless the air temperature is at least 40/F (4/C) and rising. The air temperature shall be taken 4 feet above the ground in the shade and away from artificial heat. Stabilization additives shall not be applied when any portion of the ground is frozen. The Contractor shall be responsible for the protection and quality of the stabilization additive and stabilized subgrade under any weather conditions.
- Preparation of Existing Roadbed. Prior to beginning any subgrade stabilization, the roadbed shall be compacted and shaped to reasonably close conformity with the typical sections, lines, and grades as shown on the Plans or established by the Engineer. The subgrade shall be rolled in a manner approved by the Engineer, and any soft areas revealed by this rolling shall be corrected.
- Scarifying and Loosening. Scarifying and loosening may be required prior to the application of stabilization additive to achieve the desired results as determined by the Engineer. The Contractor shall take precautions to avoid forming furrows of loosened material below the depth specified for the bottom of the stabilized subgrade. Except by special permission from the Engineer, the length of roadway scarified and loosened at any time shall not exceed the length in which the mixing with stabilization additive can be completed in two calendar days. In subgrade extents designated on the Plans or by the Engineer as having excessive rock—the dimensions or quantities of which 25 percent or more are greater than 2 ½ inches (63 mm) in size, making compliance with these Specifications impractical—the Engineer may waive certain portions of the work as described below. The Engineer may require exploratory scarifying by the Contractor before designation of extents for which full compliance of these Specifications is waived.
- Application- General. The type and proportion of stabilization additive indicated on the plans is approximate. The type and the final rate of application of stabilization additive ultimately used shall be based on tests of the subgrade soil. The tests of the subgrade soils shall be performed by the Department. However, with the approval of the Engineer the Contractor has the option of having the tests performed by a laboratory approved by the Department in accordance with the Materials Division policy for soil stabilization at no additional cost to the Department. The stabilization additive shall be applied at the rate prescribed by the Engineer based on tests of the subgrade soil.

14.3.2 The Contractor shall provide equipment necessary for proper control of the application rate of stabilization additive. Where tests indicate a significant change in the subgrade soil, the Engineer will establish a new application rate as deemed necessary for the section of road affected prior to the Contractor placing and spreading the stabilization additive.

14.4 METHOD OF MEASUREMENT. Fly ash will be measured by the ton. Cement kiln dust will be measured by the ton. Portland Cement will be measured by the ton. Cementitious stabilized subgrade will be measured by the square yards of subgrade stabilization completed in place. Lime will be measured by the ton. Lime stabilized subgrade will be measured by the square yard of subgrade stabilization completed in place. Lime Pretreatment will be measured by the square yard of subgrade pretreatment completed in place. Water and rolling will not be measured for payment.

14.5 BASIS OF PAYMENT. Accepted quantities for stabilized subgrade, measured as provided above, will be paid for at the contract unit price as follows:

FLY ASH	TON
LIME	TON
CEMENT	KILN
DUST	TON
PORTLAND CEMENT	TON
CEMENTITIOUS STABILIZED SUBGRADE	SY
LIME STABILIZED SUBGRADE	SY
LIME PRETREATMENT	SY

Such payment shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

- Payment for quick lime shall be based upon a 90 percent available lime index by rapid sugar method, calculated as percent CaO by weight.
- Payment for hydrated lime shall be based upon a 90 percent available lime index by rapid sugar method, calculated as percent Ca(OH)<sub>2</sub> by weight.
- Payment for by-product lime shall be based on a substitution ratio calculated on a 90 percent available lime index by rapid sugar method. When the available lime index percentage falls below 90 percent, payment will be made at an adjusted price—which shall be reduced at the rate of one percent of the Contract unit bid price for lime for each percent, or fraction thereof, from 90.0 percent down to and including an available lime index of 80%. When the available lime index falls below 80% for the type of lime used, add a sufficient quantity of additional lime of the same type to bring the total amount to the required 90% of available lime index at no additional cost to the City.

## 15.0 AGGREGATE BASE

15.1 DESCRIPTION. This work shall consist of furnishing and placing one or more courses of aggregates and additives, if specified, on a prepared subgrade or subbase in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses and typical cross sections shown on the Plans or established by the Engineer. Aggregate base may be mixed off the roadbed and may be blended by plant mixing or other approved methods. Aggregate base may be mixed on the roadbed with approved methods that will produce a uniformly blended material. Aggregate base shall not be mixed on any completed base or surface course.

15.2 MATERIALS. Materials shall conform to the requirements specified in these specifications. The gradation may be either Type A or Type B unless otherwise specified on the Plans or in the Special Provisions. After work starts the same gradation type and source as specified or selected shall be used throughout the project unless otherwise permitted in writing by the Engineer, provided the gradation shall be type A in the top 3-inches on any base course except when the specified thickness is 6-inches or less where it shall be for the total thickness.

15.3 CONSTRUCTION METHODS. Prior to placing any new base material or subbase and base course material on the roadbed, the subgrade shall be completed according to the requirements of Subgrade of these Specifications or the method specified on the Plans or in the Special Provisions. If there is an existing aggregate course in place, it shall be prepared in accordance with the requirements of the method of Processing Existing Base and Surface, of these Specifications as indicated on the Plans and in the Special Provisions.

15.3.1 Mixing Aggregate Base. The Contractor may mix the aggregate base offsite or onsite in a manner acceptable to the Engineer.

15.3.2 Spreading. Aggregate base materials mixed at locations off the roadbed shall be transported to the roadbed by means of suitable vehicles and deposited by means of approved spreading equipment. The layers shall be placed so that when compacted they will be true to the grades or levels required with the least possible surface disturbance. The Contractor shall make such adjustments in placing procedures or equipment as may be required to obtain true grades, to minimize segregation and degradation, to reduce or accelerate loss or accretion of water, and to assure an acceptable base.

- The aggregate base material shall be spread and compacted to the required density in one or more layers, as specified below, and of such width and thickness that after compacting, the finished base will conform to the required grade and cross section. The aggregate base material for each separate course shall be spread for the full width of the roadbed before the placing of the succeeding courses.
- Longitudinal and transverse joints shall be staggered a minimum of 12-inches in each succeeding course.
- Aggregate base material shall be laid in courses of a minimum of 3 inches compacted thickness and shall not exceed a maximum of 6-inches compacted thickness, except when shoulders are shown on a typical section to be constructed as a separate operation, then they may be constructed in one course providing they do not exceed 8-inches in thickness, and in two approximately equal courses where they exceed 8-inches. In either case, the compacted shoulders shall meet specified density requirements.
- After the blended and flattened windrow of aggregate base material mixed on the roadbed has been tested and approved by the Engineer, it shall be spread uniformly as specified above over the full length and width of the section to be compacted. This spreading shall be done in such a manner as to prevent segregation of the mixture.

15.3.3 Shaping and Compaction. Compaction of each layer shall continue until a density of not less than 100 percent of modified proctor density, as determined by AASHTO T-180, method D, has been achieved; provided that aggregate base outside the pavement edge for new construction, or outside the old pavement edge for widening, shall have a minimum density of 95 percent of standard density, AASHTO T-180, method D. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and aggregates firmly keyed. Water shall be uniformly applied over the base materials during

compaction in the amount necessary for proper consolidation. Tolerances for surface, width and thickness shall be in conformity with Plans and Specifications.

15.4 METHOD OF MEASUREMENT. Aggregate base will be measured by the cubic yard, compacted in place to the specified density. Measurement will be based on the actual length multiplied by the theoretical cross section shown on the Plans. Rolling and water as required to obtain a specified density will not be a separate pay item, but the cost of same shall be included in the price of other bid items.

15.5 BASIS OF PAYMENT. Accepted aggregate base, measured as provided above, will be paid for at the contract unit price for:

AGGREGATE BASE            CY

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

#### 16.0 PROCESSING EXISTING BASE AND SURFACE

16.1 DESCRIPTION. This work shall consist of the removal, processing, reuse or disposal of existing aggregate surface course or base course and asphalt surface. This work shall be done in accordance with one of the following methods as specified herein and shown on the Plans or as indicated by a pay item on the Plans and in the Proposal.

#### 16.2 CONSTRUCTION METHODS.

16.2.1 General. The aggregate or other materials in place shall be loosened by scarifying or the use of other suitable methods to its full depth and width. All loosened aggregate or asphalt shall be processed and broken into pieces which will pass a 3-inch sieve. The materials shall be windrowed on the subgrade or shoulder as the case may require. Care shall be exercised in loosening, removing, processing and storage of aggregate to avoid the addition of excess amounts of soil or other foreign material which would render it unsuitable for the use hereafter specified. Damaged material resulting from improper workmanship of the Contractor will not be measured for payment.

16.2.2 Method A - For Salvage and Stockpiling. The processed materials shall not contain detrimental amounts of subgrade or soil or other foreign material. The processed material shall be loaded and hauled to storage locations indicated. All materials shall be stored in a neat and workmanlike manner. All grass, weeds and other rubbish shall be removed from the storage area prior to stockpiling material.

16.2.3 Method B - For Use in Subgrade. The processed materials shall be windrowed on the shoulders during the shaping and conditioning of the subgrade. The materials shall then be spread uniformly over the full width of the section and compacted and completed with the subgrade in accordance with the method specified.

16.2.4 Method C - For Use as Subbase. The processed materials shall be spread evenly on the previously completed and compacted subgrade and then compacted to the requirements specified for the method of subgrade preparation.

16.2.5 Method D - For Use in New Base Courses, Shoulders, or Ramps. The processed materials may be placed on the completed subgrade as a base course or blended uniformly with new material for any course. These materials shall be compacted to not less than 95% of standard density for shoulders, ramps and base courses.

16.3 METHOD OF MEASUREMENT. Processing existing base and surface will be measured by the station of 100 feet or fraction thereof measured along the center line of the roadbed.

16.4 BASIS OF PAYMENT. Accepted quantities for processing existing base and surface, measured as provided above, will be paid for at the contract unit price for:

PROCESSING EXISTING BASE AND SURFACE, METHOD A	STA
PROCESSING EXISTING BASE AND SURFACE, METHOD B	STA
PROCESSING EXISTING BASE AND SURFACE, METHOD C	STA
PROCESSING EXISTING BASE AND SURFACE, METHOD D	STA

which shall be full compensation for furnishing all equipment, tools, labor and incidentals necessary to complete the work as specified.

#### 17.0 TRENCHLESS CONSTRUCTION BY JACKING

17.1 DESCRIPTION. This section covers furnishing and installation of pipe by trenchless method of Jacking as shown on the plans and in conformity with these specifications. In general, a boring head begins the tunnel excavation from an access pit and is pushed along by a hydraulic pump unit that remains in the pit. The link to the boring head is maintained by adding jacking pipe between the pushing unit and the head. By this procedure, the pipe is laid as the tunnel is bored.

17.2 MATERIALS. Acceptable pipe materials and fittings shall meet the requirements of the appropriate sections listed below using steel pipe, reinforced concrete pipe, vitrified clay pipe, polyvinyl chloride pipe and reinforced fiberglass pipe.

17.3 SUBMITTALS. Submittals shall be provided in accordance with the requirements specified in these specifications.

17.4 CONSTRUCTION METHODS. The excavation and backfill for pits and installation of shoring shall be as outlined in these specifications.

17.4.1 Heavy-duty jacks suitable for forcing the pipe through the embankment or earth shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides properly braced together to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe.

17.4.2 Soil shall be excavated or augured just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks into the space thus provided. The excavation for the underside of the pipe for at least 1/3 of the circumference of the pipe shall conform to the contour and grade of the pipe. The excavation for the top half of the pipe shall conform closely to the outside diameter of the pipe, and a clearance greater than 2-inches will not be permitted. The pipe preferably shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of 1-inch in 10-inches, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans. Nothing contained herein shall be construed as relieving the Contractor from his responsibility for the safety of the work and for all damages to persons or property.

17.4.3 All sewer service connections shall be accomplished and paid for in accordance with the Sanitary Sewer specifications.

17.5 BASIS OF PAYMENT. "Jacking" shall be measured by the lineal foot of pipe completed. Payment for "Jacking" shall be made at the unit price bid per lineal foot for each size. The price established shall be full compensation for furnishing and placing all materials, including pipe, excavation and backfill, sheeting, shoring, bracing and drainage, disposal of all surplus materials, labor, tools, equipment, and incidentals necessary to complete this item of work.

17.6 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:

JACKING (PIPE SIZE)	LF
JACKING CASING (SIZE)	LF

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

## 18.0 BORING

18.1 DESCRIPTION. This section covers furnishing and installation of pipe by trenchless method of boring as shown on the plans or specified. Boring consists of the initial installation of a steel casing pipe, installed mechanically, and with a suitable assembly designed to produce a smooth, straight shaft at the established line and grade. The pipe is then installed inside the casing pipe pursuant to the Standard Detail for Boring.

18.2 MATERIALS. Acceptable pipe materials and fittings shall meet the requirements of the appropriate sections listed below: Steel casing of 3/8-inch thickness.

18.3 SUBMITTALS. The Contractor shall furnish for the Engineer's approval, a plan showing his proposed method of handling, including the design for the equipment, equipment support of backstop, arrangement and position of jacks, pipe guides, etc., complete in assembled position. The approval of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.

## 18.4 CONSTRUCTION METHODS.

18.4.1 General. Where pipe is required to be installed under railroad embankments or under highways, streets, or other facilities by trenchless methods, construction shall be made in such a manner that will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure.

