

4.5.10 DENSE-GRADED ASPHALT. This work shall consist of mixing, laying and compacting an asphalt course of one or more layers composed of aggregate, asphalt cement, applicable additives and lime, as required. All materials shall be mixed at a central mixing plant.

4.5.10.1 RELATED WORK. Work related to asphalt concrete pavement shall include surface preparation, prime coat, tack coat, transporting, placement, compaction and finishing of asphalt mixture as required. Work zone traffic control shall be in accordance with the requirements of Section 2.5 of these specifications.

4.5.10.2 ASPHALT CEMENT. Viscosity graded asphalt cement shall meet AASHTO designation M-226-80 (1993). Viscosity is to be measured at 140°F (60°C) when used in pavement construction. The asphalt cement shall be homogeneous, free from water, and shall not foam when heated to 347° F (175° C). Sampling and testing of asphalt cements shall be in accordance with the following AASHTO Standard Methods:

- Sampling T40
- Viscosity at 140°F (60°C) T202
- Viscosity at 275°F (135°C) T201
- Penetration T49
- Flash point (COC) T48
- Solubility in bituminous materials T44
- Thin-film oven test T179
- Ductility T51
- Spot test T102
- Rolling thin film oven test T240
- Water T55

The asphalt cements shall conform to the requirements given in Table 4.5.

**TABLE 4.5
Paving Grade Liquid Asphalt Requirements**

	AC-10	AC-20	AC30
Viscosity: 140° (60°C) poises	1,000 ± 200	2,000 ± 400	3,000 ± 600
Viscosity: 275°F (135°C), Cs-minimum	250	300	350
Penetration: 77°F (25° C), 100g, 5 sec-min.	80	60	50
Flash Point: COC, C(F)-minimum	219(425)	232(450)	232(450)
Solubility in trichloroethylene: percent-minimum	99.0	99.0	99.0
Tests on residue from thin-film oven test:			
Loss on heating: percent - maximum (1)	0.5	0.5	0.5
Viscosity: 140°F (60°C), poises-maximum	4,000	8,000	12,000
Ductility: (77°F (26°C), 5cm per minutes), cm-minimum	75	50	40
Spot test (when and as specified (2) with: Standard naphtha solvent	Negative for all grades		
Naphtha-Xylene-solvent, % Xylene	Negative for all grades		
Heptan-Xylene-solvent, % Xylene	Negative for all grades		

(1) The use of loss on heating requirement is optional.

(2) The use of the spot test is optional. When it is specified, the City Engineer's Representative shall indicate whether the standard naphtha solvent, the naphtha-xylene solvent, or the heptane xylene solvent will be used in determining compliance with the requirement. If xylene solvent is used the percentage of xylene shall be indicated.

4.5.10.3 SHIPMENT OF ASPHALT MATERIAL. Asphalt cement shall be uniform in appearance and consistency and show no foaming when heated to the specified loading temperature. Shipments of asphalt shall not be contaminated with any other type or grade of asphalt material. A bill of lading shall accompany each shipment of material and shall include the following information:

- Type and grade of material.
- Type and amount of additives used, if applicable.
- Destination.
- Consignee's name.
- Date of shipment.
- Truck identification.
- Loading temperature.
- Net weight or net gallons corrected to 60°F (16.6°C).
- Specific gravity.

- Bill of lading number.
- Manufacturer of asphalt material.

4.5.11 HYDRATED LIME FOR ASPHALT MIXTURE. The physical properties of hydrated lime shall conform to ASTM C-1097, subparagraph d.1; use test method ASTM C-110, paragraph 6.

The water used in saturating the aggregate to be coated shall be potable or water that is clean and free of dirt, silt and other damaging material. The aggregate bulk specific gravity (saturated-surface-dry (SSD)) shall be not less than one and one-half percent (1 ½%) nor more than three percent (3%) using AASHTO T-85 for the course aggregate retained on a No. 4 (4.75 mm) sieve and AASHTO T-84 for the fine aggregate passing the No. 4 (4.75 mm) sieve. Hydrated lime shall be applied at a rate determined during the Marshall Design requirements in Table 4.6, unless otherwise directed by the City Engineer. Two options for coating the aggregate with lime are as follows:

4.5.11.1 Aggregate shall be monitored for SSD by taking a belt cut between the stockpile and the pugmill or drum. The pugmill or drum shall be equipped with metering devices that will introduce the required amount of hydrated lime and water into the mixer to produce an aggregate SSD of one and one-half percent (1½%) to three percent (3%).

4.5.11.2 Use of a lime slurry of one (1) part lime and three (3) parts water by volume may be used, if the plant is equipped with a mixing chamber that can maintain the lime suspension in the slurry. Spraybars for introducing the required quantity of slurry into the mixer shall be equipped with a positive shutoff. If this option is used the aggregate stockpile shall be maintained at two percent (2%) SSD.

