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DIVISION 2A

EARTHWORK

1. SCOPE

This section covers all earthwork involved in the site preparation, excavation, filling and backfilling, grade construction, grading, dressing, shaping and finishing necessary to complete the construction to the lines, grades and dimensions as indicated on the drawings and as specified herein.

2. SITE PREPARATION

All brush, saplings, weeds, heavy growths of grass and other vegetation shall be removed to a minimum depth of six (6) inches and unacceptable materials removed from the work site. All trees that will interfere with the work shall be removed to a depth of one (1) foot below the surface. All refuse shall be burned or otherwise properly disposed of in a manner acceptable to the Engineer. Areas which are to be covered by fill shall be stripped of all loose material, roots and vegetation to a minimum depth of one (1) foot prior to filling.

3. EXCAVATION

Excavation of every description and substance within the limits of the project shall be performed to the lines, grades and cross-section shown on the drawings, except when unsuitable material is encountered that shall be removed to the depth required by the Engineer and replaced with suitable materials. The excavation shall be performed in such a manner as to afford good drainage at all times.

All suitable material excavated shall be used to construct the embankment, backfilling and for such other things as the Engineer may direct during construction.

All excessive excavation, broken concrete, bricks, casting and other materials salvaged in the performance of the work shall become the property of the Owner and shall be hauled and placed by the Contractor in a location designated on the site development plan. The Contractor shall avoid scattering material along the line of haul, and when this does occur, it shall be cleared immediately.

4. EMBANKMENT

The embankment shall be constructed with suitable materials from the excavation or from borrow areas approved by the Engineer. It shall be free of trees, roots, grass, trash and other deleterious materials. The embankment shall be constructed in horizontal layers not exceeding six (6) inches and shall be compacted to 95% Standard Proctor density. Fill materials too dry or too moist to give the required compaction shall be sprinkled on air dried as required to achieve proper optimum moisture content for the required density. Frozen materials shall not be placed.

Backfilling operations shall not be started until the construction has been examined and approved by the Engineer. Backfilling shall be carried out using methods which will not disturb or damage any structures, pipes or other work. Material used shall be approved excavated or borrow material, and shall be free of any trash, lumber or other debris; it shall not contain any clods, lumps or stones that interfere with the proper compaction of the backfill. The backfill shall be placed in layers not more than six (6) inches loose depth, and shall be thoroughly and properly rammed, tamped or otherwise compacted to the required density.

Where shown on the plans or required by the Engineer, selected material shall be taken from approved borrow pits, or hauled in, and placed as directed. Selected materials will be compacted as approved by the Engineer so that minimum settlement will occur.

5. GRADING

After completion of the finished works, the Contractor shall remove all excess material and shall grade the areas as required. Where topsoil is to be provided, the Contractor shall spread it evenly to the depths shown and over such areas to give finish grades shown in the plans; the final grade shall be dressed to smooth even contours with special care being taken to provide satisfactory drainage.

6. SUBGRADE CONSTRUCTION

The bottom of the excavation and/or top of the fill shall be known as the pavement subgrade and shall conform to the lines, grade and cross sections shown on the drawings.

All soft and yielding material and other portions of the subgrade that will not compact readily when rolled or tamped shall be removed and replaced with selected material as approved by the Engineer.

The subgrade shall be brought to a firm and unyielding condition with a uniform density of not less than 95% Standard Proctor density. The material shall be compacted at or slightly above optimum moisture as approved by the Engineer.

Where rock is encountered in the subgrade constructed in cut sections, the subgrades shall be scarified to a depth of six (6) inches. All rock with a dimension of six (6) inches in any direction shall be removed. The subgrade shall then be constructed to the required grade and cross section, with additional material added as necessary and compacted to 95% Standard Proctor density.

Where solid rock is encountered in the subgrade construction beneath a paving section, excavation shall be carried to a depth of four inches (4") below subgrade and an additional four inches (4") of select fill or sand cushion material used for subgrade construction.

All utility trenches and structure excavation below the new paving shall be backfilled to natural or finished grade as soon as conditions permit. All earth backfill shall be compacted to 95% Standard Proctor density with mechanical tampers in layers of not over six inches (6") in compacted thickness, or the Contractor may use inundated sand as approved by the Engineer.

7. FILL AND BACKFILL SETTLEMENT

The Contractor shall be responsible for all settlement of fill and backfill which may occur within one year after final acceptance of the contract under which the backfilling work was performed.

The Contractor shall make, or cause to be made, all necessary fill and backfill replacements, and repairs or replacements appurtenant thereto, within thirty (30) days after notice by the Engineer or Owner.

8. FINAL GRADING

After other outside work has been finished, and backfilling and embankments completed and settled, and pavement and curbs in place, all areas on the site of the work which are to be graded shall be brought to grade at specified elevations, slopes and contours. Slopes shall be trimmed and dressed by hand. Other surfaces shall be graded to secure effective drainage. Unless otherwise shown a slope of at least one percent (1%) shall be provided.

The Contractor shall be fully responsible to restore to the existing condition as determined by the Engineer all lawns disturbed during construction and within the right-of-way. This shall include proper stockpiling of excavated topsoil and sod for reuse in final grading. Subgrade in areas to receive topsoil shall be filled or excavated as required to provide for a minimum thickness of topsoil equal to six inches (6").

9. 2" SAND CUSHION

Materials for two inch (2") sand cushion shall all pass a one inch (1") sieve and shall contain fifteen percent (15%) to thirty percent (30%) of material passing the number two hundred (200) sieve. The plasticity index shall be not less than two or more than eight.

Before placing sand cushion, the subgrade shall be tested for conformity with the cross section shown on the plans, using an approved template. If necessary, material shall be removed or added to bring all portions of the subgrade to the correct elevation. It shall then be thoroughly compacted and again tested with a template. The finished subgrade shall be kept smooth and compacted until the concrete has been placed. Immediately prior to concrete placement the sand cushion shall be thoroughly wet down so that it is saturated and the subgrade moistened.

DIVISION 2B

ASPHALTIC CONCRETE PAVEMENT

1. SCOPE

This item shall consist of various bituminous mixtures to provide asphaltic concrete leveling, base and/or surface courses as indicated on the plans and in the construction documents. The mixtures shall be composed of a mineral aggregate uniformly coated with an approved asphalt cement and shall be laid upon a previously compacted and approved subgrade, base course, or an existing pavement surface. The various bituminous courses shall be constructed 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.

2. MATERIALS

The Contractor shall submit samples of all materials to be used to an approved laboratory for test and preparation of a job mix formula in accordance with these specifications. The cost of these tests shall be borne by the Contractor.

a. Mineral Aggregate

The mineral aggregate shall be composed of coarse aggregate, fine aggregate and mineral filler.

The mineral aggregate in stockpiles at the plant shall be free of deleterious substances in excess of following limits by weight, as samples.

Mud, clay balls, sand clusters, or sandballs, retained on the No. 4 sieve (wet weight)	1.5 percent
Sticks or roots (wet weight)	0.5 percent

The percentage of wear, Los Angeles Abrasion Test, shall not exceed 40 for aggregates used in Asphaltic Concrete mixtures and shall not exceed 50 for aggregates used in Bituminous Bases.

The sand equivalent of the combined aggregate exclusive of added mineral filler shall be not less than 45 for aggregates used in Asphaltic Concrete Surface Courses and shall be not less than 40 for aggregates used in Asphaltic Concrete Base or Binder Courses. The sand equivalent for aggregates used in Bituminous Base (Coarse Aggregate) shall be not less than 30 and for aggregates used in Bituminous Base (Fine Aggregate) shall be not less than 25.

(1) Coarse Aggregate

The coarse aggregate shall be that part of the aggregate retained on the No. 10 sieve and shall consist of clean, tough, durable particles of crushed stone, crushed gravel, gravel, or any combination thereof. It shall be practically free from clay, organic or other injurious matter occurring either free or as a coating on the aggregate. At least 70 percent by weight, of the aggregate retained on the No. 4 sieve shall be composed of uniformly graded particles having one or more fractured faces.

The coarse aggregate to be used in the surface course shall have a durability factor of not less than 40 when tested in accordance with AASHO T 210.

(2) Fine Aggregate

The fine aggregate shall be that part of the aggregate passing the No. 10 sieve and shall consist of hard, durable grains of natural sand, crushed stone, stone dust, crushed gravel, mine chat, or jig-sand, or any combination of these materials.

Crushed materials shall be produced from material conforming to the abrasion requirements for coarse aggregate. Natural sand shall be fed to the dryer as a separate aggregate. In no case will the blending of crushed and natural material in the same storage be permitted.

When used in the wearing course, the material in the natural sand passing the No. 200 sieve shall be less than 50 percent of that contained in the combined aggregate including mineral filler.

(3) Mineral Filler

Mineral filler, when required in addition to that naturally contained in the aggregate, shall consist of thoroughly dry limestone dust, volcanic ash, Portland cement, hydrated lime or other approved inert mineral matter. When delivered to the mixer, mineral filler shall be free from lumps or loosely bonded aggregates.

b. Asphalt

The Contractor shall provide asphalt to be used as (1) the binder in asphaltic concrete, (2) tack coat, and (3) prime coat.

The material shall be approved by the Engineer before work starts, and the supply shall not be changed unless previously approved by the Engineer. If at any time material furnished meeting the specifications fails to produce satisfactory results as compared to materials previously furnished from the same source, further shipments will be rejected and the material will not be used for further work on the specific project underway nor for any new work until the producer satisfies the Engineer that the material has been corrected to produce satisfactory results.

Sampling and testing of bituminous materials shall be in accordance with AASHO Test Methods.

(1) Binder

The asphalt shall be asphalt cement penetration grade 85-100. All asphalt cements and fillers shall be prepared products, steam, vacuum or solvent refined, from an asphalt or semi-asphalt base petroleum, homogeneous, free from water, and shall not foam when heated to a temperature of 175° C.

The asphalt cement shall meet the requirements of AASHO Specification M 20. The spot test with Standard Naptha is required and shall be negative for all grades.

(2) Tack Coat

The bituminous material shall be Emulsified Asphalt SS-1 and shall meet the requirements of AASHO Specification M 140.

The SS-1 will be diluted as specified or as directed by the Engineer to insure the desired coverage. For average conditions, a blend of 50 percent SS-1 and 50 percent additional water will be used.

(3) Prime Coat

The bituminous material shall be Emulsified Asphalt SS-1 and shall meet the requirements of AASHO Specification M 140.

The SS-1 will be diluted as specified or as directed by the Engineer to insure the desired coverage. For average conditions, a blend of 50 percent SS-1 and 50 percent additional water will be used.

Blotter material, if required, shall be fine graded, clean sand reasonably free from silt, loam or other foreign matter.

3. PAVING MIXTURES

a. Types

The paving mixtures shall consist of a uniform mixture of the combined aggregates and asphalt cement and shall conform to the following table of mixtures for the types designated on the plans or in the proposal:

TABLE OF MIXTURES

Mixture:	Asphaltic Concrete			Bituminous Base	
Type:	A	B	C	Fine Aggregate	Coarse Aggregate
Sieve Size	Percent by Weight Passing				
1-1/2 in.	100				100
1 in.	80-100				-----
3/4 in.	-----	100	100		60-100
1/2 in.	60- 80	80-100	95-100		-----
3/8 in.	-----	70- 90	80-100	100	45- 80
No. 4	40- 55	50- 70	55- 75	75-100	35- 65
No. 10	30- 45	35- 50	40- 55	55-100	25- 50
No. 40	15- 30	15- 30	18- 33	25- 85	10- 35
No. 80	8- 20	9- 21	10- 22	-----	-----
No. 200	2- 8	3- 9	4- 10	5- 20	4- 12
%AC (Soluable in Solvent	3.6-6.5	4.4-7.5	4.4-7.5	3.0-8.0	3.0-6.0

The final gradation determined by the laboratory within the job-mix formula shall be uniformly graded from coarse to fine. It shall not vary from the top limit on any sieve to the bottom limit of the adjacent sieve or vice versa. No production of material for use under these specifications shall be started until the job-mix formula has been approved by the Engineer. The mixture shall be designed by the laboratory to have a laboratory molded density of not less than 94% nor more than 98% of its maximum theoretical density for Asphaltic Concrete; a minimum of 80% for Bituminous Base (Fine Aggregate); and not less than 92% nor more than 97% for Bituminous Base (Coarse Aggregate).