18.4.2 During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Engineer, until such time as the backfill has been completed and then shall be removed from the site.

18.4.3 The Contractor shall take proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation shown on the plans. All damages caused by excavating or blasting, either to surface or subsurface structures, shall be repaired or replaced by the Contractor at his own expense. Suitable pit shafts, or trenches shall be excavated for the purpose of conducting the trenchless operations and for placing end joints of the pipe. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner satisfactory to the Engineer to prevent earth caving. The removal of any obstruction that may be found to conflict with the placing of the pipe shall not be

measured for payment nor paid for as a separate contract pay item. The removal of any such obstruction shall be included in the cost of other items.

18.4.4 Once the pipe installation has commenced it shall be continued uninterrupted around the clock until the pipe has been installed between the specified limits. Any pipe damaged during operations shall be removed and replaced by the contractor at his expense. The pits or trenches excavated to facilitate the operations shall be backfilled immediately after the pipe has been installed.

18.4.5 Boring Requirements. Work shall comply with the Standard Detail for Boring. The excavation and backfill for pits and installation of shoring shall be as approved by the Engineer.

- Boring without the concurrent installation of a casing pipe shall not be permitted, unless shown on plans or directed by the Engineer.
- All joints in casing pipe shall be welded. Casing pipe shall extend through the entire fill and be installed in a manner that shall not disrupt traffic nor damage roadway grade and surface.
- The introduction of water into the excavation or the use of water or other fluids in connection with the boring operation shall only be permitted when approved by the Engineer.
- The size of the bored hole shall not exceed the outside diameter of the pipe bell or casing pipe more than 1-inch.
- Nothing contained herein shall be construed as relieving the Contractor from his responsibility for the safety of the work and for all damage to persons and property.

18.4.6 Skid Supports and Casing Spacers. Wood skid supports, from bell to spigot, shall be used and fastened securely to pipe with steel strapping, cables or clamps. Use of petroleum products shall not be allowed as a lubricant to ease installation. When wood skids are used, they shall be pressure treated with creosote pentachlorophenol, or salt type preservative in accordance with APWA C-2. Cut surfaces shall be given 2 each heavy brush coats of the same preservative. Skid support spacing and position shall be in accordance with the Standard Detail for Boring. Casing spacers shall be PVC with stainless steel bands as manufactured by Advance Products & Systems, Inc. of Lafayette, Louisiana or approved equal. Use and positioning of spacers shall be in accordance with the manufacturer's recommendations.

18.4.7 Both ends of the casing pipe shall be plugged with a grout or concrete having a minimum compressive strength of 2,500 psi or grouted masonry and shall conform to the applicable requirements of these specifications. Each plug shall be a minimum length of 18 inches. The grouting pressure shall be in accordance with the pipe manufacturer's recommendations. The annular space between the waterline pipe and the steel casing pipe shall not be filled.

18.5 METHOD OF MEASUREMENT. "Boring" shall be measured by the lineal foot of pipe bored. Payment for "Boring" shall be made at the unit price bid per lineal foot for each size. The price established shall be full compensation for furnishing and placing all materials including steel casing pipe, carrier pipe, grout or concrete, excavation and backfill, sheeting, shoring, bracing and drainage, disposal of all surplus materials, labor, tools, equipment, and incidentals necessary to complete this item of work.

18.6 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:



## BORING (SIZE)

LF

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

### 19.0 TUNNELING

19.1 DESCRIPTION. This section covers furnishing and installation of pipe by trenchless method of tunneling using steel plate liners. Tunneling may be accomplished by open-face mining with or without shields. Compressed air may also be required to control the entry of water into the tunnel. In the instances that tunneling is contemplated, the City shall provide a special specification providing materials, submittals, pipe materials, tunnel liner steel plates and other features of the work.

19.2 CONSTRUCTION METHODS. All construction requirements specified in these specifications shall apply. The excavation and backfill for pits and installation of shoring shall be as outlined in other paragraphs of these specifications.

19.2.1 The tunnel shall be excavated in such a manner and to such dimensions that will permit placing of the proper supports necessary to protect the excavation. The Contractor shall take the proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation shown on the plans. All damages by excavation and blasting, either to surface or subsurface structures, shall be repaired or replaced by the Contractor at his own cost and expense.

19.2.2 Adequate provisions shall be provided for safety and health of the workmen. All equipment operated in the tunnel shall be powered by either air or electricity. No equipment shall be permitted in the tunnel that uses a petroleum product for fuel. Electric lights shall be used for illumination of the tunnel construction, for illumination of completed portions of the tunnel used for passage, and wherever lighting is needed for inspection of the work. Sufficient number of lamps shall be used to properly illuminate the work and all wiring for electric power and lights shall be installed and maintained in a safe and secure manner.

19.2.3 The Contractor shall maintain the tunnel air in a condition suitable for the health of the workmen and sufficiently clear for surveying operations. A sufficient supply of fresh air shall be provided and maintained at all times in all underground places and provisions shall be made for the quick and complete removal of gases and dust resulting from blasting or other tunnel operations. Except when unnecessary due to natural ventilation, artificial ventilation shall be maintained in the tunnel by ventilating plants of ample capacity operated when needed to meet the preceding requirements.

19.2.4 Suitable steel or timber sheeting, shoring, and bracing shall be used to support the sides and roof of the excavation. Supports may be left in place provided that they clear the minimum thickness of the concrete backfill around the pipe. No separate payment will be made for supports left in place. The space between the liner plate and the limits of excavation shall be pressure grouted or mud jacked. Tolerance in line and grade shall be as specified in "Jacking".

19.2.5 Nothing contained herein shall be construed as relieving the Contractor from his full responsibility for the safety of the work and for all damages to persons and property.

19.3 METHOD OF MEASUREMENT. "Tunneling" shall be measured by the linear foot of pipe tunneled. Payment for "Tunneling" shall be made at the unit price bid per linear foot for each size. The price established shall be full compensation for furnishing and placing all materials, including

steel liner plate, waterline pipe, grout or cement, backfill, sheeting, shoring, bracing and drainage, disposal of all surplus materials, labor, tools, equipment, and incidentals necessary to complete this item of work.

19.4 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:

TUNNELING (SIZE) LF

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

## 20.0 MICRO AND SMALL DIAMETER TUNNELING

20.1 DESCRIPTION. This section covers furnishing and installation of pipe by trenchless method of micro and small diameter tunneling. Micro and small diameter tunneling is the installation of pipe by Jacking the pipe behind a remotely controlled steerable, laser guided, articulated tunnel shield. The size range of microtunneling shall be as follows:

- Microtunneling. Tunneling in diameters that are too small for man entry, i.e., 36-inches or smaller in internal diameter.
- Small Diameter Tunneling. Tunnels with an internal diameter greater than 36-inches but less than 12 feet in internal diameter.

22.1 PIPE MATERIALS. To be called for in the special specifications or shown on the Plans.

22.2 EQUIPMENT. The Microtunnel boring machine shall be operated remotely. The Small Diameter tunnel-boring machine shall be given to a system capable of being remotely operated from outside the tunnel unless otherwise specified or approved by the Engineer.

22.2.1 The Tunnel Shield shall have a full face with an enclosed plenum chamber containing slurry under pressure. The shield must be equipped with a valve system that enables the plenum chamber to be isolated from the tunnel. The machine may, if required, be capable of conversion to mechanical earth pressure balanced, screw auger shield type. The Tunnel Shield shall be capable of fully supporting the face both during excavation and during shutdown, and shall have the capability of presetting a calculated earth balancing pressure and positively measuring the earth pressure at the face. In soil conditions of very low strength and high water table, the tunnel shield may, if required by the Engineer, be equipped with a sliding cutter head. The pressure exerted by the cutter head over the excavated face shall remain constant, regardless of variations in the excavation rate. The rate of excavation must be able to be varied independent of the jacking speed and be set to zero, if necessary.

22.2.2 The system shall be laser-guided and monitored continuously with a closed circuit television or other approved control system. All functions of the system shall be monitored and transmitted to the operation console. The microtunneling system shall be capable of being remotely controlled from the surface. The minimum information to be available to the operator on the control console includes rate of advance, length of conduit installed, thrust force, deviation from line and grade, role, inclination, and valve positions. The soil transportation method shall be capable of handling and removing material of high water content from the face. The system shall be capable of any adjustment required to balance the ground water pressure to a level of plus 3 feet and an accuracy of plus or minus 1 foot. The jacking system, including any intermediate jacks used, shall be capable of continuously monitoring the jacking pressure, the rate of advancement, and the distance jacked.

22.2.3 When soil conditions dictate, the tunnel shield must be capable of crushing cobbles and boulders. The excavation system shall be fully capable of excavating all materials that it will encounter. The tunnel shield must be articulated and maneuvered by trunion mounted steering jacks or other approved method to enable accurate control of line and level. The jacking system shall develop a uniform distribution of jacking forces on the end of the pipe. Intermediate jacking stations shall be provided when the calculation of the total jacking pressure, needed to complete the installation, exceeds the maximum designed working compressive loads allowed for the pipe provided by the Contractor and approved by the Engineer.

22.2.4 A lubrication system shall be provided that injects an approved lubricant at the rear of the tunneling shield (if necessary, through the pipe wall in man entry sized tunnels) to lower the friction developed on the sides of the pipe during jacking. A separation plant shall be provided when using the slurry balance system. The plant shall clean the excavated soil from the water for disposal and return the water back to the cutting face for reuse. The over cut on the tunneling shield shall not exceed 1-inch without the approval of the Engineer. The annular space created by the over cut must be filled with bentonite or approved lubricant suitable for the particular soil condition to be tunneled.

22.2.5 The tunneling system shall be capable of maintaining grade to within plus or minus 1-1/2-inches over the total distance between the jacking and reception shaft. All groundwater encountered during the excavation of the tunnel shall be balanced by the tunneling machine. No loss of ground water shall be permitted. Slurry tunneling systems shall use a minimum volume of water in the slurry system. The tunneling shield must be capable of bi-directional drive on the cutter head wheel to minimize drift and rotation or roll of the conduit during installation.

22.3 CONSTRUCTION METHODS. The Contractor shall have discretion to select the method of microtunneled pipe installation, subject to approval by the Engineer. All other procedures and modes of construction shall be in accordance with published construction specifications pertaining to micro-tunneling or small diameter tunneling of the City of Oklahoma City, incorporated herein by reference.

22.4 METHOD OF MEASUREMENT. "Microtunneling" or "Small-Diameter Tunneling" shall be measured by the lineal foot of pipe completed. Payment for "Microtunneling" or "Small-Diameter Tunneling" shall be made at the unit price bid per lineal foot for each size, complete in place, as provided in the Proposals. The price established shall be full compensation for dewatering shafts, sheeting shoring and bracing, drainage, providing access shafts or portals, disposal of surplus excavated materials, including excavation and backfill and replacement of surface, or other improvements, furnishing all labor, tools, equipment, and incidentals, furnishing and installing the waterline pipe, steel casing pipe and performing all that is required to construct the tunnel as shown on the plans and called for in these specifications.

22.9.3 BASIS OF PAYMENT. The items measured as provided above will be paid for at the contract unit price bid:

MICRO-TUNNELING (SIZE)	LF
SMALL DIAMETER TUNNELING (SIZE)	LF

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

23.0 – EARTHWORK CONSTRUCTION STANDARD BID ITEMS. This section covers Standard Bid Items used in the contract documents for the construction of earthwork. Additional bid items may be called out in the Special Provisions, other sections of the Standard Specifications, or as directed by the Engineer for additional work covered and change orders.

SECTION	DESCRIPTION	UNIT
	UNCLASSIFIED EXCAVATION	C.Y.
	UNSUITABLE MATERIAL EXCAVATION	C.Y.
	EXCESS EXCAVATION	C.Y.
	EMBANKMENT	C.Y.
	BORROW	C.Y.
	DEWATERING	L.F.
	TRENCH EXCAVATION AND BACKFILL - ZERO (0') FT TO TEN (10') FT	L.F.
	TRENCH EXCAVATION AND BACKFILL - ZERO (0') FT TO FIFTEEN (15') FT	L.F.
	TRENCH EXCAVATION AND BACKFILL - ZERO (0') FT TO TWENTY (20') FT	L.F.
	TRENCH EXCAVATION AND BACKFILL - ZERO (0') FT TO TWENTY-FIVE (25') FT	L.F.
	TRENCH EXCAVATION AND BACKFILL - ZERO (0') FT TO THIRTY (30') FT	L.F.
	TRENCH LINEAL MEASUREMENT	L.F.
	STRUCTURAL EXCAVATION	C.Y.
	CRUSHED ROCK FOUNDATION	C.Y.
	CRUSHED ROCK FOUNDATION	TON
	LEAN MIX CONCRETE FOUNDATION	C.Y.
	EMBEDMENT MATERIAL	C.Y.
	EMBEDMENT MATERIAL	TON
	CONCRETE CRADLE PLAIN	C.Y.
	CONCRETE CRADLE TYPE I REINFORCEMENT	C.Y.
	CONCRETE CRADLE TYPE II REINFORCEMENT	C.Y.
	CONCRETE ARCHES PLAIN,	C.Y.
	CONCRETE ARCHES TYPE I REINFORCEMENT	C.Y.
	CONCRETE ARCHES TYPE II REINFORCEMENT	C.Y.
	EMBEDMENT PLUGS (TYPE)	EA.
	SUBGRADE	S.Y.
	NATURAL SOIL BASE	S.Y.
	FLY ASH	TON
	LIME	TON
	CEMENT KILN DUST	TON
	PORTLAND CEMENT	TON
	CEMENTITIOUS STABILIZED SUBGRADE	S.Y.
	LIME STABILIZED SUBGRADE	S.Y.
	LIME PRETREATMENT	S.Y.
	AGGREGATE BASE	C.Y.
	PROCESSING EXISTING BASE AND SURFACE, METHOD A	STA.
	PROCESSING EXISTING BASE AND SURFACE, METHOD B	STA.
	PROCESSING EXISTING BASE AND SURFACE, METHOD C	STA.
	PROCESSING EXISTING BASE AND SURFACE, METHOD D	STA.
	JACKING (SIZE)	L.F.

	JACKING - (PIPE SIZE)	L.F.
	JACKING - CASING (SIZE)	L.F.
	BORING (SIZE)	L.F.
	BORING (PIPE SIZE)	L.F.
	BORING - CASING (SIZE)	L.F.
	TUNNELING (SIZE)	L.F.
	MICRO-TUNNELING (SIZE)	L.F.
	SMALL DIAMETER TUNNELING (SIZE)	L.F.

**SECTION 2 EARTHWORK AND PAVEMENTS**  
**SUBSECTION 2 PAVEMENT AND SURFACE COURSES**

This Subsection covers the details of pavement and surface courses for new construction, heavy maintenance and repair of City streets and roads. It is the intent of these specifications to incorporate or expand upon the applicable content of the Oklahoma Department of Transportation Standard Specifications; and where there arises conflicts between the two specifications, the ODOT specifications shall apply with respect to materials.

**24.0 PLANT-MIX ASPHALTIC CONCRETE**

**24.1 DESCRIPTION.** This section covers base course, level course, surface course or any combination of these courses as shown on the plans. The mixture shall be composed of a mineral aggregate uniformly coated with an approved asphaltic cement and shall be laid upon an approved base course or old pavement in accordance with these specifications and in conformity with the line, grade and typical cross sections shown on the plans.

**24.2 MATERIALS.** Materials shall meet the requirements of the Materials Section. The Contractor shall have ample material in the stockpiles at the plant site at the beginning of each day's operation to supply and be used for that day's operation.

**24.3 WEATHER AND TEMPERATURE LIMITATIONS.** No asphaltic concrete shall be laid when there is frost in the course on which it is being laid. Unless specified otherwise by the Engineer, asphaltic concrete surface courses shall be laid only when one of the following conditions of temperature and wind velocity prevail:

Weather and Temperature Limitations	
Temperature (°F)	Wind Velocity MPH Maximum
60 or Above	40
50-60	15
45-50	5

Asphaltic concrete surface course shall not be laid when temperature is less than 45°F, except in unusual circumstances when the wind is virtually still and the surface on which the course is being laid is warmer than 45°F. In no case shall surface course be laid when the temperature is less than 40°F.

**24.4 EQUIPMENT.** All plants used by the Contractor for the preparation of asphaltic concrete mixture shall have both capacity and controls sufficient to produce the asphalt mixture at the rate required for the satisfactory prosecution of the job within the specified time, and to produce asphalt mixture meeting the requirements of the Materials Section.

**24.4.1 Requirements for all Plants.** Mixing plants shall be of sufficient capacity and coordinated to adequately handle the proposed bituminous construction.

**24.4.2 Equipment for Preparation of Bituminous Material.** Tanks for storage of the bituminous material shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall come in contact with the tank. The circulating system for the bituminous material shall be designed to assure proper and continuous circulation during the operating period.

Provision shall be made for measuring and sampling materials in storage tanks.

24.4.3 Cold Aggregate Feed. The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the dryer so that uniform production and temperature will be obtained. A dryer for drying and heating the mineral aggregate shall be provided. The dryer shall be capable of drying and uniformly heating the mineral aggregate to the temperature requirements set forth in these specifications without burning or overheating any portion.

24.4.4 Bituminous Control Unit. Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material in the mix within the tolerance specified. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer. Suitable means shall be provided, either by steam jacketing or other insulating for maintaining the specified temperature of the bituminous material in the pipe lines, meters, weight buckets, spray bars, and other containers or flow lines. The plant shall also be equipped with either an approved dial scale mercury actuated thermometer, and electric pyrometer, or other approved thermometric instruments so placed at the discharge chute of the dryer as to register automatically or indicate the temperature of the heated aggregates or mixture.

24.4.5 Dust Collector. The plant shall be equipped with a dust collector constructed to waste or return uniformly all or any part of the material collected as directed.

24.4.6 Truck Scales. The bituminous mixture shall be weighed on approved scales furnished by the Contractor or on public scales at the Contractor's expense. Such scales shall be inspected and sealed as often as the Engineer deems necessary to assure their accuracy, but not less than once every 6 months.

24.4.7 Asphalt Quality. The asphalt manufacturer is responsible for the quality of the produced asphalt. From time to time, the Engineer may require the QC test result on the asphalt. It shall be the responsibility of the Contractor to provide the information. The Contractor shall not change the asphalt source without written approval from the Engineer.

24.4.8 Bituminous Pavers. Bituminous pavers shall be self-contained, power propelled machines, provided with an activated, heated screed, with an approved automatic control device for laying the mix to the specified slope, grade, and crown. The screed shall effectively produce a finished surface of the required evenness and uniform texture without tearing, shoving, or gouging the mixture uniformly in front of the screed. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of asphalt mixture in widths shown on the plans. Motor graders equipped with a blade of not less than 12 feet, and a wheelbase of not less than 16 feet, tight and in good operating condition may be used for spreading leveling courses.

24.4.9 Compacting Equipment. Compacting equipment shall be designed to produce the pavement density and surface smoothness herein specified, and shall be maintained in first-class operating condition.

## 24.5 CONSTRUCTION METHODS.

24.5.1 Preparation of Asphaltic Cement and Mineral Aggregates. The asphaltic cement shall be heated at the paving plant to a temperature of between 300°F and 350°F. The mineral aggregates shall be dried and heated at the paving plant so that when delivered to the mixer they shall be at as low a temperature as is consistent with proper mixing and laying, and in no case to exceed 325°F. Aggregates may be fed simultaneously into the same drier but in such case, immediately after heating, they shall be screened into the bin sizes specified. Oversize material, crushed after passing through the drier shall not be incorporated into the mixer without

again being heated and dried. The hot aggregate prepared as prescribed above shall be accurately measured and conveyed into a mixer in the proportionate amounts of each aggregate required to meet the specified grading. The mixture shall be made by first charging the mixer with the mineral aggregate and filler and mixing these dry for a period of from 5 to 20 seconds after which the asphaltic cement shall be added and the mixing continued for a period of not less than 30 seconds, or longer, if necessary to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated.

24.5.2 Loading and Transportation of Mixture. The mixture shall be transported from the mixing plant to the work in tight vehicles with metal bottom previously cleaned of all foreign materials. When directed by the Engineer the vehicles shall be suitably insulated and each load shall be covered with canvas or other suitable material of sufficient size to protect it from weather conditions.

24.5.3 Tack Coat. Before the asphaltic mixture is laid, the surface upon which it is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer, and if indicated on the plans, shall be given a uniform tack coat application with asphalt of the type shown herein. This tack coat shall be applied, as directed by the Engineer, with an approved sprayer at the rate of not to exceed 0.10 gallon per square yard of surface. All contact surfaces of curbs and gutters, manholes and other structures shall be painted with a thin uniform coat of asphaltic material used for the tack coat or in case no tack coat is shown on the plans, curbs and other structures shall be painted with a thin uniform coating of emulsified asphalt.

24.5.4 Placing Asphaltic Mixture.

- The asphaltic mixture shall be laid at a temperature from 260°F to 300°F and only upon an approved base which is dry. The mixture shall be delivered on the job at a minimum workable temperature which will produce the density herein specified after final compaction.
- When existing paving is to be resurfaced to a crown section not conforming to that of the original paving, the asphaltic concrete leveling course shall be placed in lifts beginning at the point on the existing slab requiring the greatest addition of material and by the addition of successive lifts of material, gradually shaping the crown to conform to that required in the finished slab. The last increment of material shall consist of a uniform thickness of an asphaltic concrete wearing surface.
- When the asphaltic mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement, or placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated, when authorized by the Engineer, provided a satisfactory surface can be obtained by other approved methods.
- Immediately after any course is screeded, and before compaction is started, the surface shall be checked, and any inequalities adjusted, all fat sandy accumulation from the screen removed by a lute, and all fat spots in any course removed and replaced with satisfactory material. Irregularities in alignment and grade along the outside edge shall also be corrected by the addition or removal of mixture before the edge is compacted. The mixture shall be distributed into place by means of shovel and lute in a loose layer of uniform density and correct depth. Shovelers and rakers shall work skillfully together so that the finished product will require a minimum amount of rework after the first compactive effort.



- Placing of mixture shall be as continuous as possible and the roller shall pass over the unprotected edge of the fresh laid mixture only when the laying of this course is to be discontinued for such length of time as to permit the mixture to cool. Thickness of compacted course shall be as specified in the plans, not greater than 6-inches in depth. Thickness will be reduced by the Engineer, if the required densities cannot be obtained.
- Forms will not be required when the finishing machine is of such type as not to require forms for grade control. When forms are required they shall have a thickness equal to the compacted surface course and shall remain in place until final surface finishing, other than rolling, has been completed. In placing a level-up course with the spreading and finishing machine, the forms, binder twine or cord, shall be set to line and grade established by the Engineer. When directed by the Engineer, level-up shall be spread with an approved motor patrol grader.
- Fillets, spandrels and other large areas which cannot be laid with a machine shall be placed in accordance with Section W-IV, "Fillets, Spandrels and other Large Hand Worked Areas", in the Asphaltic Concrete Paving Manual.

24.5.5 Joints. Longitudinal and transverse joints shall be made in such a manner that a smooth, strong, neat union is obtained, between the respective lanes or lane ends. They shall be made by the methods and procedures outlined in Section W-III, "Joints" of the Asphalt Paving Manual or some other method acceptable to the Engineer. Longitudinal joints shall conform to the tolerances defined in Section W-III 1-a (3) or Section W-III b (3) "Alignment", of the manual. Transverse or longitudinal joints accumulating mud, dust, or foreign matter shall be trimmed back to the satisfaction of the Engineer so that a proper bond of asphaltic concrete will be obtained. Longitudinal joints with an undue dust film shall be tacked with an approved tack coat before the adjoining lane is placed. Joints with PC Concrete such as curbs, gutters, and pavements shall be made to conform to Section W-III, "Asphaltic Concrete to Portland Cement Joints" in the Asphaltic Concrete Paving Manual. Joints with manholes, valve boxes and inlet grates shall be made to conform to sections as shown on the sheet of details.

24.5.6 Compaction. Rolling shall be done in such a manner that a surface will be obtained meeting the tolerance for smoothness and density requirements specified and all roller marks shall be eliminated.

- The target density for compaction shall be 94 percent of the maximum theoretical density shown on the latest laboratory mix design report for the percent asphalt content recommended except in situations as described below. Tests to establish the maximum theoretical density of the plant mixture shall be performed as often as necessary to ensure an accurate value is used in the calculation of roadway density.
- The average roadway density shall be not less than the target density. Individual roadway densities more than 2% below the target densities will not be accepted. It is the intent that the contractor achieve uniform compaction at or above the target density. The difference from the high to low percent density tested shall not exceed 4%. When Type B, M or D asphalt concrete is placed on an existing surface that has not received full-width milling, in a plan thickness of 2" or less, the average target density shall be 93% of maximum theoretical density. When the existing surface has been milled full-width, or if a leveling course has been placed prior to the overlay, the average target density shall be 94% of maximum theoretical density, (Type B, M or D).
- In the interest of appearance and practicality, non-destructive tests on the pavement may

be required by the Engineer for resurface courses. See the "Asphaltic Concrete Paving Manual" for guidance. A self-propelled pneumatic roller may be required by the Engineer to obtain the specified density and surface texture.

24.5.7 Testing and Correcting Surface. The riding qualities of the finished surface shall be satisfactory to the Engineer. For the purpose of testing the finished surface, a 10 foot straightedge shall be available on the work. Depressions which may develop after the first rolling shall be remedied by loosening the surface depressions; if necessary, the surface course shall be removed and sufficient new material laid to form a true even surface.

- Prior to the acceptance of the pavement, the pavement shall be flooded with a sufficient quantity of water to show if areas of ponding exist. All areas of ponding in excess of 1/4"-inch in depth and any length of curb and gutter that ponds in excess of 1/4-inch in depth, shall be removed and replaced by the Contractor and at the Contractor's expense.
- When it is necessary to remove and replace a section of curb and gutter any remaining portion of the curb and gutter adjacent to joints that is less than ten (10) feet in length shall also be removed and replaced by the Contractor and at the Contractor's expense.
- No traffic shall be permitted on the asphaltic concrete pavement until it has received its final rolling and cooled to a temperature of less than 150°F.

24.5.8 Testing. It is the intent of these specifications that the pavement shall be constructed strictly in accordance with the thickness shown on the plans. Where any pavement is found not so constructed, the City may, at its option, core drill the pavement and measure same for thickness before being accepted by the City as hereinafter provided.

- The testing will be performed by a qualified testing laboratory. In the event that the tests show that the asphalt or thickness do not meet specifications, the Contractor shall replace the defective pavement and pay for all testing costs.
- The contractor shall retain the services of an approved testing laboratory and will compensate the testing laboratory directly for its services for projects that are not contracted and paid for by the City. Compensation for the services rendered will be based on the agreement between the contractor and the testing laboratory. However, the testing services rendered should meet the specifications and provisions of the City.