The stability value for all mixtures other than five aggregate base shall be a minimum of 35 Hveem.

Fine aggregate base courses shall be designed for Hveem stability of not less than 20.

The job-mix formula for each mixture with the allowable tolerances shall be within the master range shown in the table of mixtures. The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve, a single percentage of asphalt to be added to the aggregate and a single temperature at which the mixture is to be delivered at point of discharge. The job-mix formula for each mixture shall be in effect until modified in writing by the Engineer as directed by an independent testing laboratory.

b. Tolerances

The paving mixture as produced shall conform to the job-mix formula within the following range of tolerances:

Passing No. 4 and larger sieves	± 5 percent
Passing No. 10 sieve to No. 100 sieve (incl.)	± 4 percent
Passing No. 200 sieve	± 2 percent
Asphalt Content	± 0.4 percent
Temperatures of mix as discharged from pugmill	± 20° F.

The above variations from the job-mix forumla shall not permit the use of any mix which would be outside of the specification limits through the application of the variations. Should a change in the source of materials be made, a new job-mix formula shall be established before the new material is used. When unsatisfactory results or other conditions make it necessary, the Engineer may establish a new job-mix formula as directed by independent testing laboratory.

c. Sampling and Testing

Sampling and testing shall be done in accordance with ASSHO (T), ASTM (D), or Oklahoma Department of Transportation (OHD) Methods as noted:

(1) Aggregate

Sampling	T 2
Sieve Analysis	T 27
Material passing No. 200 sieve	T 11
Wear (Los Angeles Abrasion)	T 96
Percent Clay Lumps	T 112
Sand Equivalent	T 176
Durability factor (Plastic fines in aggregates)	T 210

(2) Asphalt

Sampling -- Plant Site	T 40
Specific Gravity	T 43
Spot Test	T 102

(3) Mixtures

Mechanical Analysis of extracted aggregate	T 30
Sampling	T 168
Bitumen Content by Centrifuge	D 1097

(4) Mix Design

Bulk Impregnated Sp. Gr. of Aggregates. . . . . OHD L-7
Compacting Materials for Stabilometer Value
(Texas Gyratory) . . . . . OHD L-8
Sp. Gravity and Wt. per C.F. of Compressed
Bituminous Mixture . . . . . T 166
Test for Stabilometer Value (Hveem) . . . . . OHD L-16

4. EQUIPMENT

a. Mixing Plant

All plants used by the Contractor for the preparation of bituminous concrete mixture shall be of sufficient capacity and coordinated to adequately handle the proposed bituminous construction.

(1) Plant Scales

Scales shall be accurate to 0.5 percent of the maximum load that may be required. Poises shall be designed to be locked in any position to prevent unauthorized change of position. In lieu of plant and truck scales, the Contractor may provide an approved automatic printer system which will print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weigh ticket for each load.

Scales shall be inspected and sealed as often as the Engineer may deem necessary to assure their continued accuracy. The Contractor shall have on hand not less than ten (10) fifty (50) pound weights for testing the scales. When necessary to check scales, the checking may be done at times so as to minimize time lost in normal construction operations.

(2) Equipment for Preparation of Bituminous Material

Tanks for the storage of 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 be 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. Provisions shall be made for measuring and sampling storage tanks.

(3) Cold Feed

The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the dryer so that uniform production and uniform temperature will be obtained.

(4) Dryer

A dryer of satisfactory design 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 the specifications without burning or overheating any portion.

(5) Screens

Plant screens, capable of screening all aggregates to the specified sizes and proportions and having normal capacities in excess of the full capacity of the mixer, shall be provided.

(6) Bins

The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates. Separate dry storage shall be provided for filler or hydrated lime when used and the plant shall be equipped to feed such material into the mixer. Each bin shall be provided with overflow pipes, of such size and at such location as to prevent backing up of material into other compartments or bins. Each compartment shall be provided with its individual outlet gate, constructed so that when closed there shall be no leakage. The gates shall cut off quickly and completely.

Bins shall be so constructed that samples can be readily obtained. Bins shall be equipped with adequate tell-tale devices to indicate the position of the aggregates in the bins at the lower quarter points.

(7) 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, weigh buckets, spray bars, and other containers or flow lines.

(8) Thermometric Equipment

An armored continuous recording thermometer of adequate range in temperature reading shall be fixed in the bituminous feed line at a suitable location near the charging valve at the mixer unit.

The plant shall also be equipped with either an approved dial-scale, mercury-actuated thermometer, and electric pyrometer, or other approved thermometric instrument so placed at the discharge chute of the dryer as to register automatically or indicate the temperature of the heated aggregates.

The engineer may require replacement of any thermometer by an approved temperature-recording apparatus for better regulation of the temperature of aggregates.

(9) Dust Collector

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

(10) 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.

(11) Safety Requirements

Adequate and safe stairways to the mixer platform and sampling points shall be provided and guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Accessibility to the top of truck bodies shall be provided at the plant site by a platform or other suitable device to enable the obtaining of samples and mixture temperature data.

A hoist or pulley system shall be provided to raise scale calibration equipment, sampling equipment and other similar equipment from the ground to the mixer platform and return. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected.

Ample and unobstructed space shall be provided on the mixing platform. A clear and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept free from drippings from the mixing platform.

b. Requirements for Batching Plants

(1) Weigh Box or Hopper

The equipment shall include a means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales and of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material is allowed to leak into the mixer while a batch is being weighed.

(2) Bituminous Control

The equipment used to measure the bituminous material shall be accurate to plus or minus 0.5 percent. The bituminous material bucket shall be a non-tilting type with a suitable

cover. The length of the discharge opening or spray bar shall be not less than 3/4 the length of the mixer and it shall discharge directly into the mixer. The bituminous material bucket, its discharge valve or valves and spray bar shall be adequately heated. Steam jackets, if used, shall be efficiently drained and connections shall be so constructed that they will not interfere with the efficient operation of the bituminous scales. The capacity of the bituminous material bucket shall be at least fifteen (15) percent in excess of the weight of bituminous material required in any batch. The plant shall have an adequately heated quick-acting, non-drip, charging valve located directly over the bituminous material bucket.

The indicator dial shall have a capacity of at least fifteen (15) percent in excess of the quantity of bituminous material used in a batch. The controls shall be constructed so that they may be fixed at any dial setting and will automatically reset to that reading after the addition of bituminous material to each batch. The dial shall be in full view of the mixer operator. The flow of bituminous material shall be automatically controlled so that it will begin when the dry mixing period is over. All of the bituminous material required for one batch shall be discharged in not more than fifteen (15) seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of bituminous material the full length of the mixer.

The section of the bituminous line between the charging valve and the spray bar shall be provided with a valve and outlet for checking the meter when a metering device is substituted for a bituminous material bucket.

(3) Mixer

The batch mixer shall be an approved type capable of producing a uniform mixture within the job-mix tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust.

The clearance of blades from all fixed and moving parts shall not exceed one inch unless the maximum diameter of the aggregate in the mix exceeds 1-1/4 inches, in which case the clearance shall not exceed 1-1/2 inches.

(4) Control of Mixing Time

The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh box gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the bituminous material bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods.

The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the start of

introduction of bituminous material. The wet mixing period is the interval of time between the start of introduction of bituminous material and the opening of the mixer gate.

The control of the timing shall be flexible and capable of being set at intervals of five (5) seconds or less throughout a total cycle of up to three (3) minutes. A mechanical batch counter shall be installed as a part of the timing device and shall be so designed as to register only completely mixed batches.

The setting of time intervals shall be performed in the presence and at the direction of the Engineer, who shall then lock the case covering the timing device until such time as a change is made in the timing periods.

c. Additional Requirements for Dryer Drum Mixing Plants.

(1) Aggregate Handling and Proportioning.

The aggregate feeding system shall provide a means for accurately calibrating the material feed for each individual aggregate. A screening unit shall be placed between the aggregate stockpiles and the drum mixer to remove oversized aggregate and roots, clayballs, etc.

Moisture adjustments of the cold aggregate will be taken into consideration before the aggregate is weighed. The cold aggregate shall be weighed by use of a belt scale or other device which will automatically regulate the bituminous feed and permit instant correction of variations in the load. A method and facilities shall be provided for obtaining representative samples of the combined mix of aggregate from the belt at any time during production operations.

(2) Bituminous Control.

The bituminous material shall be introduced through an indicating meter which will accurately measure only the flow of that material. The asphalt pump shall be operated within the rated capacity of the manufacturers recommendation.

A pressure gauge shall be installed between the pump and the meter.

(3) Interlocking Control.

The aggregate feeding system shall be interlocked with the asphalt pump and shall be quick adjusting and shall maintain a constant and uniform flow throughout the range of its calibration.

The interlocking control shall indicate a visual and/or an audible signal when the level of material on any one feeder approaches the strike-off capacity of the fee gate or otherwise fails to feed the proper proportion of aggregate, or the pressure falls on the bituminous supply lines.

(4) Drum Dryer Mixer.

The drum-dryer mixer shall be equipped with automatic burner controls and temperature sensing of the mixture at discharge.

(5) Hot Mix Storage.

The drum mix plant shall be quipped with a surge bin or storage bin conforming to Subsection 411.03(f) of Oklahoma Department of Transportation Specifications.

d. Surge or Storage Bins.

If storage of the hot mix asphalt is required or permitted, the surge or storage bin to be used shall have received prior evaluation and approval by the Engineer.

The evaluation will determine the degree of composition uniformity, temperature characteristics, and degree of asphalt cement hardening of mixture processed through the surge or storage unit. Approval will be granted for bin usage that consistently results in mixture having gradation, temperature and asphalt hardening properties of no lesser quality than acceptable mixtures discharged directly from the plant's mixer. However, a penetration loss in storage of up to ten (10) units will be permitted based on comparative tests (AASHTO T49) of samples obtained from the mixer and bin discharges.

In the event that an approved surge or storage system is changed or altered, the Engineer shall be notified of the modification. Any departure from the approved system will necessitate reevaluation and approval.

The material shall dump directly from the storage facility into trucks through quick opening and closing gates. Significant segregation, damage or cooling of materials, as determined by the Engineer will not be permitted. If the characteristics of the mixture are changed to the extent the material is unsuitable as determined by the Engineer, storage shall be terminated and all unsuitable material disposed of by the Contractor at his expense.

e. Hauling Equipment

Trucks used for hauling bituminous mixtures shall have tight clean, smooth metal beds which have been thinly coated with a minimum amount of release agent which will prevent sticking and will not be harmful to the bituminous mixture. Each truck shall have a cover of canvas or other suitable material of such size as to protect the mixture from the weather. When necessary, so that the mixture will be delivered on the road at the specified temperature, truck beds shall have covers that shall be securely fastened.

f. Distributor

The distributor for applying tack coat and/or prime coat shall be so designed, equipped, maintained and operated that bituminous material at even heat may be applied uniformly on variable width of surface up to 26 feet at readily determined and controlled rates from 0.05-0.5 gallons per square yard, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.03 gallons per square yard.

Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically.

g. Bituminous Pavers

Bituminous pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thicknesses shown on the plans. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of bituminous plant mix material in widths shown on the plans.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture.

When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture.

h. Rolling Equipment

Rollers shall be of the steel wheel and/or pneumatic tire type and shall be in good condition, capable of reversing without backlash, and shall be operated at speeds slow enough to avoid displacement of the bituminous mixture. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. The use of equipment which results in excessive crushing of the aggregate will not be permitted.

5. CONSTRUCTION METHODS

a. Weather Limitations

The minimum air temperature in the shade at which asphaltic concrete may be laid shall be 35^{o} F. if rising or 40^{o} F. if falling. No asphaltic concrete shall be laid when there is frost in the foundation course. When a strong wind is blowing or conditions otherwise are such that the material becomes chilled to an extent which prevents proper leveling and thorough consolidation, the Engineer shall stop the laying of the asphaltic concrete.

b. Preparation of Bituminous Material

The bituminous material shall be heated to 250^{o} to 325^{o} F. in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature at all times.

c. Preparation of Aggregates

The aggregates for the mixture shall be dried and heated to not more than 325^{o} F. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and to avoid soot on the aggregate.

Immediately after heating and drying, the aggregates shall be screened into two or more fractions as specified and conveyed into separate compartments ready for batching and mixing with the bituminous material.

Except for mineral aggregate for use in Type C mixture, the mineral aggregate shall be stored in not less than three (3) bins. Mineral aggregate for use in Type C mixture shall be stored in not less than two (2) bins:

Bin No. 1 shall contain approved aggregate, 85 to 100 percent of which will pass a No. 10 sieve.

Bin No. 2 shall contain approved aggregate, 80 to 100 percent of which will be retained on a No. 10 sieve; no other bin shall contain, in excess of 10 percent, aggregate passing a No. 4 sieve.

Continued variations in excess of these limitations shall be corrected by increasing the amount of screening area or reducing the rate of plant production.

d. Mixing

The dried aggregates shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula.

When batch type mixers are used, the mixture shall be made by first charging the mixer with the mineral aggregates and filler and mixing these dry for a period of from five (5) to twenty (20) seconds after which the asphalt cement shall be added and the mixing continued for a period necessary to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated. Wet mixing time shall be determined by the Engineer for each plant and for each type of aggregate used.

When dryer drum mixers are used, the cold aggregates and bituminous materials in job mix formula proportions shall be introduced into the dryer in a manner approved by the Engineer.

The position and shielding of the burner; the length of the flame; the length, slope, rotational speed and configuration of the dryer; air velocity controls; rate of feed and stack temperature shall be so designed and operated to produce a well-coated homogeneous bituminous mixture meeting the requirements on Page 2B-3 for the type specified.

e. Loading

Precaution shall be taken to prevent segregation of materials in the mixture.

f. Prime Coat

Bituminous material shall not be applied when the temperature is below 50° F. air temperature in the shade, unless otherwise provided, or when weather conditions would otherwise prevent the proper construction of the prime coat.

Before priming, the subgrade, subbase or base shall be cleaned of loose material and shall be in a condition that maximum pentration of the prime will be obtained.

Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform.

continuous spread at the approximate rate of 0.1 to 0.4 gallon per square yard as directed by the Engineer. Emulsified Asphalt shall be applied at a temperature of 50° F to 140° F. When traffic is to be maintained, not more than 1/2 of the width of the section shall be treated in one application. Care shall be taken that the application of bituminous material at the junctions of spreads is not in excess of the specified amount. Excess bituminous material shall be removed from the surface.

When traffic is to be maintained, one-way traffic shall be permitted on the untreated portion of the roadbed. As soon as the bituminous material has been absorbed by the surface and will not pick up, traffic shall be transferred to the treated portion and the remaining width of the section shall be primed.

Succeeding applications of bituminous materials or other courses shall not be applied until after sufficient time has elapsed to allow both proper penetration and hardening of the prime coat.

If, after the application of the prime coat, the bituminous material fails to penetrate within the time specified and the roadway must be used by traffic, blotter material shall be spread in the amounts required to absorb any excess bituminous material.

g. Tack Coat

The existing surface shall be thoroughly cleaned and be dry before the tack coat is applied. The tack coat shall be applied as directed by the Engineer, with an approved distributor or spray equipment at a rate not to exceed 0.10 gallons per square yard of surface. All contact surfaces of curbs and gutters, manholes, and other structures shall be painted with a thin uniform coating of the approved tack coat material.

The tack coat shall be applied in such a manner as to offer the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the bituminous material.

The tack coat shall not be applied during wet or cold weather, after sunset, or to a wet surface. The quantity, rate of application, temperature and areas to be approved by the Engineer before application of the tack coat.

h. Spreading and Finishing

The asphalt mixture shall be laid at a temperature of from 225° to 300° F. and only upon an approved base which is dry. Bituminous Base (Fine Aggregate) shall be laid at a temperature of 180° F. to 300° F. The mixture shall be delivered on the job at a minimum workable temperature which will produce the density herein specified after final compaction. After the minimum workable temperature is determined, it shall not vary more than plus or minus 20° F.

The alignment of one edge of the asphalt mixture shall be established by a string or wire line in advance of the placing of the asphalt mixture.

The asphalt mixture shall be spread by means of a mechanical self-powered paver, capable of spreading the mixture true to the line, grade, and crown set by the Engineer.

The longitudinal joint in one layer shall offset that in the layer immediately below by approximately six (6) inches; however, the joint in the top layer shall be at the center line of the pavement if the roadway comprises two (2) lanes in width, or at lane lines if the roadway is more than two (2) lanes in width.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked and luted by hand tools. For such areas, the mixture shall be dumped, spread and screeded to give the required compacted thickness.

When production of the mixture can be maintained and when practical, pavers shall be used in echelon to place the wearing course in adjacent lanes.

Placing of mixtures 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 mixtures to become chilled.

In placing a leveling course with the spreading and finishing machine, binder cord or twine shall be set to line and grade established by the Engineer. When directed by the Engineer, leveling may be spread with an approved motor grader.

Immediately adjacent to curbings, gutters, manholes, and other structures, the wearing course mixture shall be spread uniformly high so that after compaction it will be approximately 1/4 inch above the edges of such structures.

i. Joints

Longitudinal and transverse joints shall be staggered approximately six (6) inches and made in a careful manner. Well bonded and sealed joints are required. Joints between old and new pavements or between successive day's work, shall be carefully made in such a manner as to insure a thorough and continuous bond between the old and new surfaces. The edge of the previously laid course shall be cut back to its full depth so as to expose a fresh surface, after which the edge shall be painted with a tack coat and the hot mixture shall be placed in contact with it and raked to a proper depth and grade. Before placing mixture against them, all contact surfaces of curbs, gutters, headers, manholes, etc., shall be cleaned and painted with a thin uniform tack coat of a type specified herein.

In making the joint along any adjoining edge such as curb, gutter, or an adjoining pavement, and after the hot mixture is placed by the finishing machine, just enough of the hot material shall be carried back to fill any space left open. This joint shall be properly "set-up" with the back of rake to proper height and bevel to receive the maximum compression under rolling. The work of "setting-up" this joint shall be performed always by competent workmen, who are capable of making a correct, clean and neat joint.

Transverse or longitudinal joints accumulating mud, dust or other foreign matter shall be trimmed back to the satisfaction of the Engineer so that a proper bond of asphaltic concrete will be obtained at all joints.

j. Compaction

Immediately after the bituminous mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling.

The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving.

The number, weight and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The sequence of rolling operations and the selection of roller types shall provide the specified pavement density.

Unless otherwise directed, rolling shall begin at the sides and proceed longtitudinally parallel to the road center line, each trip overlapping one-half the roller width, gradually progressing to the crown of the road. When paving in echelon or abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. On superelevated curves, the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the center line.

Self-propelled pneumatic tired rollers shall be used following the initial rolling with steel wheel roller and before finish rolling with steel wheel roller. During rolling operations, the pneumatic tired roller shall weigh not less than ten (10) tons, with tire pressure (cold inflation) of not less than 60 p.s.i. The tire pressure in individual tires shall not vary by more than ten (10) pounds. The course shall be rolled a minimum of five (5) coverages with pneumatic tired roller unless the required density is obtained with less coverages.

When vibratory rollers are used and the contractor demonstrates that he can achieve the required compaction, the use of pneumatic rollers may be waived by the Engineer.

Rollers shall move at a slow but uniform speed with the drive roll or wheels nearest the paver. Rolling shall be continued until all roller marks are eliminated and a minimum density of 95 percent of a laboratory compacted density has been obtained.

The Contractor shall cut test samples from the pavement by sawing or coring at locations directed by the Engineer. The cost of cutting samples and placing new material and finishing satisfactorily areas where samples have been taken will be included in the price bid for the mixture in place.

Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture when required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture.

To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted.

Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons or with mechanical tampers. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency or bituminous material shall be removed and replaced.

k. Tolerances

In order to provide a surface course or courses of acceptable smoothness, width and thickness, reasonably accurate control shall be maintained in placing, spreading, finishing and compacting of surface courses. The Contractor shall use equipment as may be required to provide acceptable construction within the prescribed tolerances.

SURFACE TYPE	TOLERANCES	
	SURFACE	THICKNESS
Dense Graded Bituminous Surface	3/16" in 10'	Reasonable conformity with plans
Asphalt Surface (Hot Mix-Cold Laid)	3/16" in 10'	Same
Plant Mix Asphaltic Concrete Pavement	3/6" in 10'	Same

Testing with a ten (10) foot straightedge or other approved device for compliance with specified surface tolerances will be done by the Engineer at selected locations. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall at no point exceed the specified tolerance. Humps or depressions exceeding the specified tolerance shall be corrected in an acceptable manner.

Testing for thickness tolerance will be in accordance with the method specified under the section where this test is applicable.

DIVISION 2C

LIME TREATED SUBGRADE

1. SCOPE

This work shall consist of constructing one or more lime stabilized subgrade courses by mixing soil, lime and water in accordance with these specifications and in conformity with the lines, grades, depths and typical cross sections shown on the plans or as determined by the Engineer. The work will include scarification and pulverization, lime application, mixing and watering, compaction, curing and any other necessary manipulations of the subgrade required by the Engineer to complete the required work.

2. MATERIAL

All materials used shall conform to the following requirements:

a. Lime

All lime used in the work shall be QUICK LIME for stabilization purposes. QUICK LIME shall consist of calcium oxide or calcium oxide in natural association with a lesser amount of magnesium oxide capable of slaking with water.

When tested under the appropriate sections of ASTM C-25, the available lime index expressed as CaO shall be not less than ninety percent (90%).

When tested in accordance with ASTM C-110, the percent passing No. 200 sieve shall be ninety percent (90%) or more.

b. Water

All water used in mixing or curing lime treated subgrade shall be clean and practically free from oil, salt, acid, alkali, organic matter or other substances injurious to the finished product.

Water from doubtful sources will be tested in accordance with AASHTO T26 prior to use and is subject to approval by the Engineer.

Water from City water supply may be used without being tested.

c. Soil

All soil to be treated with quick lime will conform to the following:

(1) In cut areas, the existing soil will be treated in place in accordance with the plans and these specifications.

(2) Fill material for roadway embankment shall have a plasticity index not greater than 30.