24.6 METHOD OF MEASUREMENT. Asphaltic concrete may be measured by the square yard of surface area of specified thickness or by the ton (2000 lbs.) of mixture accepted in place. Asphaltic concrete leveling course shall be measured by the ton (2000 lbs.) of material accepted in place. Tack coat will be measured by the gallon at the temperature applied.

24.7 BASIS OF PAYMENT. The various items measured as provided above will be paid for at the contract unit price bid:

ASPHALTIC CONCRETE TYPE (A – E) (X INCHES)	SY
ASPHALTIC CONCRETE TYPE (A – E)	TON
ASPHALT CONCRETE, TYPE (A – E) (POL. MOD.)	TON
ASPHALTIC CONCRETE LEVELING COURSE	TON

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

25.0 RECYCLED HOT-MIX ASPHALT CONCRETE (RHM – ASPHALT CONCRETE)

25.1 DESCRIPTION. This section covers the construction of asphaltic concrete using a combination of salvaged bituminous material and virgin material.

25.2 MATERIALS. The bituminous mixture shall comply with the requirements of the Materials Section. Salvaged materials shall be sized to pass a 2" sieve. Liquid asphalt will meet the requirements with a Viscosity Grade to be established by the mix design. Commercial softening agents must be approved by the Engineer and only after they have been tested for premature hardening with the salvaged and virgin materials to be used on this project. All virgin aggregates shall meet the requirements of the Materials Section. A maximum of 25 percent salvaged bituminous material by weight may be used in all bituminous mixtures. All salvaged bituminous material shall be assumed to contain 30 percent natural sand for mix design purposes.

25.3 EQUIPMENT. Mixing shall be performed in either a batch plant or a dryer drum plant, modified as required to facilitate recycling operations in conformance with current air pollution standards. Mixing shall continue until homogeneity and a uniform coating can be achieved.

#### 25.4 CONSTRUCTION METHODS.

25.4.1 Preparation of Asphaltic Cement. The asphaltic cement shall be heated at the paving plant to a temperature of 275°F to 325°F.

25.4.2 Preparation of Mineral Aggregates. The mineral aggregates shall be dried and heated at the paving plant so that when delivered to the mixer they shall be at as low a temperature as is consistent with proper mixing and laying, and in no case to exceed 325°F. Aggregates may be fed simultaneously into the same drier but in such case, immediately after heating, they shall be screened into the bin sizes specified. Oversize material, crushed after passing through the drier shall not be incorporated into the mixer without again being heated and dried.

25.4.3 Preparation of Bituminous Mixture. The hot aggregate prepared as prescribed above shall be accurately measured and conveyed into a mixer in the proportionate amounts of each aggregate required to meet the specified grading. The mixture shall be made by first charging the mixer with the mineral aggregate and filler and mixing these dry for a period of from 5 to 20 seconds after which the asphaltic cement shall be added and the mixing continued for a period of not less than 30 seconds, or longer, if necessary to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated.

25.4.4 Loading and Transportation of Mixture. The mixture shall be transported from the paving plant to the work in tight vehicles with metal bottom previously cleaned of all foreign materials. When directed by the Engineer the vehicles shall be suitably insulated and each load shall be covered with canvas or other suitable material of sufficient size to protect it from weather conditions. The inside surface of all vehicles used for hauling mixtures may be lightly lubricated with a thin oil or soap solution just before loading, but excess of lubricant will not be permitted. No loads shall be sent out so late in the day as to interfere with spreading and compacting the mixture during daylight unless artificial light satisfactory to the Engineer is provided.

25.4.5 Tack Coat. Before the asphaltic mixture is laid, the surface upon which it is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer, and if indicated on the plans, shall be given a uniform tack coat application with asphalt of the type shown herein. This tack coat shall be applied, as directed by the Engineer, with an approved sprayer at the rate of not to exceed 0.10 gallon per square yard of surface. All contact surfaces of curbs and gutters, manholes and other structures shall be painted with a thin uniform coat of asphaltic material used for the tack coat or in case no tack coat is shown on the plans, curbs and other structures shall be painted with a thin uniform coating of emulsified asphalt.

25.4.6 Placing Asphaltic Mixture. The asphaltic mixture shall be laid at a temperature from 225°F to 300°F and only upon an approved base which is dry. The mixture shall be delivered on the job at a minimum workable temperature that will produce the density herein specified after final compaction.

- When existing paving is to be resurfaced to a crown section not conforming to that of the original paving, the asphaltic concrete leveling course shall be placed in lifts beginning at the point on the existing slab requiring the greatest addition of material and by the addition of successive lifts of material, gradually shaping the crown to conform to that required in the finished slab. The last increment of material shall consist of a uniform thickness of an asphaltic concrete wearing surface.
- When the asphaltic mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement, or placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated, when authorized by the Engineer, provided a satisfactory surface can be obtained by other approved methods.
- Immediately after any course is screeded, and before compaction is started, the surface shall be checked, and any inequalities adjusted, all fat sandy accumulation from the screen removed by a lute, and all fat spots in any course removed and replaced with satisfactory material. Irregularities in alignment and grade along the outside edge shall also be corrected by the addition or removal of mixture before the edge is compacted.
- The mixture shall be distributed into place by means of shovel and lute in a loose layer of uniform density and correct depth. Shovelers and rakers shall work skillfully together so that the finished product will require a minimum amount of rework after the first compactive effort.
- Placing of mixture shall be as continuous as possible and the roller shall pass over the unprotected edge of the fresh laid mixture only when the laying of this course is to be discontinued for such length of time as to permit the mixture to become chilled.
- Thickness of compacted course shall be not more than 8-inches in depth. Thickness will be reduced by the Engineer, if the required densities cannot be obtained.
- Fillets, spandrels and other large areas which cannot be laid with a machine shall be placed in accordance with Section W-IV, "Fillets, Spandrels and other Large Handworked Areas", in the Asphaltic Concrete Paving Manual.

25.4.7 Joints. Longitudinal and transverse joints shall be made in such a manner that a smooth, strong, neat union is obtained, between the respective lanes or lane ends. They shall be made by the methods and procedures outlined in the Asphalt Paving Manual or some other method acceptable to the Engineer. Transverse or longitudinal joints accumulating mud, dust, or foreign matter shall be trimmed back to the satisfaction of the Engineer so that a proper bond of asphaltic concrete will be obtained. Longitudinal joints with an undue dust film shall be tacked with an approved tack coat before the adjoining lane is placed. Joints with PC Concrete such as curbs, gutters, and pavements shall be made to conform to the Asphaltic Concrete Paving Manual. Joints with manholes, valve boxes and inlet grates shall be made to conform to sections as shown on the sheet of details.

25.4.8 Compaction. Rolling shall be done in such a manner that a surface will be obtained

meeting the tolerance for smoothness and density requirements specified and all roller marks shall be eliminated.

- The target density for compaction shall be 94 percent of the maximum theoretical density shown on the latest laboratory mix design report for the percent asphalt content recommended except in situations as described below. Tests to establish the maximum theoretical density of the plant mixture shall be performed as often as necessary to ensure an accurate value is used in the calculation of roadway density. The average roadway density shall be not less than the target density. Individual roadway densities more than 2% below the target densities will not be accepted.
- It is the intent that the contractor achieve uniform compaction at or above the target density. The difference from the high to low percent density tested shall not exceed 4%. When Type B, M or D asphalt concrete is placed on an existing surface that has not received full-width milling, in a plan thickness of 2" or less, the average target density shall be 93% of maximum theoretical density. When the existing surface has been milled full-width, or if a leveling course has been placed prior to the overlay, the average target density shall be 94% of maximum theoretical density, (Type B, M or D).
- In the interest of appearance and practicality, non-destructive tests on the pavement may be required by the Engineer for resurface courses. See the "Asphaltic Concrete Paving Manual" for guidance. A self-propelled pneumatic roller may be required by the Engineer to obtain the specified density and surface texture.

25.4.9 Testing and Correcting Surface. The riding qualities of the finished surface shall be satisfactory to the Engineer. In case of dispute, the remaining provisions of the standard specifications shall apply.

- For the purpose of testing the finished surface, a 10-foot straightedge shall be available on the work. Depressions which may develop after the first rolling shall be remedied by loosening the surface depressions not being noticeable until the final compaction has been made, the surface course shall be removed and sufficient new material laid to form a true even surface. The finished pavement surface shall show no deviation from the general surface in excess of 1/16-inch per foot as measured in the following manner:
- Such portions of the completed pavement as are defective in finish, density, or composition, or that do not comply in all respects with the requirements of these specifications shall be taken up, removed and replaced with suitable material properly laid in accordance with these specifications.
- Prior to the acceptance of the pavement, the pavement shall be flooded with a sufficient quantity of water to show if areas of ponding exist. All areas of ponding in excess of 1/4-inch in depth and any length of curb and gutter that ponds in excess of 1/4-inch in depth shall be removed and replaced by the Contractor and at the Contractor's expense. The water may be applied by tank truck or with fire hose if a fire hydrant is available. The water shall be applied as directed and all expenses borne by the Contractor.
- When it is necessary to remove and replace a section of curb and gutter any remaining portion of the curb and gutter adjacent to joints that is less than ten (10) feet in length shall also be removed and replaced by the Contractor and at the Contractor's expense.
- Opening to Traffic. No traffic shall be permitted on the asphaltic concrete pavement until it has received its final rolling.

25.4.10 Testing. It is the intent of these specifications that the pavement shall be constructed

strictly in accordance with the thickness shown on the plans. Where any pavement is found not so constructed, the City may, at its option, core drill the pavement and measure same for thickness before being accepted by the City as hereinafter provided.

- The testing will be performed by a qualified testing laboratory. In the event that the tests show that the asphalt or thickness do not meet specifications, the Contractor shall replace the defective pavement and pay for all testing costs. The acceptance criteria based on post-application testing, and the penalties for misapplication, shall be in accordance with the project special specifications.
- The contractor shall retain the services of an approved testing laboratory and will compensate the testing laboratory directly for its services for projects that are not contracted and paid for by the City. Compensation for the services rendered will be based on the agreement between the contractor and the testing laboratory. However, the testing services rendered should meet the specifications and provisions of the City.

25.5 METHOD OF MEASUREMENT. Asphaltic concrete may be measured by the square yard of surface area of specified thickness or by the ton (2000 lbs.) of mixture accepted in place. Asphaltic concrete leveling course shall be measured by the ton of material accepted in place. Tack coat will be measured by the gallon at the temperature applied.

25.6 BASIS OF PAYMENT. The various items measured as provided above will be paid for at the contract unit price bid

RHM - ASPHALTIC CONCRETE TYPE (A – E) (X INCHES)	SY	
RHM - ASPHALTIC CONCRETE TYPE (A – E)	TON	
RHM - ASPHALT CONCRETE, TYPE (A – E) (POL. MOD.)		TON
RHM - ASPHALTIC CONCRETE LEVELING COURSE	TON	

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

26.0 MICRO-SURFACING. If and when required, Micro-Surfacing shall be specified in the special specifications for the particular project at hand or as otherwise provided in the ODOT Standard Specifications.

## 27.0 PORTLAND CEMENT CONCRETE PAVEMENT

27.1 DESCRIPTION. This section covers the wearing course of Portland Cement Concrete constructed in 1 course on the prepared subgrade in accordance with these specifications and in conformity with the lines, grades, thickness and typical cross section shown on the plans.

27.2 MATERIALS. All materials, including fly ash, portland cement concrete, sealing fillers, and reinforcing steel shall conform to the requirements specified in the special references and the Materials Section.

27.3 EQUIPMENT. The City Engineer shall approve design, capacity, and mechanical condition of equipment and tools necessary for handling materials and performing all parts of the work. The equipment shall be at the job site sufficiently ahead of the start of construction operations to be examined thoroughly and approved.

27.3.1 Batching Plant and Equipment. The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in

bulk, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation.

- Bins and Hoppers. Bins with adequate separate compartments for fine aggregate and for each size of coarse aggregate shall be provided in the batching plant.
- Scales. The scales for weighing aggregates and cement shall be of either the beam type or the springless dial type. They shall be accurate within 0.5% throughout the range of use. When beam-type scales are used, provision, such as a "tell-tale" dial, shall be made for indicating to the operator that the required load in the weighing hopper is being approached. A device on weighing beams shall indicate critical position clearly. Poises shall be designed to be locked in any position and to prevent unauthorized change. The weigh beam and "tell-tale" device shall be in full view of the operator while charging the hopper, and he shall have convenient access to all controls. Scales shall be inspected and sealed as often as the Engineer may deem necessary to assure their accuracy but not less than every six (6) months.
- Automatic Batching Equipment. Automatic batching of aggregates and bulk cement will be permitted provided that the automatic batching equipment shall be capable of conversion to manual operation if necessary.

27.3.2 Mixers. Concrete may be mixed at the site of construction or at a central point or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades. The mixer shall be equipped with a calibrated water measuring device so designed that the accuracy of measurement will not be affected by variations of pressure in the water supply line, and capable of accurately measuring the water to within 1% of the amount of mixing water required.

- Mixers at Site of Construction - Mixing shall be in an approved mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period, and of discharging and distributing the mixture without segregation on the prepared grade. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, providing that each batch is mixed 90 seconds.
- Truck Mixers, Truck Agitators, and Non-Agitator Trucks - Vehicles used for mixing and hauling central-mixed concrete, shall conform to the requirements of AASHTO M-157; the permissible wear of blades shall be not more than 1/6th of the original width of blades, according to the manufacturer's specification.