3. EQUIPMENT

All equipment used shall be suitable and adequate for the work and shall be approved by the Engineer. Grader-scarifier, disc harrow and rotary mixer may be used for pulverizing the soil. When the soil is unusually dry, water shall be added to aid pulverization. If extremely wet, the rotary mixer or disc harrow should be used for aerating and drying out the soil, particularly highly plastic clays. Motor graders may be used for shaping the stabilized course. Compacting to obtain the required density shall be performed with sheepsfoot, pneumatic and steel wheel rollers as necessary.

4. CONSTRUCTION METHODS

It is the primary requirement of these Specifications to secure a completed course of treated material containing a uniform lime mixture, 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. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime, maintain the work, and rework the courses as necessary to meet the above requirements.

a. Weather Limitations

Dry quick lime shall not be applied unless the temperature is at least 30°F. (-1.4°C) and rising. The Contractor shall be responsible for the protection and quality of the lime treated subgrade under any weather conditions.

b. Subgrade Preparation

Prior to beginning any lime treatment, 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 Contractor shall be required to roll the subgrade, as directed by the Engineer, and correct any soft areas that this rolling may reveal.

c. Scarifying and Loosening

Scarifying and loosening may be required prior to the application of lime to achieve the desired results as determined by the Engineer. Precautions shall be taken to avoid forming furrows of loosened material below the depth specified for the bottom of the treated subgrade. Except by special permission from the Engineer, the length of roadway scarified and loosened at anytime shall not exceed the length in which the first mixing (paragraph 5.1) can be completed in two (2) calendar days.

d. Application of Lime

The proportion of lime indicated on the plans is approximate.

Lime shall be applied at the rate as prescribed by the Engineer, based on tests of the subgrade soil. Equipment necessary for proper control of application rate of the lime shall be provided by the Contractor. Where tests indicate a significant change in the subgrade soil, the Engineer will establish a new rate as deemed necessary for the section of road affected and at the time of placing and spreading the lime will advise the Contractor of the final rate for the said section.

Lime shall not be applied when wind conditions are such that the blowing lime becomes objectionable to traffic and adjacent property owners.

When lime is applied to the soil ahead of the mixing plant, the lime shall be placed only on that area where the first mixing operations can be completed during the same working day. During the interval of time between application and mixing, lime that has been exposed to the open air for a period of six (6) hours or more, or to excessive loss due to washing or blowing, may not be accepted for payment.

The equipment for spreading quick lime shall be approved type which shall demonstrate its ability to distribute the lime at controlled amounts uniformly.

5. MIXING AND WATERING

Mixing and watering shall be accomplished in two stages: First mixing and Final mixing as herein described.

a. First Mixing

The soil, lime and water shall be mixed until a uniform mixture is obtained in which all clods and non-aggregate lumps are reduced to a maximum of 2.5 inch diameter size. The quantity of water necessary for the first mixing operation will vary with the nature of the material, normally 3 to 5 percentage points above the optimum moisture content of the compacted treated soil. Sufficient water shall be added in the first mixing process to insure proper chemical action between the lime and soil. When proper mixing has been accomplished, the mixture shall be left to cure. Curing time for quick lime shall be 48 hours of temperatures above 32^{o}F. During the curing period the material shall be maintained in a moist condition.

It will be permissible to seal the surface of the modified area by light rolling to the extent that the surface will repel water and contain the moisture below, provided that the material is evenly distributed in the roadway.

When deemed necessary by the Engineer, any portion of the area under modification shall be rescarified for additional sprinkling to insure proper moisture for curing.

b. Final Mixing

After the required curing time, the material shall be uniformly mixed by approved methods. All clods shall be reduced in size until the soil-lime mixture meets the following requirements when tested dry by laboratory sieves:

Mimimum passing 1.5 inch	100%
Minimum passing No. 4 sieve	60%

Fill areas shall be constructed to not more than two (2) feet courses and treated. Lime treatment may be accomplished by adding and mixing the amount of lime as required on the Plans to each six (6) inch lift during normal fill construction or by completing a two foot (2') depth of fill to the typical section shown on the Plans and then adding lime in the required amount for the two (2) feet of fill.

On each properly compacted 2 foot course, the initial mixing shall be considered the final and only mixing necessary.

Within two hours after spreading quick lime and before water is added, approved means will be used to turn under a significant portion of the quick lime to reduce harmful exposure to the heat of hydration. (Caution - uncovered quick lime may be hazardous when in the presence of moisture). Sufficient water shall be added within 6 hours after spreading to permit hydration of the quick lime.

6. COMPACTION

Compaction of the mixture shall be accomplished during the same day as the final mixing, unless approval is obtained from the Engineer to continue compaction on the following day. The target density shall be determined in the field by the soil-lime mixture obtained from the roadway when compaction is started. The test method for the target density will be AASHO T99, method C or D to provide one compacted specimen of the soil-lime mixture as obtained from the roadway, and separate portions of the sample used for additional specimens with the moisture reduced or increased. The material shall be aerated or sprinkled as necessary to provide the optimum moisture, within plus or minus 2 percentage points. Compaction shall continue until the entire depth of mixture is uniformly compacted to not less than 100 percent of the target density. Field density will be determined in accordance with AASHO T205.

Depths of 2 ft. compacted thickness may be compacted in one operation. The material shall be sprinkled or dried as necessary to provide the moisture for proper compaction. Compaction shall continue until the entire depth of mixture is compacted to a satisfactory

condition as demonstrated by test rolling as directed by the Engineer, with the further requirement that the top six inches (6") of the uppermost course be compacted to not less than 100 percent of the target density established in accordance with the paragraph above.

The material shall be sprinkled and rolled. All irregularities, depressions, or weak spots, which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required, and reshaping and recompacting by sprinkling and rolling.

In addition to the requirements specified for density, the full depth of the material shown on the Plans shall be uniformly compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests as necessary will be made by the Engineer. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation the shape of the course shall be maintained and the surface upon completion shall be smooth and in conformity with the typical sections shown on the Plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density, or finish before the next course is placed or the work is accepted, it shall be recompacted and refinished at the sole expense of the Contractor.

7. FINISHING AND CURING

After each layer or course of the lime treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by rolling as directed with a pneumatic tire or other suitable roller sufficiently light to prevent hair cracking. The completed section shall be moist-cured for a minimum of seven (7) days before further courses are added or any traffic is permitted, unless otherwise directed by the Engineer. In cases where subgrade treatment or subbase sets up sufficiently to prevent objectionable damage from traffic, such layers may be opened to traffic two (2) days after compaction.

The uppermost course of lime treated subgrade shall be moist-cured for a minimum of 14 days or sealed with one (1) shot of cutback asphalt, MC-70, at a rate of 0.25 gal/sq. yd. within one day after final rolling has been accomplished.

The finished subgrade will be allowed to cure undisturbed for a period of seven (7) days prior to pavement surface being constructed.

8. TOLERANCE

a. Surface Requirements

For the purpose of testing the finished surface, a ten (10) foot straightedge shall be available on the site. Any variation in excess

of 1/4 inch, when tested with the ten (10) foot straightedge shall be immediately corrected by loosening the surface material, as the case may require, after which it shall be sprinkled and recompacted to true grade, as required for new work.

b. Thickness

The thickness of the course shall not be deficient by more than 1/2 inch anywhere and the average thickness shall be at least as much as that indicated.

DIVISION 2D

CONCRETE: PAVEMENT AND STRUCTURES

1. SCOPE

This section covers the construction of concrete pavement and appurtenant concrete structures including materials, construction methods, test requirements, allowable tolerances, replacement or correction of defective work, required to complete the construction of the work which shall conform to the lines, grades, thickness and cross sections shown on the drawings.

2. MATERIALS

All materials used shall conform to the following requirements:

a. Cement

All cement used in the work shall be a standard branch of Portland Cement and shall comply with the cement A.S.T.M. C150 Standard Specifications for Air-Entraining Portland Cement. The cement shall be Type I or IA as required. High-Early strength cement Type III shall be used where required, or may be used at the option of the Contractor subject to approval of the Engineer.

All cement hauled to the job shall be in original unopened containers, bags or sacks showing the brand name of manufacturer. Only one brand of cement shall be used in any individual structure. Cement reclaimed by cleaning bags or cement that has leaked from containers shall not be used. Cement shall be used in the sequence of shipments received, unless otherwise directed.

Different brands, grade or types of cement must be stored separately. All cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment, in a suitable weather-tight building that will protect it from dampness and deterioration. Packages of cement which for any reason have become partially set, or which contain any lumps or caked cement shall be rejected; and in no instance will any portion of a bag of damaged or faulty cement be used.

The Contractor will, upon demand, furnish the Engineer with the results of mill tests and the manufacturer's certification of compliance with the specifications.

b. Aggregate

All aggregates used shall conform to the requirements of ASTM C33 Specifications for Concrete Aggregate unless otherwise indicated on the drawings or directed by the Engineer. Aggregate shall be classified and separated into Fine Aggregate and Coarse Aggregate as defined below:

(1) Fine Aggregate

Fine aggregate for concrete and mortar shall be sand composed of clean, hard, durable, uncoated grains, free from conglomarate, soft or flakey particles, salt, alkali or loam. Fine aggregate shall be free from injurious organic impurities, deleterious substances and in no case will aggregate containing lumps or frozen materials be used. The aggregate shall be well graded from coarse to fine and shall conform to the following laboratory sieve analysis:

FINE AGGREGATE

Sieve Size	Percent Passing
3/8 Inch	100%
No. 4	95-100%
No. 16	45-85%
No. 50	5-30%
No. 100	0-7%

MORTAR SAND

Sieve Size	Percent Passing
No. 8	100%
No. 50	15-40%
No. 100	0-10%

Stone screening will not be used for fine aggregate.

(2) Coarse Aggregate

Coarse aggregate for Portland cement concrete shall be crushed stone obtained from clean, tough, hard, sound, durable rock consisting of angular fragments of uniform quality throughout, or gravel consisting of clean, tough, durable pebbles, free from clay, coatings of any character, disintegrated or soft pieces, conglomerates, mud balls, sticks, salt, alkali, or vegetable matter. Coarse aggregate shall be free of injurious deleterious substances and shall be well graded from coarse to fine conforming to the following laboratory sieve analysis:

PAVEMENT AND BASE COURSES

Sieve Size	Percent Passing
2 1/2 inch	100%
2 inch	95-100%
1 1/2 inch	70-95%
1 inch	50-85%
No. 4	0-5%

CLASS A, AA, A (AF) AND AA (AE) CONCRETE

Sieve Size	Percent Passing
1 1/2 inch	100%
1 inch	90-100%
1/2 inch	25-60%
No. 4	0-5%

CLASS B, C, B (AE), C (AE) CONCRETE

Sieve Size	Percent Passing
2 inches	100%
1 inch	40-75%
No. 4	0-5%

THIN SECTION CONCRETE

Sieve Size	Percent Passing
3/4 inch	100%
3/8 inch	40-75%
No. 4	0-5%

(3) Sampling and Testing

Sampling and testing shall be in accordance with the latest revision of the AASHO Methods.

Sampling	T-2
Sieve Analysis	T-27
Material Passing No. 200	T-11
Organic Impurities	T-21
Clay, Lumps and Friable Particles	T-112 Modified
Coal and Lignite	T-113
Mortar Tensile Strength	G-35

(4) Aggregate Storage

Aggregate shall be stored in a manner that will allow good drainage and will insure that the aggregate is kept free of foreign matter. Sites for stock piles shall be graded and cleaned prior to storing materials. Care shall be taken to prevent segregation; material which becomes segregated to the extent that it no longer satisfies the grading requirements shall be combined to satisfy such requirements before being used in concrete.

c. Water

Water used in mixing concrete shall be clean, clear and free from deleterious amounts of acids, alkalis, oil, salt, organic materials or any other substances injurious to the finished concrete.

Water from city water supply may be accepted without being tested. Water from doubtful sources shall not be used until tested and approved. Testing of water shall be in accordance with AASHO Method T-26.

d. Air-entraining Agents

Air-entrained concrete shall be used where specified and may be used in all concrete work at the option of the Contractor subject to approval by the Engineer. Either an air-entraining cement produced at the mill or an air-entraining agent added at the batching plant may be used. When necessary to increase the air content of a mill-produced air-entraining cement concrete, additional air-entraining admixture identical with that already in the cement shall be added at the plant. Air-entraining admixtures shall conform to ASTM Specifications C-260.

e. Other Admixtures

Other admixtures, unless specifically called for shall be used only with the written notification of the Engineer, and shall be used in accordance with the manufacturer's instructions and recommendations.

f. Reinforcing Steel

All reinforcing bars shall be rolled from new billets and shall conform to the A.S.T.M. A615 Specifications for Billet-Steel Bars for Concrete Reinforcement and shall be of the grade specified for the particular class of work involved. Unless otherwise shown, all reinforcing bars shall be deformed and shall conform to the requirements of the A.S.T.M. A615 Specifications for Minimum Reinforcement. The deformed bars used shall have a net sectional area at all points equivalent to that of plain bars of equal nominal size. Twisted steel bars shall not be used.

Welded wire fabric shall conform to the requirements of the A.S.T.M. A185 Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement.

3. CLASSIFICATION, STRENGTH REQUIREMENTS AND PROPORTIONS

All concrete shall be of the strength or classification specified and/or shown in the plans. When the classification or strength is not expressly indicated, the concrete shall be Class A, or better.

High Early Strength-Paving Mix concrete shall contain not more than five and one-half (5 1/2) gallons of water to the sack of cement, including the water in the aggregates with four percent (4%) to six percent (6%) air, and have a twenty-eight (28) day compressive strength of at least 4,000 psi. All pavement and other concrete shall be Standard Paving Mix concrete unless specified herein or shown on the plans.

Standard Paving Mix concrete shall contain not more than six (6) gallons of water to the sack of cement, including the water in the aggregates, with four percent (4%) to six percent (6%) air and have a twenty-eight (28) day strength of at least 3,500 psi. All pavement or other concrete shall be Class A concrete unless specified herein or shown on the plans.

The exact proportions of the ingredients shall be determined by trial batches, to secure a maximum density plastic mix of satisfactory workability acceptable to the Engineer. The slump shall be not less than two (2) nor more than three (3) inches for vibrated concrete, with the exception of concrete for thin reinforced walls and other narrow vertical sections in which case the slump shall be not less than three (3) inches nor more than four (4) inches. The proportions shall be such as will produce a mixture readily workable into the corners and angles of the forms, and around reinforcement, but without permitting the materials to segregate or free water to collect on the surface.

4. READY-MIXED CONCRETE

Ready-mixed concrete may be used from an approved source. Ready-mixed concrete shall conform to the latest A.S.T.M. Specifications C94 for Ready-mixed concrete. Other requirements shall be the same as for site-mixed concrete. The concrete shall be deposited within ninety (90) minutes after mixing.

5. BATCHING AND MIXING

The methods of measuring concrete materials shall be such that the proportions can be accurately controlled and easily checked at any time during the work. The aggregate shall be measured by weights,corrected for moisture content of the aggregate. All materials entering the mix shall be determined by using the absolute volume method. When cement is not weighed, the quantities of aggregate for each batch shall be exactly sufficient for one or more full bags of cement. Proportioning aggregate for fractional sacks will not be permitted. Bulk cement shall be weighed on a separate scale; water may be measured by weight or by volume.

The concrete shall be mixed in a batch mixer of approved type and capacity for a minimum of one and one-half (1 1/2) minutes after all materials are in the mixer. The mixer shall be rotated at a speed recommended by the manufacturer; in no case shall the rated capacity of the mixer be exceeded by more than ten (10) percent.

6. PAVING

a. Forming

Forms shall be of such cross-section and strength and so secured as to resist the pressure of the concrete when placed and the impact and vibration of any equipment which they support, without springing or settlement. The method of connection between sections shall be such that the joints shall not move in any direction. The maximum deviation of the top surface shall not exceed one-eighth (1/8) inch in ten (10) feet or the inside face not more than one-fourth (1/4) inch in ten (10) feet from a straight line.

The subgrade under the forms shall be compacted and cut to grade so the form when set will be uniformly supported for its entire length at the specified elevation. The supply of forms shall be sufficient to permit their remaining in place for at least twelve (12) hours after the concrete has been placed. All forms shall be cleaned and oiled each time they are used.

The Contractor shall check and correct alignment and grade elevations of the forms immediately before placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

All forms used shall be inspected and approved by the Engineer prior to beginning of construction. Forms determined to be unsatisfactory for use by the Engineer shall be removed from the site.

b. Reinforcing Steel

The Contractor shall submit to the Engineer four (4) copies of detailed shop drawings showing the layouts, sizes and arrangements of reinforcing steel proposed for the work, and shall not commence fabrication of the reinforcement until he receives written approval of the shop drawings submitted.

Reinforcing steel shall be fabricated in accordance with the applicable Concrete Reinforcing Steel Institute and the American Concrete Institute Standards.

Reinforcing steel shall be accurately positioned to the dimensions indicated on the plans. Concrete cover, bar spacing, splices and other details shall conform to the requirements of the American Concrete Institute ACI-318 Building Code Requirements for Reinforced Concrete unless otherwise indicated.

All reinforcing shall be completely clean of mud, clay, ice, grease, oil, loose rust and scale of any substance whatsoever which would reduce or destroy the bond. Reinforcing bars reduced in section, damaged by bending, or with kinks and bends not required in the design, shall not be used. Reinforcement will be accurately placed and securely tied at all intersections and spliced with eighteen (18) gauge black annealed wire, and shall be securely held in position during the placing of concrete by

spacers, chairs, or other approved supports. Wire-tie ends shall point away from the form faces. Unless otherwise indicated, the number, type and spacing of supports shall conform to the American Concrete Institute ACI-315 Detailing Manual. The use of blocks, rocks, bricks, or any other unapproved method of supporting reinforcing will not be permitted.

c. Placing and Finishing

The concrete shall be deposited on the grade in such manner as to require as little rehandling as possible. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. The vibrator shall never be operated longer than 15 seconds in any one location.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped onto a joint assembly.

The pavement shall be struck off and consolidated with a mechanical finishing machine, vibrating screed, or by handfinishing methods when approved by the Engineer.

In general, adding water to the surface of the concrete to assist in finishing operations shall not be permitted. If it is permitted, it shall be applied as a fog spray with approved spray equipment.

After the pavement has been struck off and consolidated, it shall be scraped with a straightedge ten (10) feet long equipped with a handle to permit operation from the edge of the pavement. Any excess water and laitance shall be removed from one surface of the pavement. The straightedge shall be operated parallel to the centerline of the pavement and shall be moved forward one-half its length after each pass. Irregularities shall be corrected by adding or removing concrete. All disturbed places shall be again straightedged. The use of longhandled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment.

Before final finishing is complete and before the concrete has taken its initial set, the edges of the slab and curb shall be carefully finished with an edger of the radius shown on the plans.

A burlap drag belt or coarse broom shall be used for final finishing. The drag shall be at least three (3) feet wide and the belt shall be at least eight inches (8") wide and each long enough to cover the entire pavement width. It shall be kept clean and saturated while in use. It shall be laid on the pavement surface and dragged in the direction in which the pavement is being placed.

Concrete curbs shall be required along the edges of all street pavement where shown on the drawings. Curbs shall be formed simultaneously with the pavement with extrusion equipment or shall be extruded separately. If curbs are extruded separately, the Contractor shall demonstrate that he can construct a suitable curb. Curbs shall be doweled to the pavement with No. 4 reinforcing bars eight inches (8") long on eighteen inch (18") centers.

The drainage at the gutter shall be checked while the concrete is still plastic with a straightedge ten (10) feet in length. Necessary corrections shall be made at this time, and the curb shall then be given a textured finish to match the pavement.

The Contractor shall have always available materials to protect the surface of the plastic concrete against rain. These materials shall consist of burlap, cotton mats, curing paper, or plastic sheeting.

No concrete shall be placed unless an inspector has been notified.

d. Curing

Concrete shall be cured by protecting it against loss of moisture, rapid temperature change, and mechanical injury for at least three (3) days after placement. Moist curing, waterproof paper, white polyethylene sheeting; white liquid membrane compound, or a combination thereof may be used. After finishing operations have been completed, the entire surface of the newly placed concrete shall be covered by whatever curing medium is applicable to local conditions and approved by the Engineer. The edges of concrete slabs exposed by the removal of forms shall be protected immediately to provide these surfaces with continuous curing treatment equal to the method selected for curing the slab and curb surface. Leaving forms in place as a method of curing will not be permitted.

The Contractor shall have the equipment needed for adequate curing at hand and ready to install before actual concrete placement begins. If the curing medium requires the use of water, the curing shall have prior right to a water supply.

Moist curing shall be accomplished by a covering of burlap or other approved fabric mat used singly or in combination. Curing mats shall be thoroughly wet when applied and kept continuously wet and in intimate contact with the pavement surface for the duration of the moist curing period. Burlap or fabric mats shall be long enough to cover the entire width and edges of the pavement and lapped at joints to prevent drying between adjacent sheets.

Waterproof paper or white polyethylene sheet shall be in pieces large enough to cover the entire width and edges of the slab and shall be lapped not less than twelve inches (12"). The paper or polyethylene shall be adequately weighted to prevent displacement or billowing due to wind, and material folded down over the side of the pavement edges shall be secured by a continuous bank of earth. Tears or holes appearing in the paper or polyethylene during the curing period shall be immediately repaired.

Membrane curing shall be applied behind the final finishing operation after all free water has disappeared from the surface. Complete and uniform coverage at the required rate of two hundred (200) square feet per gallon shall be required. The compound shall be kept agitated to prevent the pigment from settling, and it shall be applied to the pavement edges immediately after the forms have been removed. Membrane curing will not be permitted in frost affected areas on paving that will be exposed to deicing chemicals within thirty (30) days after completion of the curing period. Membrane curing compounds to be used shall conform to Section 2D-18.

No concrete shall be placed when the air temperature is at or below thirty-five (35) degrees Fahrenheit, nor when concrete without special protection is liable to be subjected to freezing temperature before final set has occurred. Any concrete damaged by freezing shall be removed and replaced at the expense of the Contractor. No concrete shall be placed when the temperature of the concrete is above ninety (90) degrees Fahrenheit at the truck.

e. Joints

Construction joints, expansion joints, and all longitudinal joints shall be placed as indicated on the plans. Transverse construction joints shall be used as required. Transverse joints shall extend continuously through the pavement and curb.

Transverse contraction joints shall consist of planes of weakness created by forming or cutting grooves in the surface of the pavement. They shall be equal to at least one-fourth the depth of the slab.

(1) Transverse Strip Contraction Joints

Transverse strip contraction joints shall be formed by installing a parting strip to be left in place.

(2) Formed Grooves

Formed grooves shall be made by depressing an approved tool or device into the plastic concrete. The tool or device shall remain in place until the concrete has attained its initial set and shall then be removed without disturbing adjacent concrete.

(3) Sawed Contraction Joints

Sawed contraction joints shall be created by sawing grooves in the surface of the pavement with an approved concrete saw. After each joint is sawed, the saw cut and the adjacent concrete surface shall be thoroughly cleaned.