27.3.3 Finishing Equipment.

- Finishing Machine. The finishing machine shall be equipped with at least 2 each oscillating type transverse screeds or other approved method of striking off the concrete.
- Vibrators. Vibrators, for full width vibration of concrete paving slabs, may be the internal type with either immersed tube or multiple spuds. Pan type vibrators, if used, shall be used in conjunction with internal type vibrators. They may be attached to the spreader

or the finishing machine, or may be mounted on a separate carriage. They shall not come in contact with the joint, load transfer devices, subgrade, or side forms. The rated frequency of the surface vibrators shall not be less than 3,500 impulses per minute. And the frequency of the internal type shall not be less than 5,000 impulses per minute for tube vibrators and not less than 7,000 impulses per minute for spud vibrators. When spud type internal vibrators, either hand operated or attached to spreaders or finishing machines, are used adjacent to forms, they shall have a frequency of not less than 3,500 impulses per minute.

- Transverse Grooving Machine. When specified, the transverse grooving machine shall be either a vibrating roller or a comb equipped with steel tines. The machine shall be self-propelled and shall automatically lift the roller or tine comb bar near the edge of the pavement to minimize edge damage. Hand grooving methods will be permitted in a manner approved by the Engineer in those areas where the mechanical equipment cannot be used.
- Concrete Saw - When sawing joints is elected or specified, the Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions and at the required rate. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the work at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete placement.

27.3.4 Forms. The side forms shall be metal, of approved cross section and bracing, of a height not less than the prescribed edge thickness of the concrete section, and a minimum of 10 feet in length for each individual form. Forms shall be of ample strength and shall be provided with adequate devices for secure setting so that when in place they will withstand the impact and vibration of equipment imposed thereupon without appreciable springing or settlement. In no case shall the base width be less than 8-inches for a form 8-inches or more in height. The forms shall be free from warps, bends, or kinks and shall show minimum variation from the true plane for face or top. Each 10-foot length of forms shall be provided with at least three (3) pins for securely staking in position. Sufficient forms shall be provided for satisfactory prosecution of the work. Ten (10) foot metal form sections shall be used in forming curves with a 250-foot, and larger, radius. For curves with a radius of less than two hundred fifty (250) feet, acceptable flexible metal forms or wood forms may be used. Forms shall be clean of old accumulated concrete, grout, or other materials. The forms shall be sprayed or covered with a form release agent prior to their use.

#### 27.3.5 Miscellaneous Machines and Tools.

- The subgrade machine shall be of an approved type that will cut the subgrade, subbase or base reasonably close to the lines, grades and typical cross sections shown on the plans.
- Subgrade Roller - Subgrade rollers shall be of adequate size to compact the subgrade or subbase to the required density.
- Header Boards - Header boards to be used when paving operations are stopped, shall be of two (2) inch material and cut to the exact cross section of the paving slab. The boards shall be so designed as to permit accurate installation of dowels or tie bars as called for on the plans.



- Longitudinal Float - The longitudinal float may either be a mechanical float or screed mechanism meeting the approval of the Engineer or a manually operated float. The hand operated float shall be a rigid straightedge float not less than 12 feet nor more than 18 feet in length with a troweling or smoothing surface not less than 8-inches nor more than 12-inches in width, and shall be worked from bridges spanning the pavement. Longitudinal floats shall be maintained in good repair and working order at all times. If satisfactory results are not being obtained by use of a mechanical float, a manually operated float shall be available on the job for immediate use in lieu of the mechanical float. In lieu of the mechanical or hand operated longitudinal float, the use of a finishing machine with the float pan type finisher will be permitted provided that satisfactory performance and specified surface smoothness and tolerances are obtained.
- Small Tools, Belt and Burlap Drag - The Contractor shall furnish a sufficient number of work bridges, hand floats, 10-foot straightedges, and small tools to satisfactorily complete the pavement as specified herein. Any float or straightedge which becomes warped or distorted and any belts or finishing tools which are defective, shall be promptly replaced with acceptable appliances
- Spraying Equipment. The equipment for applying the curing membrane shall be the fully atomizing type equipped with a tank agitator which will keep the compound thoroughly mixed during application. Hand sprayers of the pressure tank type approved by the Engineer may be used to apply curing membrane to vertical surfaces, irregular areas or edges after form removal.
- Joint Sealing Equipment - The joint sealing equipment used on the project shall meet the ODOT specifications.

#### 27.4 CONSTRUCTION METHODS.

27.4.1 Setting Forms. All forms shall be set on a firm solid subgrade which has been thoroughly compacted. Any variations in the subgrade above or below grade shall be corrected by cutting or filling with earth. Fills shall be thoroughly tamped as required by the Engineer. The forms shall be set to the required grade and alignment with exactness and shall be joined together neatly and tightly. The accuracy of the alignment and grade of the forms shall be checked both while they are being set, and just before the placing of the concrete, with a straightedge. The forms shall not deviate from true line by more than 0.25 inch at any point. Forms which show a variation from the correct alignment and grade, shall be reset or removed and replaced with other forms, as directed by the Engineer. If the subgrade under the forms becomes unstable at any time before concrete is placed, the forms shall be reset on a firm foundation. All forms shall be cleaned and oiled before concrete is placed. If the Contractor so elects, he may use a slip form paver in lieu of the conventional paving train and stationary side forms. The concrete shall be placed with an approved slip form paver designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finish will be necessary to provide a dense and homogenous pavement in accordance with the plans and specifications. The machine shall vibrate the concrete for the full width and depth of the strip of pavement being placed. Such vibration shall be accomplished with vibrating tubes or arms working in the concrete. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms.

27.4.2 Placing Concrete. All concrete shall be placed within a maximum time of 1-1/2 hours from the time the Portland Cement and water is introduced into the mixer. No concrete shall be placed unless an Inspector is present.

- The prepared subgrade shall be wet down by sprinkling uniformly with water before the placing of concrete begins. Only an amount of water that will be immediately absorbed by the subgrade shall be applied, care being taken that no pools of water or muddy spots are created. During dry, warm weather, the Contractor shall wet the subgrade down thoroughly several hours before the placing of concrete begins. No concrete shall be placed unless the subgrade has been approved by the Engineer.
- The concrete shall be deposited on the subgrade in such a manner as to require as little rehandling as possible. The necessary spreading shall be done by means of shovels. Spreading by means of rakes will not be permitted. Any portion of a batch of concrete in which there is any segregation of materials during the operation of depositing and spreading shall be thoroughly mixed with the main body of the batch during the process of spreading.
- The operation of placing concrete shall be continuous between regular transverse joints provided, however, when work is unavoidably suspended for a period longer than 30 minutes after the depositing of concrete has begun or until the concrete has taken initial set, then a transverse joint shall be placed and the slab completed to this joint. Mixing and placing of concrete shall be stopped in time to allow finishing to be completed in daylight hours, unless special permission to do otherwise is granted by the Engineer. When concrete is placed or finished at night, adequate illumination satisfactory to the Engineer, shall be provided.
- For unreinforced Slabs, The concrete shall be placed the full depth of the slab in as nearly 1 single operation as possible. When the slab is to be reinforced, concrete shall first be deposited, spread and struck off uniformly as shown on the plans. When required by the Engineer, the Contractor shall check the uniformity and accuracy of the surface of this lower portion of the slab by use of the strike-off template. All variations in excess of one inch (1") above or below the required elevation shall be eliminated. The reinforcement shall then be placed as hereinafter specified. The placing of the top portion of the slab shall then begin immediately after the reinforcement is properly placed but in no instance shall the time interval between the placing and striking off of the lower portion of the slab be longer than 15) minutes. Any dirt or other foreign matter which collects on the surface of the first layer shall be carefully and completely removed before the upper layer is placed. The concrete shall be brought up to and struck-off at an elevation slightly above the required finish grade.
- No concrete shall be placed on a soft, wet or frozen subgrade. No concrete shall be placed when the air temperature in the shade and away from artificial heat is below 40°F and falling unless with the special permission of the Engineer. The Engineer may require that no concrete be placed when in his opinion the concrete might become damaged from subsequent low temperatures.

27.4.3 Placing Reinforcing Steel. Steel reinforcing bars including tie bars, if shown and required on the plans, shall be of the size and type indicated thereon and shall be open hearth new billet steel of structural, intermediate, or hard grade, ASTM Designation A615, or shall be rail steel concrete reinforcement bars, ASTM Designation A616. All steel shall be bent cold. When tie bars are to be bent they shall be of structural or intermediate grade.

- Deformed Bars. When deformed bars are specified, the forms of the bar shall be such as to provide a net sectional area at all points equivalent to that of a plain square or round bar of equal nominal size.

- Fabricated Steel Bar or Rod Mats - When fabricated steel bar or rod mats are specified, the mats shall meet the current requirements of specifications for "Fabricated Steel Bar or Rod Mats for Concrete Reinforcement", ASTM Designation A-184.
- Steel Wire Fabric Reinforcement. When steel wire fabricated reinforcement is specified, or permitted as an option, the wire fabric shall conform to the gauge and wire spacing shown on the plans and the requirements of the standard specifications for "Cold-Drawn Steel Wire for Concrete Reinforcement", ASTM A82. Longitudinal and transverse wires shall be electrically welded together at all points of intersection and the welds shall be of sufficient strength that they will not be broken during handling or placing. All welding and fabrication of the fabric sheets shall conform to the requirements of the standard specifications for "Welded Steel Wire Fabric for Concrete Reinforcement", ASTM A185. Welded steel wire fabric shall be furnished in flat sheets as per plan dimensions. Steel fabric having been previously bundled into rolls will not be accepted. If wire fabric is used, it will replace or only be used for the longitudinal and transverse bars. The tie bars and load transmission units at joints will not be affected.

27.4.4 Joints in Pavements. The type and dimensions of joints shall be as shown on the plans or called for in these specifications. All joints shall be constructed true to line, having no variation therefrom greater than 1/2-inch at any joint. Transverse joints shall be perpendicular to, and longitudinal joints shall be parallel to, the centerline of the pavement. The plane of all joints shall be perpendicular to the subgrade. All joints shall extend the full length and width of the slab, and, with the exception of dummy joints, shall extend the full depth of the slab so as to entirely separate slabs, or slabs and structure. All headers or forms used in joint construction shall be securely held in place so as to be rigid and unyielding during the entire operation of placing and finishing the concrete and constructing the joint. Headers shall be held in place by iron pins of sufficient length to serve the purpose properly, unless permission to do otherwise is granted by the Engineer. After the concrete is placed, all iron pins shall be removed. Headers shall be kept oiled or greased while in use. All formed or tooled joints shall be edged with a 1/4-inch radius edging tool.

- The location of joints in pavements shall be as shown on the plans, and as provided in these specifications, or as directed by the Engineer. Where shown on the plans or directed by the Engineer, expansion joints 1-inch in thickness shall be placed between the pavement slab and all rigid structures projecting into or confined within the pavement slab.
- Expansion joints shall be placed at the PC & PT of each intersection return. Contraction joints shall be evenly spaced between expansion joints. Spacing will be not less than 10 feet, nor more than 16 feet. When, due to unavoidable suspension of work, a joint is required, such joint shall be located not nearer than 10 feet to any other transverse joint. When the concrete deposited on the subgrade is not sufficient to permit the location of the joint 10 feet or more past the last joint constructed, the concrete shall be removed from the subgrade and disposed of by the Contractor. During the placing of any longitudinal slab section, the joint as required above shall be a transverse construction joint having bonded dowel bars, provided that the location of the joint be 10 feet or more past the last transverse joint and not nearer than 10 feet to the next transverse joint located in compliance with these specifications. All slabs placed adjacent to an existing slab shall have joints placed to match those in the existing slab.
- Longitudinal joints shall be formed by sawing. Deformed steel tie bars of specified length, size, spacing and material shall be placed perpendicular to longitudinal joints.

- For sawed longitudinal joints, tie bars shall be placed perpendicular to the longitudinal joints. They shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports to prevent displacement. Tie bars shall not be painted or coated with asphalt or other material, or enclosed in tubes or sleeves.
- When tested with a straightedge, the surface across any joint shall not vary from the straightedge by more than 1/8-inch. Concrete edges at joints which are not sawed shall be tooled to 1/8-inch radius or as otherwise shown on the plans. The longitudinal joint shall be sawed before the end of the curing period or shortly thereafter and before any equipment or vehicles are allowed on the pavement. The sawed area shall be thoroughly cleaned and the joint shall immediately be filled with sealer.
- For transverse expansion joints, the expansion joint filler shall be continuous from form to form, shaped to the subgrade and to the keyway along the form. Preformed joint filler shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint filler shall not be used.
- The expansion joint filler shall be held securely in position. An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. Finished joints shall not deviate more than 1/4-inch in the horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted anywhere within the expansion space.
- Pre-molded joint filler shall be appropriately punched to the exact diameter and location of the dowels. It shall, unless otherwise provided, be furnished in lengths equal to the pavement width; however, in cases where pavement two or more traffic lanes wide is being placed, the pre-molded filler may be furnished in sections, provided the length of each section is equal to the width of one lane. Where more than one section is used in a joint, the sections shall be securely laced or clipped together. The pre-molded joint filler shall be placed on the side of the installing bar nearest the mixer. The bottom edge of the filler shall project to or slightly below the bottom of the slab and unless otherwise prescribed, the top edge shall be 1-inch below the surface of the pavement. While the concrete is being placed, the top edge of the filler shall be protected by a metal channel cap of at least 1-1/2-inch sheet thickness material, having flanges not less 1-1/2-inch in depth.
- Transverse Contraction Joints shall be formed by sawing or tooling. Sawing of transverse contraction joints shall begin as soon after pouring the pavement as can be done without causing undue raveling. Succeeding joints shall be sawed consecutively from beginning to end of the day's run, and all transverse joints shall be sawed to the depth specified on the plans soon enough to prevent uncontrolled transverse cracking.
- Transverse construction joints shall be constructed when there is an interruption of more than 30 minutes in the concrete operations. No transverse joint shall be constructed within 10 feet of an expansion joint, contraction joint, or plane of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, the excess concrete back to the last preceding joint shall be removed and disposed of as directed.
- Approved load transfer devices shall be firmly held in the position indicated on the plans. Dowels shall be held in position parallel to the surface and centerline of the slab by an approved support. Dowels for expansion joints shall be capped as shown on the plans.