Sawing of the joints shall begin as soon as the concrete has hardened sufficiently to permit sawing with-

out excessive raveling, usually four (4) to twenty-four (24) hours. All joints shall be sawed before uncontrolled shrinkage cracking occurs. If necessary, the sawing operations shall be carried on both day and night, regardless of weather conditions. A standby saw shall be available in the event of breakdown.

The sawing of any joint shall be omitted if a crack occurs at or near the joint location before the time of sawing. In general, all joints shall be sawed in sequence. All construction joints in lanes adjacent to previously constructed lanes shall be sawed before uncontrolled cracking occurs. If extreme conditions make it impracticable to prevent erratic craking by early sawing, the contraction joint groove shall be formed before initial set of concrete as provided above.

(4) Transverse Formed Contraction Joints

Transverse formed contraction joints shall consist of a groove or cleft extending downward from and normal to the surface of the pavement. These joints shall be made while the concrete is plastic by an approved mechanically or manually operated device to the dimensions indicated on the plans.

(5) Transverse Construction Joints

Transverse construction joints of the type shown on the plans shall be placed whenever the placing of concrete is suspended for more than thirty (30) minutes. A butt joint with dowels or a thickened-edge keyed joint shall be used if the joint occurs at the location of a contraction joint. Keyed joints with tiebars shall be used if the joint occurs at any other location.

(6) Transverse Expansion Joints

For transverse expansion joints, the expansion joint filler shall be continuous from form to form, shaped to the subgrade, curb section, 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 unless approved by the Engineer.

(7) Expansion Joint Filler

The expansion joint filler shall be in a vertical position. An approved installing bar or other device shall be used if necessary to ensure proper grade and alignment during placing and finishing of the concrete. Finishing joints shall not deviate in horizontal alignment

more than one-fourth (1/4) inch 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. Expansion joint filler shall conform to Section 2D-20.

(8) Dowels

Dowels shall be of the dimension and at the location indicated on the plans. They shall be firmly supported in place, accurately aligned parallel to the pavement grade and centerline by means of a shop fabricated support, which will remain in the pavement and will insure that the dowels are not displaced during construction. One-half of each dowel shall be painted and greased and in an expansion joint, one end shall be equipped with a tight-fitting sleeve of the dimensions shown on the plans.

(9) Longitudinal Center Joints

Longitudinal center joints shall consist of planes of weakness created by forming or cutting grooves in the surface of the pavement. They shall be equal to at least one-quarter (1/4) the depth of the slab plus one-quarter (1/4) inch.

(10) Sawed Longitudinal Center Joints

Sawed longitudinal center joints shall be sawed grooves made with a concrete saw after the concrete has hardened. The joint may be sawed at any time before use by construction traffic or before opening if construction traffic does not use the pavement.

(11) Longitudinal Dummy Groove Joints

Longitudinal dummy groove joints are formed in the same manner as transverse formed groove joints.

(12) Longitudinal Strip Joints

Longitudinal strip joints are formed in the same manner as transverse strip joints.

(13) Longitudinal Construction Joints

Longitudinal construction joints shall be of the dimensions shown on the plans. Where a key is required, it shall be constructed by forming when the first lane adjacent to the joint is placed. These joints shall be

finished with an edger of the radius shown on the plans. When placing the second slab, concrete must not be left overhanging the lip formed in the first slab by the edging tool.

(14) Joints to be Sealed

Joints to be sealed shall be filled with joint-sealing material before the pavement is opened to traffic and as soon after completion of the curing period as is feasible. Just before sealing, each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound, and the joint faces shall be clean and surface-dry when the seal is applied. Material for seal applied hot shall be stirred during heating to prevent localized overheating.

(15) Sealing Material

The sealing material shall be applied to each joint opening in accordance with the details shown on the plans or as directed by the Engineer. The joint filling shall be done without spilling material on the exposed surfaces of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned. The use of sand or similar material to cover the seal shall not be permitted. Joint-sealing material shall not be placed when the air temperature in the shade is less than 50 degrees Fahrenheit, unless approved by the Engineer. Joint sealing material shall conform to Section 2D-23.

f. Tolerance in Pavement Thickness

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 following rules relative to core drilling pavement shall govern. All pavement shall be cored and measured for thickness before being accepted as hereinafter provided.

(1) Core Drilling Pavement

At such points as the Engineer may select in each block or at points not in excess of five hundred (500) feet apart, a core shall be made. Paving placed in strips or lanes will be considered a separate unit and will be tested individually as outlined above.

Should any core show a deficiency of more than one-fourth (1/4) inch, but less than one-half (1/2) inch, additional cores shall be taken each way in the lane from the deficient core at intervals until the average thickness between any two adjacent cores is not more than one-fourth (1/4) inch deficient. When the measurement of any core indicates a deficiency of more than one-half (1/2) inch, additional cores will be taken each way from such core

on a line parallel with the centerline of the lane until a core is obtained, in each direction, the height of which indicates a deficiency of less than one-half (1/2) inch.

The cost in connection with core drilling the pavement, refilling the core holes with concrete and testing the cores will be borne by the Contractor.

(2) Tolerance in Pavement Thickness

Pavement with an average thickness equal, within one-fourth (1/4) inch, to the required thickness will be paid for at the contract unit price. For pavement with thickness less than the thickness shown on the plans by more than one-fourth (1/4) inch, but less than one-half (1/2) inch, an adjusted unit price will be used in payment. The proportional part of the contract unit price for payment will be seventy-five (75) percent of the ratio of the average thickness of the pavement to the thickness specified on the plans.

If, in the opinion of the Engineer, a deficiency in slab thickness of one-half (1/2) inch or more is sufficient to impair seriously the service of the pavement, the Contractor will be required to remove and replace such pavement at the expense of the Contractor. If, in the opinion of the Engineer, there will be no probability of immediate failure, he may allow the Contractor the choice of leaving the defective slab in place and receiving no compensation, or payment for such pavement as provided.

g. Surface Tolerances and Test

In order to provide a riding surface of acceptable smoothness, reasonably accurate control should be maintained in place, spreading, consolidating and finishing the concrete pavement. The Contractor shall use equipment as may be required to provide a surface tolerance, not to exceed those listed below.

As soon as the concrete has hardened sufficiently to permit foot traffic, the pavement shall be tested with a 10-foot straightedge or other Engineer approved device for compliance with permissible tolerances.

Areas which exceed the acceptable tolerance, shall be corrected as directed by the Engineer, and the cost of such corrective measures as may be required shall be borne by the Contractor. Areas showing high spots may be ground by approved grinding tools, if in the opinion of the Engineer the surface can be restored to an acceptable tolerance.

If so directed by the Engineer, defective payment shall be replaced as required to correct such defects and of such an area as may be required to conform to the paving plan.

Roadway width 29' Bk-Bk or less.....3/16 inch in 10 feet

Roadway widths more than 29' Bk-Bk....1/8 inch in 10 feet

h. Replacement of Defective Pavement During Construction and Maintenance Period

When so directed by the Engineer, the Contractor shall replace pavement which is not in accordance with the plans and specifications. The cost of such replacement shall be borne by the Contractor. Defective pavement shall be cracked or spalled or other irregularities as determined by the Engineer. Defects occurring within the outer 1/3 of a panel may be corrected by sawing the full width of the panel perpendicular to the centerline at 1/3 the panel length or a minimum of six inches beyond such defect, whichever is greater. Defects extending into the interior 1/3 of a panel shall be corrected by replacing 1/2 panel or six inches beyond such defect, whichever is smaller. Defects extending across the center 1/3 shall be corrected by replacing the entire panel.

7. STRUCTURES

a. Forms and Falsework

The Contractor shall be responsible for the adequacy and strength of all forms and falsework. Forms shall conform to the shape, lines and dimensions of the structures as called for on the plans and shall be properly braced or tied so as to maintain accurate position and shape. The Contractor will be held responsible for the accuracy of all construction.

Forms shall be fitted to accurate alignment to assure a smooth complete surface free from irregularities. Form lining, such as plywood or other approved material, shall be used for all surfaces which shall be visible after completion of the project. Plywood, if used, shall be commercial standard Douglas fir, moisture resistant, or concrete form plywood. Metal forms, when used, shall be of an approved type that will produce surfaces equal to those obtained with use of wood forms. Hard board forms may be of hard-pressed fiberboard especially treated for concrete form use. Temporary openings shall be arranged in wall forms and where otherwise required, to facilitate cleaning and inspection. Form lumber which is to be reused shall have all nails withdrawn and shall be thoroughly cleaned. All lumber shall be free from bulge or warp.

Form ties shall be of suitable design and of adequate strength for the purpose. Wire type and bolts or rods which must be completely withdrawn will not be permitted. Holes left shall be filled solid with cement mortar in a neat and acceptable manner. Holes passing entirely

through walls shall be filled from the inside face with a device that will force the cement mortar through to the outside face using a stop held at the outside wall surface to insure complete filling. No wood device of any kind used to separate forms shall be permitted to remain in the finished forms as the concrete is being placed. Pipe spacers shall not be used.

Form oil shall be a non-staining mineral oil. Forms for exposed surfaces shall be oiled before reinforcement is placed, and any surplus oil removed. Forms for surfaces not exposed to view may be thoroughly wetted in lieu of oiling, except that in cold weather, oiling shall be mandatory.

b. Reinforcing Steel

The Contractor shall submit to the Engineer four (4) copies of detailed shop drawings showing the layouts, sizes and arrangements of reinforcing steel proposed for the work, and shall not commence fabrication of the reinforcement until he receives written approval of the shop drawings submitted. Reinforcing steel shall be fabricated in accordance with the applicable Concrete Reinforcing Steel Institute and the American Concrete Institute Standards.

Reinforcing steel shall be accurately positioned to the dimensions indicated on the plans. Concrete cover, bar spacing, splices and other details shall conform to the requirements of the American Concrete Institute ACI-318 Building Code Requirements for Reinforced Concrete unless otherwise indicated.

All reinforcing shall be completely clean of mud, clay, ice, grease, oil, loose rust and scale of any substance whatsoever which would reduce or destroy the bond. Reinforcing bars reduced in section, damaged by bending, or with kinks and bends not required in design, shall not be used. Reinforcement will be accurately placed and securely tied at all intersections and spliced with eighteen (18) gauge black annealed wire, and shall be securely held in position during the placing of concrete by spacers, chairs, or other approved supports. Wire tie-ends shall point away from the form faces. Unless otherwise indicated, the number, type and spacing of supports shall conform to the American Concrete Institute ACI-315 Detailing Manual.

c. Placing Concrete

It shall be the responsibility of the Contractor to ensure the inclusion of all wall castings, conduits, sleeves, pipes, anchor bolts, frames, and other items shown on the plans or required for proper completion of the work specified. The Contractor shall notify the Engineer and all affected sub-contractors and manufacturers' representatives in advance of his intentions to pour any particular portion of the concrete work.

All debris, ice and any previously spilled and set concrete shall be removed before concrete is placed. Concrete footings and

slabs shall be placed on undisturbed clean moist film surfaces free from frost, mud, ice, water or loose material or debris of any sort.

Concrete shall be transported by methods which will prevent the separation or loss of materials; equipment for chuting, pumping or otherwise conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end without separation of the materials. The Engineer may order the discontinuance of any type of conveyance and the substitution of a satisfactory method of placing, if the concrete is not being satisfactorily placed.