#### 27.4.5 Placing Dowel Bars and Tie Bars.

- Dowel bars and tie bars shall be accurately spaced during the placing of concrete, as shown on the plans. The bars shall be carefully placed so that they will project an equal distance into each slab adjacent to the joint and so that they will be parallel to the subgrade and perpendicular to the joint. All bars shall be maintained in their proper position using metal supports approved by the Engineer, until firmly and securely embedded in the concrete. All forms, headers or premoulded expansion joint material used shall have the necessary holes drilled or punched, or the necessary notches or slots provided at proper locations to permit the bars extending through them. Bars shall be placed at the midpoint of the depth of the slab.
- Tie bars (across all joints other than expansion or contraction joints) shall be deformed bars. The concrete shall be thoroughly spaded adjacent to the bars to secure good bond throughout the length of the bars and prevent the formation of voids.
- The ends of tie bars which are to protrude from the edge of the pavement slab where driveway slabs are to be built, or in other instances directed by the Engineer, may be carefully bent at right angles so as to lay along the form or header, when the concrete is placed. As soon as the form is removed, the bent and partially embedded portion of the bar shall be carefully pried out and straightened to its proper position, care taken not to damage the concrete or the bar.
- Slip Dowel Bars for Expansion Joints shall be plain bars mounted in a supporting cage as shown on the plan. On one side of the joint, the bars shall be completely coated with a heavy paint. The ends of the bars which are painted shall be encased in a metal or cardboard tube. Where necessary to provide a grip on the bar to prevent the tubes being displaced from their proper position, the tubes shall be knocked out-round slightly. The open end of the tube shall be maintained in its proper position on the bar by means of a felt plug or wire across tube.
- Dowels shall be held in place accurately parallel to the surface and centerline of the slab by a device of metal rods, which is left in the pavement. Dowels shall be installed in this device before it is placed on the subgrade. The device shall be rigid enough to hold the dowels in proper position. None of the members of the device shall cross the joints in such a way as to restrict the free opening and closing of the joint.

27.4.6 Consolidating and Finishing Concrete Pavement. The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight-edging, and final surface finish. The addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted routinely. If the application of water to the surface is required, it shall be applied as a fog spray by means of approved spray equipment.

- Machine Finishing. The concrete shall be distributed or spread as soon as placed. As soon as the concrete has been placed, it shall be struck off and screeded by an approved finishing machine. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and to leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation tending to affect the precision finish. During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed for its entire length. If uniform and satisfactory density of the concrete is not obtained by the vibratory

method at joints, along forms, at structures, and throughout the pavement, the Contractor will be required to furnish equipment and methods which will produce pavement conforming to the specifications.

- Hand Finishing. Hand finishing methods will not be permitted routinely and only except under the following conditions: In the event of breakdown of the mechanical equipment or in areas of irregular dimensions, hand methods may be used to finish the concrete already deposited on the grade or in transit when the breakdown occurs.
- Concrete as soon as placed shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete if reinforcement is used. Consolidation shall be attained by the use of a suitable vibrator or other approved equipment.
- Floating. After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a longitudinal float, by hand, mechanical or alternative approved method. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance shall be removed from the surface of the pavement by a straightedge 10 feet or more in length. Successive drags shall be lapped 1/2 the length of the blade.
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- Belting (Paving with Rigid Forms). When straightedging is completed and water sheen has practically disappeared and just before the concrete becomes nonplastic, the surface may be belted with a suitable belt. The belt shall be operated with short strokes transverse to the road centerline and with a rapid advance parallel to the road centerline. Either machine belting or hand belting will be permitted. The transverse belt will not be required if a satisfactory finish can otherwise be obtained.
- Burlap Drag. A burlap drag may be used for the finish of the pavement surface. The burlap or cotton fabric drag shall produce a uniform surface of gritty texture after dragging it longitudinally along the full width of pavement.
- Final Surface Finish Requirements - The pavement surface shall be worked and finished during the operation of consolidating and finishing so that the final surface has no depressions or high spots. When tested with the straightedge as soon as the concrete has hardened sufficiently to permit walking on it without marring the surface, any high spots found in excess of the tolerance above permitted shall be removed by rubbing with a carborundum stone. Such rubbing shall cease when the coarse aggregate is reached and care shall be taken not to loosen any coarse aggregate.
- Prior to acceptance of the pavement, the pavement shall be flooded with a sufficient quantity of water to indicate areas of ponding, should they exist. All areas of ponding in excess of 1/4-inch in depth, and any length of curb and gutter that ponds in excess of 1/4-inch in depth, shall be removed and replaced by the Contractor and at the Contractor's expense. Any area or section of pavement removed shall be not less than 10 feet in length nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab and/or curb and gutter, adjacent to joints, that is less than ten (10) feet in length, shall also be removed and replaced to the particular joint by the Contractor at the Contractor's expense.

27.4.7 Consolidating and Finishing Concrete Curb. While the curb forms are being filled, the concrete shall be thoroughly spaded next to the forms to assure a smooth, dense surface. The concrete shall then be carefully tamped until a uniformly dense concrete is obtained.

After this initial compacting, additional concrete shall be added, tamped and struck off to the required finish curb grade, care being taken to work the coarse aggregate well beneath the surface. As soon as the concrete has set sufficiently to retain its shape without support of the face form, the clamps, spreaders and face form shall be removed. The back forms shall be removed within 24 hours after pouring the concrete. Any honeycombed or rough surfaces shall be immediately corrected when the forms are removed, using mortar when necessary.

27.4.8 Curing Concrete Pavement. A membrane type-curing compound will be used for curing all concrete pavement. The curing compound shall be applied under pressure by means of a spray nozzle in such a manner as to cover the entire exposed surface thoroughly and completely with a uniform film deposited by a fine mist.

- The compound shall be applied to the fresh concrete immediately after the surface has been finished and before the initial set of the cement has taken place. The application of curing compound shall be close to the finishing at all times and all finished concrete shall be sprayed immediately after the superficial water, if any has subsided. The edges of paving slab shall be coated with the sealing compound within 30 minutes after removal of the forms. This shall be a continuous process, and waiting until all forms have been removed before making application will not be permitted.
- The sealing compound shall be applied at a coverage rate 1 gallon per 25 sq yds. Whenever the atmospheric temperature is 100°F or more, the Engineer shall have the right to require an additional coat at a rate of approximately 30 square yards per gallon, if he deems the additional material essential to obtain adequate water retention, in which case the second coat shall be applied thirty (30) minutes after the first. The membrane curing compound shall conform to the requirements of the Materials Section. The membrane curing compound shall be applied to the green concrete as soon as the excess water has disappeared from the surface and the slab is finished, but before the concrete has taken initial set.

27.4.9 Protection of Concrete in Cold Weather. Concrete shall not be placed unless the temperature is at least 40°F and rising unless special permission is granted by the Engineer, subject to the following special requirements.

- When concrete is placed while the temperature is below 35°F or below 40°F and falling, the headers and curb back shall not be removed for 7 days and the slab and curb shall be covered with visqueen and dry burlap, cotton blankets, or equal.
- When concrete is placed under the temperature conditions given above, or, when at any time within 72 hours after concrete is poured, the air temperature goes below 35°F, a layer of dry straw not less than 8-inches in thickness shall be placed on the burlap and loose, dry dirt shall then be placed over the straw layer in sufficient quantity only to prevent the straw becoming displaced or blown off.
- The straw layer shall be placed regardless of the curing method which may be in effect at the time and shall remain in place throughout the regular curing period. While cold weather prevails during the curing period, water shall be applied to the pavement or covering material only as directed by the Engineer.

27.4.10 Backfilling Slab Edges and Curbs. Slab edges and the back side of integral curbs shall be banked with earth as soon as the forms are removed and the required finishing operations completed. Before the pavement is opened to traffic or the work accepted, the area outside the slab edges or back of the curbs shall be backfilled with select earth approved by the Engineer,

thoroughly compacted in layers not exceeding 6-inches in depth and neatly graded off flush with the top of the slab or top of curb or as shown on the plans. Where the general elevation of the parking area is lower than the top of the curb or slab where there is no curb, the minimum width of the backfill shall be 2 feet measured at the top of curb or slab surface.

27.4.11 Opening to Traffic. Between April 1, and October 15, pavement may be opened to traffic in not less than 7 calendar days from the date the concrete is placed. A 14-day curing period will be required at all other times.

27.4.12 Opening for Driveways. Opening for driveways shall be left in the curb where directed by the Engineer, and shall be constructed in conformity with the detailed drawing and "Ardmore Standard Residential Driveway Openings".

27.5 TESTING. The City shall order, obtain and pay for all concrete cylinder tests necessary to confirm the efficacy of the work; provided that the Contractor shall pay for the costs of any laboratory tests which are unsatisfactory. A test shall consist of 4 cylinders, 2 to be tested at an age of 7 days and 2 to be tested at an age of 28 days. One test for slump, temperature and entrained air content may also be made for each set of 4 concrete test cylinders or test beams cast. Air entrainment tests shall be made in accordance with ASTM Designation C173 or C231 or subsequent revisions thereto. In the event the slab on a street is poured in strips or lanes of less than 26 feet in width, a minimum of 1 set of concrete cylinders will be made in each block of each strip or lane so poured. Portland Cement Concrete shall meet the requirements of the Materials Section with a compressive strength of 4000 psi. The pavement shall be constructed strictly in accordance with the plans. Any deficiency in excess of 1/2-inch shall be subject to replacement.

27.6 METHOD OF MEASUREMENT. The yardage to be paid for under this item shall be number of square yards of concrete pavement of the type shown on the Plans or in the Proposal, completed and accepted, measured complete in place. The width for measurement will be the width from outside to outside of the completed pavement, but not to exceed the width as shown on the Plans or as directed by the Engineer. The length will be the actual length measured along the riding surface of the centerline of the road, and shall exclude the length occupied by bridges, approach slabs, and all other exceptions. Reinforcing steel, load transfer devices, joint fillers and joint sealers will not be measured for payment. The quantity of approach slabs to be paid for under this item will be measured by the square yard.

27.7 BASIS OF PAYMENT. The accepted quantities of concrete pavement, and approach slabs, measured as provided above, will be paid for at the contract unit price for:

PORTLAND CEMENT CONCRETE PAVEMENT	SY
APPROACH SLABS	SY
PORTLAND CEMENT CONCRETE PAVEMENT (Continuously Reinforced)	SY

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified. No additional compensation will be allowed when the Contractor, at his option, uses high-early-strength portland cement in lieu of standard cement.

## 28.0 CONCRETE CURB AND GUTTER

28.1 DESCRIPTION. This section covers the construction of concrete curbs and gutters, either separate or in combination, for pavements and roadways in accordance with these specifications and in conformity with the lines, grades, and cross sections shown on the plans. The mixture of the Portland Cement Concrete shall conform to the Materials Section.



28.2 MATERIALS. All materials shall conform to the requirements specified in the Materials Specification.

28.3 CONSTRUCTION METHODS. Excavation shall be made to the required depth, and the base upon which the curb is to be set shall be compacted in accordance with applicable density requirements for the base material. The forms shall be of metal, wood, or other suitable material, straight and free from warp, and of such construction that there will be no interference to the inspection of grade or alignment. All forms shall extend for the entire depth of the curb or curb and gutter and shall be braced and secured sufficiently so that no deflection from alignment or grade will occur during the placing of the concrete. All forms shall be cleaned thoroughly and oiled before the concrete is placed against them.

28.3.1 Curb Placement. A self-propelled curb machine may be used when approved by the Engineer. The curb machine shall be capable of extruding a uniformly textured material to the shape and density specified and placing it in reasonably close conformity to the established line and grade. The subgrade and/or base, and forms shall have been checked and approved by the Engineer before concrete is placed. During placing, the concrete shall be thoroughly consolidated next to the forms by use of a suitable vibrator or other approved equipment.

28.3.2 Finish. As soon as the curb concrete has set sufficiently to retain its shape without support, the final surface finish shall be obtained by uniformly brushing the surface in a manner approved by the Engineer. The edges of the curb shall be neatly rounded to the required radii. The top and front face of curbs shall be checked for irregularities during the finishing operation using a 10 foot straightedge, and all variations greater than 1/4-inch shall be corrected immediately.