Concrete shall be placed as nearly as practicable in final position to avoid segregation due to rehandling or flowing. No concrete that has partially hardened or been contaminated shall be deposited in the work, nor shall retempered concrete be used. The free fall of concrete shall be held to a minimum, and in no case shall concrete be allowed to drop freely more than five (5) feet. Where greater drops are required, a tremie or other approved means of placing shall be employed. Forms for walls or other thin sections of considerable height shall be provided with openings or other devices to permit the concrete to be placed in a manner avoiding accumulation of concrete on the forms or reinforcement above the level being poured.

Concrete shall be deposited continuously as rapidly as practicable until the entire section between construction joints is complete. Immediately after placing, the concrete shall be compacted by the proper use of internal vibrators supplemented by hand-spading, rodding and tamping as required to give a dense uniform mass free of voids, honeycomb or other irregularities impairing the strength, watertightness or appearance of the finished work. No concrete shall be poured without vibration with internal vibrators of adequate capacity. Vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation. Vibrations shall not be applied directly or through reinforcement to those sections of concrete that have begun to set. Use of form vibrators will not be permitted. Special care shall be taken to avoid over-vibration of concrete with a slump above three (3) inches.

Concrete in walls shall be placed in level lifts throughout the length of the wall. The height of each will depend upon the length and breadth of the wall, but in no case shall the lift exceed two (2) feet. The previous layer of concrete shall still be plastic when the next lift is placed. The vibrator shall be extended into the previous layer only far enough to consolidate the concrete to prevent a cold joint. Concrete shall be placed at a rate not less than two (2) vertical feet per hour.

No concrete shall be placed when the air temperature is at or below thirty-five (35) degrees Fahrenheit, nor when concrete without special protection is liable to be subjected to freezing temperature

before final set has occurred. Any concrete damaged by freezing shall be removed and replaced at the expense of the Contractor.

d. Construction Joints

Construction joints not indicated on the plans shall be made and located as to least impair the strength of the structure. The location of the construction joints shall be planned in advance of the Contractor and submitted to the Engineer for approval before any concrete work is commenced. Except where they are detailed differently in the plans, all construction joints shall be square and normal to the forms. No joints shall be nearer than forty (40) bar diameters from splices in reinforcing. Keys will be provided as shown or as directed by the Engineer. In all construction, joints in walls and slabs below finished grade and in water bearing structures water stops of any approved type shall be used, properly jointed, soldered or glued at all joints.

Where a joint is to be made, the surface of the concrete shall be thoroughly cleaned of dirt, scum, laitance or other soft material with stiff wire brushes and if deemed necessary by the Engineer, shall be roughened by a steel tool. The surface shall then be thoroughly washed with clean water and coated with a 1:2 cement mortar immediately before concreting.

e. Removal of Forms

Concrete forms and false work shall not be removed until the concrete has attained sufficient strength to support it own weight, construction line loads and other loads to which it may be subject after removal of the forms. The time shall be one (1) day per foot of span with a minimum of seven (7) days.

Forms shall be removed in a manner to insure complete safety of the structure and only as approved by the Engineer. Care shall be taken to avoid spoiling the concrete surface. Forms shall remain in place until the expiration of the curing period for all portions of the work that cannot be properly cured after forms are removed. Pinch bars or other metal tools shall not be placed against the concrete to wedge forms loose and care shall be taken to prevent damaging the concrete while removing forms.

f. Defective Work

Any defective work discovered after the forms have been stripped shall be removed immediately and renewed. If the surface of the concrete is bulged, uneven, or shows excess honeycombing or settlement, which in the opinion of the Engineer cannot be repaired satisfactorily, the entire section shall be removed and renewed at the expense of the Contractor.

g. Finishing

Concrete shall be properly finished immediately after removal of the forms. Projecting ties shall be cut off or otherwise removed

back of the concrete surface; and all resulting holes, rough spots, slight honeycomb and other minor defects shall be patched with 1:2 mortar of the same mix as used in the concrete. All honeycombed and hollow spots shall be cut out and cleared of any loose or improperly bonded aggregate before patching. Care shall be taken that patches in all exposed concrete work exactly match the previously poured concrete. All fins, form marks and rough edges will be removed.

After the concrete has set sufficiently so that the coarse aggregate will not become exposed when the concrete is rubbed, all exposed surfaces will be carborundum rubbed to a smooth uniform finish. Special care will be taken to maintain sharp, well defined corners on chamber lines. Rounded corners will not be acceptable.

h. Curing

All exposed concrete surfaces shall be protected from premature drying, and freshly placed concrete shall be protected against washing by rain. All concrete surfaces shall be kept wet continuously for seven (7) days after placing, or longer if directed by the Engineer. Membrane curing compounds may be used only when and where specifically approved by the Engineer.

i. Removal of Existing Concrete

Where the plans or specifications require that existing concrete is to be removed, such removal shall be done in a manner that will not crack, break or damage concrete or other materials which are to remain in place. Remaining surfaces which are to be left exposed shall be smoothed and left as neat and workmanlike as possible. Broken surfaces against which new concrete is to be placed shall be left rough and irregular but shall be cleaned of all dust, dirt or other foreign materials. Debris resulting from the removal of existing concrete shall be disposed of as directed by the Engineer.

8. WHITE PIGMENTED MEMBRANE CURING COMPOUND

a. General Requirements

(1) Material

The material shall be a membrane curing compound of the highest quality capable of high water retention, and shall consist of finely ground pigment in the curing vehicle.

(2) Color

The compound, when applied to a new concrete surface at the specified coverage, shall provide a uniformly white appearance and shall effectively obscure the original color of concrete.

(3) Containers

Curing compound shall be shipped in barrels, upon which shall be plainly stenciled the manufacturer's name and a lot number indicating the particular batch of which the contents are a part. A jobber's name or brand may supplement, but not replace, the manufacturer's name and lot number. Quantities smaller than a barrel may be shipped in a suitable container providing that the manufacturer's name and lot number appear on the label.

b. Special Requirements

(1) Hiding Power

After the compound has dried in a curing cabinet for 24 hours, it shall have an apparent daylight reflectance of not less than 65 percent compared to magnesium oxide as determined by ASTM E-97.

(2) Viscosity

The viscosity of the material furnished shall be such as to enable it to be used at atmospheric temperatures above 40° Fahrenheit. It will be applied to the concrete as a fine mist by means of an atomizing nozzle at an air pressure of 50 pounds or less.

(3) Reaction with Concrete

There shall be no deleterious reaction between the concrete and the curing compound.

(4) Drying Time

The material shall dry to touch on moist concrete in one to four hours under ordinary conditions. The resulting surface shall not be tacky or slippery when walked upon.

(5) Adherence

The material, when sprayed on moist concrete, either vertical or horizontal, shall adhere to the moist surface and make a tight bond to the concrete. The dry membrane shall not disintegrate or peel within thirty (30) days; however, by the end of sixty (60) days, it is expected that the membrane will chalk away due to weather and erosion.

(6) Moisture Retention

When tested in accordance with OHD L-17, the curing compound shall have a water retention of at least 90 percent.

(7) Storage

Membrane curing compounds, particularly those containing paraffin or similar wax, should be stored inside where they will not freeze. Freezing may cause hard deposits of wax or resin, difficult to redissolve. Storage temperatures of 60° Fahrenheit or higher are desirable.

(8) Mixing

The compound shall be thoroughly mixed by air jet or by mechanical stirring before used in the field.

9. PREMOLDED BITUMINOUS EXPANSION JOINT FILLER

a. Description

Premolded bituminous asphalt filler shall contain sufficient asphalt to form a coherent matrix between the felt and the mineral filler. The asphalt shall be present as a saturant of the felt, as a flux or binder, or to increase the softening point of the combined asphalt. Not less than seventy-five percent (75%) of the total asphalt shall be intimately associated as a saturant of the felt.

The felt shall be roofing felt free from particles of foreign substances such as: stone, metal, leather, rubber, straw or wood. If asbestos is present, it shall appear only as a filler.

The mineral filler shall consist of firmly crushed slate, limestone, silica, sand, or other similar mineral matter, all of which shall pass a No. 100 sieve,

The completed joints shall not contain wood in any form, nor shall they contain coarse fragments of any description. The presence of straw or cornstalks used as a substitute for felt, or the presence of large particles of slate or other foreign matter, will be deemed sufficient cause for rejection.

(1) Proportions

The asphalt, felt, and mineral filler shall be combined in the following proportions by weight:

Asphalt	70%
Felt (organic)	10%
Mineral (inorganic)	1.5% to 7.5%

(2) Absorption

When tested for absorption as specified herein, the amount of water absorbed shall not exceed five (5) percent by weight.

(3) Deflection

When tested for deflection, the longitudinal specimen shall have a deflection from the horizontal of not more than one-half (1/2) inch, and the transverse specimen shall have a deflection from the horizontal of not more than three-fourths (3/4) inch.

(4) Brittleness

When tested for brittleness, the joint shall not crack or shatter.

b. Method of Sampling

Three (3) samples, each twelve (12) inches in length and full width, shall be taken from each one thousand (1,000) linear feet or joint fraction thereof.

Individual samples shall be taken from separate pieces of joints, selected at random.

c. Methods of Testing

Tests shall include the extraction of asphalt determinations of the quantity of mineral (inorganic), and felt (organic), absorption, deflection and brittleness.

(1) Extraction of Asphalt

The asphalt shall be extracted by means of a Soxhlet extraction apparatus (large) equipped with a glass extraction shell having a round perforated bottom. A small quantity of glass wool shall be placed in the bottom of the extraction shell. A sixty (60) gram sample shall then be cut into narrow strips and packed in the shell above the glass wool. The solvent shall be carbon tetrachloride (CCL_4). The residue, after extraction, shall be weighed, and the quantity of asphalt determined by difference.

(2) Determination of Quality of Mineral (Inorganic)

A ten (10) gram sample shall be ignited in a weighed silica dish and the quality of mineral (inorganic) remaining, after ignition, determined.

(3) Determination of Quantity of Felt (Organic)

The quantity of felt (organic) shall be determined by difference.

(4) Absorption

The sample two (2) inches by six (6) inches shall be cut in such manner that all edges are freshly exposed. The sample shall be weighed to the nearest 0.1 gram and immersed in water at approximately 77 degrees Fahrenheit for twenty-four (24) hours. It shall then be removed, the surface water wiped off with a slightly dampened cloth, and weighed immediately. The test result shall be calculated to the nearest decimal place in percent of the initial weight.

(5) Deflection

Both longitudinal and transverse specimens, two (2) inches by six (6) inches and of the full thickness of the joint, shall be tested. The specimen shall be clamped in a horizontal position between two (2) blocks so that it projects three and one-half (3 1/2) inches. The clamp and joint shall then be heated in an oven to a temperature of 125 degrees Fahrenheit, which temperature shall be maintained for two (2) hours, the specimen shall then be removed from the oven, and the deflection measured.

(6) Brittleness

Both longitudinal and transverse specimens, two (2) inches by six (6) inches and of the full thickness of the joint shall be tested.

The specimen shall be brought to a temperature between 39.2 degrees Fahrenheit and 42.8 degrees Fahrenheit, which temperature shall be maintained for a period of at least one (1) hour. The specimen then shall be clamped between two (2) blocks so that it projects three and one-half (3 1/2) inches and the blocks shall be fastened in a suitable support. A cast iron ball, having a diameter of 1.875 inches and weighing 0.95 pounds, shall be suspended above the specimen in such manner that when released, it will strike the center of the catilevered portion. The ball shall be one (1) foot above the specimen for joints one-half (1/2) inch and not less in thickness, and two (2) feet for joints nine-sixteenths (9/16) inch or more in thickness.