28.3.3 Joints. All joints in curb and gutters shall be perpendicular to the subgrade, at right angles to the longitudinal axis of the curb and shall entirely separate the adjacent sections of concrete. Expansion and contraction joints shall be constructed at the same location as similar joints in the paving slab (if present). Expansion joints shall be pre-molded expansion joint filler and shall be of the thickness and placed at the locations shown on the plans or as directed by the Engineer. Joints shall, in general, be placed in the curb, gutter, or combined curb and gutter opposite the joints in the pavement.

28.3.4 Curb Openings. Where curb is to be omitted for driveways or other cause, the top of the curb shall be constructed slightly higher at the back than at the front as shown on the plans or as directed by the Engineer. Such curb may be classified as "Lip Curb" in the special provisions shall be considered as regular curb.

28.3.5 Curing and Opening to Traffic. Concrete curbs and gutters shall be cured, protected during cold weather, and opened to traffic in accordance with the requirements specified from Portland Cement Concrete Pavement. The back side of curbs and gutters shall be backfilled as soon as the forms have been removed and the required finishing operations completed. The backfill shall be of earth approved by the Engineer and neatly graded off flush with the top of the curb or gutter, or as shown on the plans. Backfill material shall be wheel rolled as it is placed. Care shall be taken not to damage the concrete in placing or compacting the backfill. Where the general elevation of the parking area is lower than the top of the curb or gutter, or where there is no curb, the minimum width of the backfill shall be 2 feet at the level of the top of the curb or gutter, unless shown as otherwise on the plans.

28.4 TESTING. The provisions for curb and gutter are the same as that for regular concrete pavements.

28.5 METHOD OF MEASUREMENT. Concrete curb and gutter will be paid for at the contract unit price per linear foot. The price bid per linear foot shall include the cost of the required depression at sewer inlets as shown on the inlet design of the required construction, expansion and contraction joints including the expansion joint filler and expansion joint filler seal, any reinforcing or dowels required by the plans, and any extra or special height curb required at inlet depressions. Such price shall be full compensation for all labor, materials, tools, equipment, tests and incidentals necessary to complete the work in accordance with the plans and specifications.

28.6 BASIS OF PAYMENT. The curb and gutter measured as provided above will be paid for at the contract unit price bid

CURB AND GUTTER

LF

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals, and for performing the work in accordance with these specifications.

#### 29.0 HIGH-EARLY-STRENGTH CONCRETE PAVEMENT

29.1 DESCRIPTION. When high-early-strength concrete pavement is specified, it shall meet the requirements of the Materials Section, except that the compressive strength shall not be less than 3000 psi when tested 72 hours after being batched. All other requirements herein before specified for concrete pavement shall be applicable subject to the following modifications.

29.2 TESTING. Pavement tolerances will be according to that shown on the plans. Pavement slabs may be rejected because of unsound concrete, uncontrolled cracking, malfunctioning of the sawed joints, spalling, honeycombing, surface irregularities, insufficient thickness, or for any deficiencies commonly associated with poor quality pavements. Rejected slabs shall be removed and replaced with new pavement conforming to these requirements. The removal and replacement shall be at least one lane in width and 10 feet in length. Where the linear extent of removal falls within 10 feet of a transverse joint, the removal limits shall be extended to the joint.

29.3 METHOD OF MEASUREMENT. The yardage to be paid for under this item shall be number of square yards of concrete pavement of the type shown on the Plans or in the Proposal, completed and accepted, measured complete in place. The width for measurement will be the width from outside to outside of the completed pavement, but not to exceed the width as shown on the Plans or as directed by the Engineer. The length will be the actual length measured along the riding surface of the centerline of the road, and shall exclude the length occupied by bridges, approach slabs, and all other exceptions. Reinforcing steel, load transfer devices, joint fillers and joint sealers will not be measured for payment. The yardage to be paid for approach slabs under this item will be measured as provided above concrete pavement.

29.4 BASIS OF PAYMENT. The accepted quantities of concrete pavement, and approach slabs, measured as provided above, will be paid for at the contract unit price for:

HIGH-EARLY-STRENGTH CONCRETE PAVEMENT	SY
HIGH-EARLY-STRENGTH CONCRETE APPROACH SLABS	SY
HIGH-EARLY-STRENGTH CONCRETE PAVEMENT (Continuously Reinforced)	SY

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified. No additional compensation will be allowed when the Contractor, at his option, uses high-early-strength portland cement in lieu of standard cement.

## 30.0 PLANER PROFILING PAVEMENTS

30.1 DESCRIPTION. This work shall consist of profiling the existing pavement surface to a depth shown on the Plans below the present finished grade and removing gouges, spalls, ridges, ruts or other imperfections. The planer profiling work shall produce a plane surface with surface aggregate sheared by the scarifying action yielding a surface of uniform texture free from longitudinal ridges, with a pattern which will meet straightedge requirement for "plant mix asphalt concrete pavement" and textured in a manner approved by the Engineer.

30.2 EQUIPMENT. The planer profiling machine shall be one piece of equipment especially designed and built for this type of work. It shall be self-propelled, fully automated to control the depth of cut and slope from a preset or traveling reference line. The machine shall be capable of cutting reasonably flush to the curb and to inlets, manholes, or similar items within or adjacent to the pavement. The planing operation shall be performed continuously by the forward motion of the machine. If a heater planer machine is used it shall have, in addition to the above, the means in combination, for controlled heating and planing the existing surfaces without burning or tearing the surface. The blades for cutting shall be self-sharpening, controlled from the operator's station and shall deliver the cuttings into windrows in a manner approved by the Engineer. The width of the heating and cutting shall be not less than 4 feet and the effective wheel base of the machine shall be not less than eighteen 18 feet. The heating method used shall not detrimentally soot or oil-coat the aggregates or asphaltic materials.

30.3 CONSTRUCTION METHODS. The Contractor shall provide all necessary warning lights, barricades, flagmen and signs incidental to the protection of the public and workmen during the planer profiling operations as required by the current edition of the Manual on Uniform Traffic Control Devices. The existing pavement surface shall be uniformly profiled. If a heater planer is used the surface shall be heated to a temperature of no more than 275°F and shall be shaved or cut to the new planed surface. The temperature at which the work is performed, the nature and condition of the equipment, and the manner of performing the work shall be such that the pavement is not torn, broken, burned or otherwise damaged by the planing operation. The machine shall make as many passes as necessary to remove the irregularities and to profile the surface to the depth required. Unless otherwise shown on the Plans, all material removed from the surface will not be paid for separately but shall become the property of the Contractor and shall be disposed of by him in a manner approved by the Engineer.

30.4 METHOD OF MEASUREMENT. Planer profiling will be measured by the square yard of surface area of completed and accepted work.

30.5 BASIS OF PAYMENT. Accepted quantities of planer profiling, measured as provided above, will be paid for at the contract unit price for:

PLANER PROFILING	SY
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which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

## 31.0 COLD MILLING PAVEMENT

31.1 DESCRIPTION. This work shall consist of cold milling and removing existing pavement surfaces below the present grade to a depth shown on the plans, removing ridges, ruts and other imperfections. The milling operation shall produce a plane surface that will provide a reasonably smooth riding surface for traffic which may thereafter be properly overlaid.

31.2 EQUIPMENT. The Contractor shall provide a power operated milling machine capable of planing or milling a minimum depth of 1-1/2-inches in a single pass. The equipment shall be self-propelled with sufficient power, traction and stability to maintain accurately and automatically establishing profile grades along each edge of the machine by referencing the existing pavement by means of a ski, or matching shoe or from an independent grade control, and shall have an automatic system for controlling cross slope at a given rate. The machine shall be equipped with an integral loading means to remove the material being cut from the pavement surface and to discharge the cuttings into a truck, all in a single operation.

31.3 CONSTRUCTION METHODS. The existing pavement shall be uniformly milled to provide a uniform texture, true to line, grade and cross section, it shall have no deviations in excess of 3/16-inch in ten 10 feet. Any portion of the planed surface not meeting this requirement shall be corrected in a manner approved by the Engineer. The machine shall make as many passes as necessary to remove irregularities and to profile the surface to the depth and cross slope shown on the Plans. Cold milling shall be done in a manner that will not create undue traffic hazards. The milling operation shall be performed in each lane in such a manner that the milled lanes are evened up as near as practical at the end of each day's operation so as to eliminate the hazard of an exposed vertical edge when traffic is carried through construction. All materials removed shall become the property of the Contractor and shall be disposed of by him in a manner approved by the Engineer.

31.4 METHOD OF MEASUREMENT. Cold milling pavement will be measured by the square yard of surface area.

31.5 BASIS OF PAYMENT. Accepted quantities of cold milling pavement, measured as provided above, will be paid for at the contract unit price for:

COLD MILLING PAVEMENT	SY
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which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

### 32.0 CONCRETE JOINT REHABILITATION

32.1 DESCRIPTION. This work shall consist of sawing, cleaning and sealing contraction joints in existing portland cement concrete pavement in reasonably close conformity with the details shown on the Plans or as approved by the Engineer.

32.2 MATERIALS. Materials shall meet the requirements of the Materials Section.

32.3 EQUIPMENT. All necessary equipment shall be furnished by the Contractor. The minimum requirements for the construction equipment as required to complete the work as specified herein.

- Concrete Saw. Sawing equipment adequate in size and power to complete the sawing of concrete joints to the required dimensions.
- High Pressure Water Pumping System. High pressure water pumping system capable of delivering sufficient pressure and volume of water to thoroughly flush concrete slurry and detritus from sawed joints.
- Sand Blasting Unit.. Compressed air pressure type sand blasting equipment of proper size and capacity to clean joint surfaces as specified. The unit shall be equipped with suitable

traps for removal of all free water and oil from the compressed air.

- Air Compressors. Air compressors capable of delivering compressed air having a pressure in excess of 90 psi and equipped with suitable traps for removal of all free water and oil from the compressed air.
- Extrusion Pump and Injection Tool. Air powered extrusion pumps as required for applying joint sealer with an output capable of delivering a sufficient volume of material to the joint through the appropriate injection tool as required for applying the sealer into the joint.

**32.5 CONSTRUCTION METHODS.** Unless authorized by the Engineer, all concrete joint rehabilitation work involving the actual sawing and cleaning of the joint which generates dust shall be performed between the hours of 8 am and 4 pm.

**32.5.1 Sawing and Flushing Joints.** The existing contraction joints shall be cut to the width and depth shown on the Plans. Sawing shall be done in such a manner as to produce a new joint having a cut face on both sides and be uniform in width along its full length. Within 5 minutes after sawing, the resulting slurry shall be removed from the joint and immediate area flushed with a high-pressure water system and other equipment necessary to thoroughly remove the slurry.

**32.5.2 Cleaning Joint Faces.** The cut faces of the joints shall be thoroughly cleaned of all foreign materials, as may be required for proper installation and bonding of the joint sealer or filler, including old sealant or any residue from water flushing operations, by sandblasting as required. The use of portable hand saws will not be permitted for cleaning joint faces.

- The cut faces of the joint shall be thoroughly air dried for a minimum of 48 hours after flushing with water. Blow-drying of the joints with compressed air will not be permitted.
- After complete drying, the joint shall be sandblasted. The sandblaster nozzle shall be attached to a mechanical aiming device so as to direct the sandblast to approximately a 45 degree angle and at a maximum of 2-inches from the faces of the joint. Both joint faces shall receive sandblasting.
- After sandblasting the joints shall be blown out using filtered oil free and moisture free air at a minimum of 90 psi and 120 cfm. Blowing out of the joint shall be accomplished by using a blow tube that will fit into the joint. After blowing, the joint shall be checked for any residual dust or coating. If any is found the sandblasting and blowing operations shall be repeated until the joint is cleaned.
- The cleaned joints shall be sealed the same day as cleaned. Joints left open overnight shall be recleaned prior to sealing. In the event the open joints prepared for installation of joint sealing materials become contaminated by traffic, or the result of weather conditions, they shall be recleaned as specified above or as approved by the Engineer.

**32.5.3 Bond Breaker Rod.** When shown on the plans or recommended by the sealant manufacturer, a bond breaker rod shall be installed prior to application of the joint sealant. The bond breaker rod shall be of the type recommended by the manufacturer of the sealant material. The bond breaker rod shall be installed in a manner that will produce the dimensions (width and depth) described on the Plans.

**32.5.4 Sealing Joints.** The Department's inspectors will examine joints prepared for sealing just prior to installation of the joint filler or sealer. Joints will not be approved for sealing if contaminated or not adequately dry as required for bonding of sealing materials.

- Installation of Joint Sealers and Fillers. A representative of the joint filler and/or joint sealer manufacturer shall be on the job site at the beginning of the joint sealing operation to demonstrate to the Contractor and to the Department's inspectors the manufacturer's acceptable standards for installation of the joint sealant materials.
- Application of Joint Sealers. The joint sealer shall be applied, using a mechanical injection tool approved by the Engineer. Application of the joint sealer will not be permitted when the joint temperature is less than 40°F.
- Joints shall not be sealed unless they are thoroughly clean and dry. Sealers to fill the joint shall be injected into the joint and applied in a manner which causes it to bond to the joint face surfaces. The surfaces of sealers requiring tooling shall be tooled, using an approved mechanical device to produce a slightly concave surface approximately 0.25 to 0.50-inches below the pavement surface. Tooling shall be accomplished before a skin forms on the surface of the sealer. The use of soap or oil as a tooling aid will not be permitted. Tooling will not be required if the sealer is self-leveling.
- Failure of the sealant to bond to sawed surfaces of the concrete joint will be cause for rejection and repair shall be at the Contractor's expense. Traffic shall not be allowed on the fresh applied sealant until it becomes tack free.