10. ASPHALT-PA-F FILLER GRADE

a. Use

Asphalt PA-F filler grade shall be used for filling poured expansion joints, brick filler, for sealing joints and cracks in pavements, and for use in bituminous sewer joints compound.

b. Description

The asphalt shall be homogeneous, free from water, shall not foam when heated to 175 degrees Centigrade (327 degrees Fahrenheit), and after oxidation, shall conform to the following requirements:

(1)	Flash Points not less than	200 degrees C.
(2)	Melting Point (ball and ring) not less than	70 degrees C.
(3)	Penetration at 0 degrees C. (32 degrees) Fahrenheit), 200 gms, 60 sec., not less than	18
(4)	Penetration at 25 degrees Centigrade (77 degrees Fahrenheit), 100 gms, 5 Sec., not less than	30 to 50
(5)	Penetration at 46.1 degrees Centigrade (115 degrees Fahrenheit), 50 gms, 5 Sec., not less than	80
(6)	Loss of heating, 163 degrees Centigrade (325 degrees Fahrenheit), not more than	1%

Penetration of residue at 25 degrees Centigrade (77 degrees Fahrenheit) 100 gms, 5 Sec., not less than fifty (50) percent of original penetration.

(7)	Ductility at 25 degrees Centigrade (77 degrees Fahrenheit), not less than	3.5 cm
(8)	Ductility at 0 degrees Centigrade (32 degrees Fahrenheit), not less than	1.0 cm
(9)	Percent bitumen soluble in carbon tetrachloride, not less than	99

11. DRAINAGE DITCH PAVING

a. Description

Drainage Ditch Paving shall consist of furnishing all materials, labor, equipment and other expense involved in the placing of the

paving complete and in place to the lines and grades shown on the plans. All material and workmanship shall comply with previous requirements of this section, except as modified below. There will not be measurement or payment of filter material as indicated on the standard sections shown on the plans and the cost thereof shall be included in the cost of ditch paving.

b. Concrete Paving

Concrete lined ditch paving shall be Standard Paving Mix concrete as specified in these specifications and shall be placed as previously specified.

c. Filter Material

Filter material shall be placed beneath all drainage ditch paving to the lines, grades and dimensions indicated on the drawings. The material shall be natural gravel, crushed rock or a mixture of natural gravel and crushed rock. The material shall be cleaned and well graded as specified.

Type I material shall have one hundred percent (100%) passing the one-half (1/2) inch sieve and not more than five (5) percent passing the No. 200 sieve. Type I material shall be used to provide the drainage blanket to the thickness specified under the ditch paving.

Type II material shall have one hundred percent (100%) passing the two (2) inch sieve and not more than ten percent (10%) passing the No. 10 sieve. Type II material shall be placed around each weep hole. The weep holes shall be located as indicated on the drawings. One (1) cubic foot of No. II material shall be placed at each location.

d. Weep Holes

The weep holes shall consist of a two (2) inch diameter PVC pipe section, of a length indicated on the drawings, embedded in the concrete as shown on the drawings and spaced at ~~ten (10)~~ TWENTY (20) foot intervals. The pipe shall be bevel cut so that the exposed end is flush with the finished paving.

e. Joints

Transverse contraction joints shall be spaced not to exceed fifteen (15) feet between joints. Transverse expansion joints shall be spaced at intervals not to exceed three hundred (300) feet.

Construction joints shall be placed in the locations shown on the plans. Construction joints required at the end of each days run shall be dowelled with No. 4 bars at twenty-four (24) inch centers. Additional construction joints may be required by the Engineer to prevent cold joints from being formed during pouring operations.

DIVISION 2E

STORM SEWERS

1. SCOPE

This section covers pipe storm sewers and related items as shown on drawings and specified herein, including, if required by drawings, piping and connections to building drains at points indicated.

2. QUALITY ASSURANCE

Reference Standards: Latest Publications of American Society for Testing and Materials (ASTM), as listed herein by designation numbers. Oklahoma Department of Transportation (ODOT) Standard Specifications, 1989 Edition and current revisions. American Association of State Highway and Transportation Officials (AASHTO).

3. SUBMITTALS

A. Submit product data.

B. Certificates: Suppliers certification that products meet or exceed specification requirements.

4. PRODUCT HANDLING

A. Deliver products on manufacturer's original skids, or in original unopened protective packaging with labels intact and legible.

B. Store products to prevent physical damage.

C. Protect products during transportation and installation to avoid physical damage.

5. PIPE MATERIALS

A. Reinforced Concrete Pipe (RCP): ASTM C 76, Class III

B. Corrugated Galvanized Metal Pipe (CGMP), AASHTO M-36, M-218, M-245 - Corrugation and gauge as shown on plans

6. SEWER STRUCTURE MATERIALS

A. Brick: Either clay brick (ASTM C 32, Grade MS) or concrete brick (ASTM C 55, Grade S-I or S-II) at Contractor's option.

B. Concrete: 3,500 p.s.i. compressive strength at 28 days per Section 2D-3.

C. Reinforcing: See Section 2D-2.

7. MORTAR FOR PIPE JOINTS AND SEWER STRUCTURES

A. General:

1. Materials: As required by ASTM C 270, with exceptions as specified herein.

2. Mixing procedures:

a. Proportion ingredients by volume, as specified herein. Use measuring devices of known volume; do not measure ingredients by shovel.

b. Mix dry ingredients in clean mechanical mixer or by hand in watertight boxes until uniformly mixed. Introduce water uniformly to dry ingredients and mix to produce a workable consistency. If mechanical mixer is used, mix between 3 to 5 minutes with drum revolving at rate of 14 to 20 revolutions per minutes.

c. Mix only in quantities required for immediate use. Retempering of mix is not permitted.

B. Mix Proportions, by Volume:

1. For Pipe Joints: 1 part Portland Cement (Type 1), 2 parts approved fine aggregate graded in compliance with ASTM C 144, and maximum 6 gallons of water per sack of cement. Use of Masonry Cement and hydrated lime or lime putty is not permitted.

2. For Sewer Structures: ASTM C 270, Type M Mix. Use of Masonry Cement is not permitted.

8. FILL MATERIAL

Refer to Section 2A-4.

9. MISCELLANEOUS MATERIALS

Gray Iron Castings: ASTM A 48, as shown on drawings.

10. COMPRESSION JOINTS

A. Install joints according to manufacturer's direction.

B. As soon as possible, after joint is made, place backfill to prevent pipe movement from line and grade.

11. EXCAVATION

A. General:

1. Open Cut Excavation: Type required for this project unless otherwise indicated. Make to required depths, alignment and grade.

2. Tunnel Excavation: Short sections of trenches may be tunneled provided tunneling and pipe installation method is submitted and written approval is obtained from Contracting Officer.

3. Sheeting and Shoring: Install as required for protection of work and personnel.

4. Dewatering: Prevent surface water and subsurface or ground water from entering excavations. Provide and maintain pumps, sumps, suction and discharge lines and other dewatering system components necessary to convey water from and away from excavations.

5. Suitable Excavated Backfill Material: Stockpile away from banks of excavations to avoid overloading and cave-ins. Remove excess material which is not reused from Owner's property.

6. Excavation Classification: Unclassified. No additional payment will be made for excavation regardless of material encountered. Examine site prior to bidding and include costs for excavation of rock or unsuitable material which may be encountered.

B. Trench Excavation:

1. Cut banks as nearly vertical as practicable, with trench width for proper laying of pipe as follows:

a. Trench Width Below Top of Pipe: Maximum of outside diameter of pipe plus 12" for pipe diameters of 24" or less, plus 24" for pipe diameters from 24" to 42", and plus 48" for pipe diameters more than 42".

b. Trench Width Above Pipe: As required for sheeting and shoring, and property performance of work.

2. Accurately grade bottom to provide uniform bearing and support for each section of pipe on undisturbed soil along its entire length, with holes and depressions for joints dug after trench bottom has been graded. Remove stones to avoid point bearing.

3. If rock is encountered, excavate to minimum overdepth of 6" below required trench depth; backfill overdepths with material specified for backfilling lower portion of trenches. Compact to density of adjacent soils.

4. Remove wet or otherwise unstable material encountered beyond depths indicated and replace with satisfactory material.

C. Excavation for Appurtenances: Excavate for manholes and similar structures to leave at least 12" clear between outer surfaces and embankment or timber that may be used to hold and protect banks. Fill overdepth excavation with sand, gravel or concrete.

12. PIPE INSTALLATION

A. Do not lay pipe until it has been inspected. Remove and relay (or replace) at Contractor's expense any pipe laid which is found to be defective or damaged, not in true alignment, or to property grade, or which shows undue settlement after laying.

B. Start at low outlet point of line. Lay each section on its prepared bed to correct grade and alignment, with bell socket or groove upgrade. Adjust to grade by shaping or reshaping bottom of trench. Blocking, buckling in, or filling and ramming earth or other material under pipe to raise it to grade not permitted. Keep trench free of water until joint mortar has set. Lay no pipe when condition of trench or weather is unsuitable.

C. Bedding: Carefully bed pipe in soil shaped and rounded to conform to lower 1/4 of outside portion of pipe for its entire length. Where necessary, tamp bedding. Make bell holes and depressions for joints only to length, depth, and width required.

D. Cement Mortar Joints:

1. After first pipe is bedded to grade, carefully wet brush, clean the interior surfaces of abutting pipes flush and even. Wet brush, clean spigot end and match into bell. After each section is laid, fill remainder of joint with mortar, and form a bead around outside of joint with additional mortar. Finish inner surfaces of joint smooth with surface of pipe.

2. Cover upper half of exterior surfaces of completed joints with strips of moist burlap or other approved material.

E. Closures: Close dead ends and stub outs with approved stoppers or bulkheads cemented in place. If work is temporarily stopped, install approved temporary closures at pipe ends.

13. BACKFILLING

A. General:

1. Do no backfilling until installed piping has been approved.

2. Remove all sheeting and shoring unless authorized by the Engineer to be left in place.

3. Except as otherwise specified for special conditions of overdepths, backfill trenches to ground surface with material suitable for specified compaction. Reopen trenches improperly backfilled and refill and compact as specified.

4. Restore ground surface to its original condition.

5. Replace pavements, base course and compacted subgrade disturbed by new work with materials equal to existing.

6. Provide additional approved type fill material if acceptable material is not available from excavation.

7. All backfill under streets, drives and parking lots shall be sand.

B. Lower portion of trench (from trench bottom to 24" above pipe):

1. Deposit selected satisfactory material in 6" layers and compact to density of adjacent soil or grade as herein specified, using material with moisture content that will facilitate compaction and is free of stones larger than 3" in any dimension, hard clods, and frozen conglomerates larger than 6" in any dimension.

2. If any portion of cover in lower portion of trench is in depth of special compaction and material requirements under pavements, special requirements shall control.

C. Remainder of Trench:

1. Except for special materials for pavements, backfill remainder of trench with satisfactory material free of stones larger than 6" in any dimension or one-half the layered thickness, whichever is smaller.

2. Thickness of layers and degree of compaction shall be:

a. Under Pavements: Six-inch layers, 95% of STandard Proctor Density up to elevation at which requirements for pavement subgrade material and compaction take effect.

b. Under Lawn Areas and Sidewalks: Twelve-inch layers, 90% of Standard Proctor Density. Use topsoil for top 4" of areas designated to be prepared for grass or planting.

c. Under Other Areas: Two-foot layers, density equal to adjacent soil, using topsoil for top 4".

D. Optional Material: A good grade of clean concrete or river sand, if approved, may be substituted for backfill material except for the upper 24" under areas other than pavements.

E. Compaction Control: A Commercial Testing Laboratory employed by the Contractor and approved by the City shall make field density tests at locations directed. The deficient tests are at Contractor's expense. Recompact deficient areas.