32.6 METHOD OF MEASUREMENT. Concrete joint rehabilitation will be measured by the linear foot after the joint sealant is in place.

32.7 BASIS OF PAYMENT. The accepted quantities, measured as provided above, will be paid for at the contract unit price for:

CONCRETE JOINT REHABILITATION	LF
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which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

### 33.0 FABRIC REINFORCEMENT FOR ASPHALT CONCRETE PAVEMENT

33.1 DESCRIPTION. This work shall consist of the application of reinforcement fabric for plant mix asphalt concrete pavement in accordance with these Specifications and in reasonably close conformity with the locations and dimensions shown on the Plans or established by the Engineer.

33.2 MATERIALS. Materials shall meet the requirements specified Materials.

33.3 EQUIPMENT. Materials, equipment and tools necessary for performing all parts of the work shall be furnished by the Contractor. The mechanical fabric Laydown Equipment shall be capable of handling full or partial rolls of fabric and shall be capable of laying the fabric smoothly without excessive wrinkles and/or folds. When manual laydown is required, a length of standard 1-inch pipe, together with suitable roll tension devices shall be used for proper roll handling. Miscellaneous equipment shall include stiff bristle brooms to smooth the fabric, scissors or blades to cut the fabric, and brushes as required for use in applying asphalt binder to fabric overlap as spliced joints.

### 33.4 CONSTRUCTION METHODS.

33.4.1 Surface Preparation and Application. The surface on which the fabric is to be placed shall be free of dirt, dust, water, oil or other foreign matter. Bituminous binder material shall be heated and uniform spray applied over the area to be fabric covered. Laps shall be mopped between layers of fabric. The longitudinal lap may be sprayed with the distributor.

- The minimum application temperature of the bituminous binder shall not be less than 290°F. If the fabric is oversprayed, the maximum application temperature shall not exceed 325°F to avoid damage to the fabric. Asphalt binder shall not be applied for installation of the fabric when the air temperature is less than 50°F unless otherwise approved by the Engineer.
- The bituminous binder shall be applied at the rate of 0.20 to 0.35 gal/SY (actual application rates will be based on asphalt retention tests for the fabric used) as established by the Engineer. Application of the bituminous material shall be accomplished with an asphalt distributor. Areas not accessible to the distributor shall be hand sprayed.
- The distributor shall be started and stopped over paper or roofing felt to provide neat cutoff lines. The width of binder application shall be 2 to 6-inches wider than the fabric width. Care shall be exercised in the application of the binder to avoid spills or excessive application to cause flushing of the bituminous material.

33.4.2 Placement of Reinforcement Fabric. The fabric shall be placed after the bituminous binder has been applied and before the binder has cooled and lost tackiness. The fabric shall be unrolled and placed into the binder with the unfused (fuzzy) side down with a minimum of wrinkles.

- Every effort shall be made to lay the fabric as smoothly as possible. The fabric shall be broomed to remove air bubbles and maximize fabric contact with the pavement surface. Wrinkles shall be cut and laid out flat. If misalignment of the fabric occurs the fabric shall be cut, realigned and jointed as directed by the Engineer.
- Overlap of fabric at joints shall be between 4 and 6-inches. Transverse joints shall be shingled in the direction of paving to prevent edge pick up by the paver. Additional binder shall be applied to joints at 0.35 gals/SY. Transverse joints shall be mopped, brushed or hand sprayed. The longitudinal joints shall be sprayed with the distributor.
- The reinforcement fabric shall be embedded into the bituminous binder and bonded to the pavement. Self-propelled pneumatic tired rollers may be used if deemed necessary by the Engineer. Fabric not overlaid the same day shall be blotted with clean apparently dry sand before being turned to traffic. Sand for blotting will be included in other items for payment.

33.4.3 Tack Coat. Tack coat shall be routinely required for the pavement overlay. The bituminous material type, grade, rate of application and temperature shall be approved by the Engineer. Cut-back asphalt or emulsified asphalt containing petroleum distillate additives shall not be used.

33.4.4 Pavement Overlay. Placement of the asphalt concrete pavement overlay shall closely follow fabric lay down unless otherwise permitted by the Engineer. Any damage or disbonding of the fabric reinforcement membrane caused by traffic or wet weather conditions due to unnecessary delay or negligence of the Contractor shall be repaired at his own expense.

- In the event excess binder bleeds through the fabric before the overlay is placed, the excess material shall be blotted by spreading sand on the affected area as directed by the Engineer.
- The temperature of the paving mix at time of placement on the reinforcement fabric membrane shall not exceed 325°F to prevent damage to the fabric.
- The turning of pavers or other vehicles should be gradual and kept to a minimum to avoid damage to the fabric. Should equipment tires pick up the fabric or the paver cause movement of the membrane during paving operations asphalt paving mix may be broadcast ahead of trucks and the paver to prevent damage. Any damage to the reinforcement membrane due to equipment shall be repaired by the Contractor at his expense.

33.5 METHOD OF MEASUREMENT. Fabric reinforcement will be measured by the square yard in place. Bituminous binder will be measured by the gallon.

33.6 BASIS OF PAYMENT. The accepted quantities of fabric reinforcement and bituminous binder, measured as provided above, will be paid for at the contract unit price for:

FABRIC REINFORCMENT	SY
BITUMINOUS BINDER	GAL

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

#### 34.0 DIAMOND GRINDING CONCRETE PAVEMENT

34.1 DESCRIPTION. This work shall consist of grinding portland cement concrete pavement to restore drainage and riding characteristics to the pavement surface. This work shall be accomplished in accordance with these Specifications and in reasonably close conformity to the details shown on the Plans.

34.2 EQUIPMENT. The grinding equipment shall be a power driven, self-propelled machine that is specifically designed to smooth and texture portland cement concrete pavement with diamond blades. The effective wheel base of the machine shall not be less than 12 feet. It shall have a set of pivoting tandem bogey wheels at the front of the machine and the rear wheels shall be arranged to travel in the track of the fresh cut pavement. The center of the grinding head shall be no further than 3 feet forward from the center of the back wheels. The equipment shall be of a size that will cut or plane at least 3 feet wide. It shall also be of a shape and dimension that does not encroach on traffic movement outside of the work area. Equipment that causes excessive ravels, aggregate fractures, spalls or disturbance of the transverse and longitudinal joints or cracks will not be permitted.

#### 34.3 CONSTRUCTION.

34.3.1 Grinding Pavement. Grinding shall be performed in the longitudinal direction so that grinding begins and ends at lines normal to the pavement centerline. The entire area designated on the Plans shall be ground until the pavement surfaces of adjacent sides of transverse joints and cracks are in the same plane. Extra depth grinding to eliminate minor depressions in the pavement to obtain 100% texturing will not be required. The construction operation shall be scheduled and proceed in a manner that produces a uniform finished surface. Grinding shall be accomplished in a manner that eliminates joint or crack faults, while providing positive lateral drainage by maintaining a constant cross-slope between the edges of grinding operations.



Auxiliary or ramp lane grinding shall transition as required from the mainline edge to provide positive drainage and an acceptable riding surface.

34.3.2 Surface Texture and Grooving. The grinding process shall produce a pavement surface that is uniform in appearance with a longitudinal line type texture. The surface shall have grooves between 0.09 to 0.15 inches wide, spaced up to 0.125-inches apart. The peaks of the ridges shall be approximately 1/16-inch higher than the bottom of the grooves.

34.3.3 Slurry Removal. The Contractor shall provide positive means for removal of grinding slurry or residue by vacuum or other continuous methods. Slurry shall not be allowed to flow across lanes being used by traffic. The Contractor shall arrange for the disposal of the slurry at an approved location, the cost of which shall be included in the bid price for diamond grinding.

34.3.4 Pavement Smoothness. All ground surfaces shall be profiled by the Contractor for smoothness using a profilograph. Profiles will be made 3 feet from and parallel to each edge of pavement and at the approximate location of each longitudinal joint for all pavement areas. Pavement so tested shall have a profile index of 5-inches per mile or less using 0.2-inch blanking width. Individual high points in excess of 0.3-inch, as determined by measurements of the profilograph shall be reduced by grinding, until such high points as indicated by reruns of the profilograph do not exceed 0.3 inch. After grinding has been completed to reduce individual high points in excess of 0.3 inch, additional grinding shall be performed as necessary to reduce the profile index to values specified above in any 0.1 mile section along any line parallel with the pavement edge. Additional grinding shall be performed as necessary. All ground areas shall be neat rectangular areas of uniform surface appearance.

34.3.5 Straight Edge Tolerance. The surface may be straightedged, at locations to be determined by the Engineer, with a 10 foot long straightedge. When the straightedge is laid on finished pavement parallel to centerline or normal to the centerline, the maximum distance to the roadway surface from the bottom edge of the straightedge shall not exceed 1/8-inch at any point. Additional grinding will be required at the locations found in excess of the tolerance.

34.3.6 Traffic Control. Contractor shall endeavor to provide for bypass traffic by single lane closure if practicable; or establish detours when necessary. Traffic control shall be in accordance with the Manual on Uniform Traffic Control Devices.

34.4 METHOD OF MEASUREMENT. Diamond grinding concrete pavement will be measured by the square yard. The square yards measured will be the final textured surface area regardless of the number of passes required to achieve acceptable results. Minor areas of untextured pavement within the designated areas to be textured will be included in the measurement.

34.5 BASIS OF PAYMENT. The accepted quantities, measured as provided above, will be paid for at the contract unit price for:

DIAMOND GRINDING SY

### 35.0 TACK COAT

35.1 DESCRIPTION. This work shall consist of preparing and treating an existing bituminous or concrete surface with bituminous material in accordance with these Specifications and in reasonably close conformity with the lines shown on the Plans or established by the Engineer.

35.2 MATERIALS. Materials shall meet the requirements specified in the following Section of Section 900-Materials. The emulsified asphalt may be diluted as specified by the Engineer.

35.3 EQUIPMENT. Distributors, heating equipment, and supply tanks shall meet the requirements of this Specification hereinabove.

35.4 CONSTRUCTION METHODS. Clean the existing surface or course to the satisfaction of the Engineer before tack coat is placed. Apply the tack coat, as directed by the Engineer, at the rate of not more than 0.1 gallon per square yard of surface. Paint all contact surfaces of curbs and gutters, manholes, and other structures with a thin, uniform coat of asphalt material used for the tack coat. Apply the tack coat in such manner as to minimize damage, offer the least inconvenience to traffic, and permit one-way traffic without pickup or tracking of the bituminous material. Do not apply tack coat during wet or cold weather, when wind drift presents a potential problem to the traveling public or adjacent property, after sunset, or to a wet surface; however, the surface may be damp. Tack coat that is not "covered" the same day may be reapplied at a rate that insures proper adhesion as directed by the Engineer. The quantity, rate of application, temperature, and areas to be treated shall be approved prior to application.

35.5 METHOD OF MEASUREMENT. Tack coat will be measured by the gallon before dilution. [Water used in dilution of emulsified asphalt will not be measured for payment.]

35.6 BASIS OF PAYMENT. The accepted quantities, measured as provided above, will be paid for at the contract unit price as follows:

TACK COAT                      GAL

Such payment shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified

36.0 PAVEMENT AND SURFACES CONSTRUCTION STANDARD BID ITEMS. This section covers Standard Bid Items used in the contract documents for the construction of pavements and surfaces. Additional bid items may be called out in the Special Provisions, other sections of the Standard Specifications, or as directed by the Engineer for additional work covered and change orders

SECTION	DESCRIPTION	UNIT
301	ASPHALTIC CONCRETE TYPE (A - E) (X INCHES)	S.Y.
301	ASPHALTIC CONCRETE TYPE (A - E)	TON
301	ASPHALT CONCRETE, TYPE (A - E) (POL. MOD.)	TON
301	ASPHALTIC CONCRETE LEVELING COURSE	TON
302	RHM - ASPHALTIC CONCRETE TYPE (A - E) (X INCHES)	S.Y.
302	RHM - ASPHALTIC CONCRETE TYPE (A - E)	TON
302	RHM - ASPHALT CONCRETE, TYPE (A - E) (POL. MOD.)	TON
302	RHM - ASPHALTIC CONCRETE LEVELING COURSE	TON
303	EMULSIFIED ASPHALT	GAL.
303	EMULSIFIED ASPHALT	TON
303	TYPE I AGGREGATE	TON
303	TYPE II AGGREGATE	TON
303	TYPE III AGGREGATE	TON
304	PORTLAND CEMENT CONCRETE PAVEMENT	S.Y.

304	APPROACH SLABS	S.Y.
304	PORTLAND CEMENT CONCRETE PAVEMENT (CONTINUOUSLY REINFORCED)	S.Y.
305	CURB AND GUTTER	L.F.
306	HIGH-EARLY-STRENGTH CONCRETE PAVEMENT	S.Y.
306	HIGH-EARLY-STRENGTH CONCRETE APPROACH SLABS	S.Y.
306	HIGH-EARLY-STRENGTH CONCRETE PAVEMENT (CONTINUOUSLY REINFORCED)	S.Y.
307	PLANER PROFILING	S.Y.
309	COLD MILLING PAVEMENT	S.Y.
310	CONCRETE JOINT REHABILITATION	L.F.
311	FABRIC REINFORCMENT	S.Y.
311	BITUMINOUS BINDER	GAL.
312	DIAMOND GRINDING	S.Y.
313	TACK COAT	GAL.