Asphalt plants shall provide a positive signal system that automatically closes down the cold feed when the appropriate amount of hydrated lime and water ceases to be introduced into the aggregate. This shall be accomplished by the use of interlocked and synchronized metering devices and feeders. The plant shall be equipped in such a way that the quantity of hydrated lime incorporated into the mix can be readily checked at any time.

**TABLE 4.6
MARSHALL DESIGN REQUIREMENTS**

TRAFFIC CATEGORY*	I		II	
ASTM D-1559 (number of blows)	75		50	
TEST PROPERTY	MIN	MAX	MIN	MAX
MARSHALL STABILITY, LB.	1500	--	1200	--
FLOW, 0.01 IN	8	16	10	18
AIR VOIDS: PERCENT	3	5	3	5
VOIDS IN MINERAL AGGREGATE (VMA)	13	17	13	17
FRACTURED FACES RETAINED ON THE NO. 4 (4.75 mm) SIEVE PER FLH DESIGNATION: T-506-94 2.1	100%	---	75%	--
SAND EQUIVALENT PER AASHTO T-176-86 (1993) 4.3.2, 4.3.3	55	---	40	---
WEAR TEST AASHTO T-96	---	30%	---	30%
DRY-RODDED UNIT WEIGHT AASHTO T-19	AM. STD.	METRIC	AM. STD.	METRIC
	75 pounds per cubic foot	1200 kg/m ³	75 pounds per cubic foot	1200 kg/m ³
STRIPPING TESTS: AASHTO T-283 ASTM D-4687 including Note 5	Shall be used to determine the required amount of hydrated lime or anti-stripping agent in the asphalt. The mix design shall have a tensile strength ratio of 70 percent.			

* Traffic Category I applies to arterial streets or truck routes with a Traffic Index of seven or more.
Traffic Category II applies to streets with a Traffic Index of less than seven.

4.5.12 AGGREGATE. The requirements for crushed rock, rock dust, gravel, stone, slag, and sand are included in this subsection. All aggregate shall be clean, hard, sound, durable and uniform in quality. The quality of soft, friable, thin, elongated, laminated pieces and disintegrated materials will be determined by the supplier's professional Geotechnical Engineer at the time the mix design is submitted, at

which time the City's Representative will have the option to approve or reject the material. Organic matter, oil, alkali or other salts shall not exceed two percent (2%) total weight. In the surface course this material may be restricted to less than one percent (1%) by weight.

4.5.12.1 Aggregate for three-quarter (3/4) inch (19.0 mm) Category I (NR), (see Table 4.7) shall be one hundred percent (100%) crushed material (all manufactured). This is considered a non-rutting (NR) mix.

4.5.12.2 Coarse aggregate for three-quarter (3/4) inch standard (19.0 mm standard) and one-half inch (12.5 mm) Category II (see Table 4.7) shall be retained on the No. 4 (4.75 mm) sieve and shall have no less than seven-five percent (75%) fractured face material as defined in FLH T 506-94 2.1.

4.5.12.3 Fine aggregate for other than the three quarter (3/4) inch NR, may be a natural or manufactured product. It shall pass the No. 4 (4.75 mm) sieve. It shall be clean, hard-grained angular, non-plastic, and have no more than two percent (2%) by weight of organic matter or other detrimental substances, including gypsum.

4.5.12.4 The test for gypsum shall be conducted using City of St. George Chemical Quantitative Analysis of Gypsum in Aggregates, Test Procedure S-3171-96.

4.5.12.5 Surface courses, or asphalt wearing courses, shall be free from organic materials and contain less than one percent (1%) by weight of soluble minerals, such as gypsum, and phosphates.

[r, a.1, 05/01]

TABLE 4.7

DENSE-GRADED ASPHALT AGGREGATE GRADATION

PERCENT OF TOTAL AGGREGATE PASSING (DRY WEIGHT)				
TRAFFIC CATEGORY		I	II	
METRIC		19.0 mm NR	19.0 mm std.	12.5 mm
AMERICAN STANDARD		3/4 inch NR	3/4 inch std.	1/2 inch
SIEVE SIZE				
METRIC	AMERICAN STANDARD			
25.0 mm	1 inch	---	---	---
19.0 mm	3/4 inch	100	100	---
12.5 mm	1/2 inch	74 - 99	---	100
9.5 mm	3/8 inch	69 - 91	75 - 91	---
4.75 mm	#4	49 - 65	46 - 62	60 - 80
2.36 mm	#8	33 - 47	---	---
1.18 mm	#16	21 - 35	22 - 34	28 - 42
.300 mm	#50	6 - 18	11 - 23	11 - 23
.075 mm	#200	2 - 6	5 - 9	5 - 9

4.5.13 STORING, MIXING AND SHIPPING OF PLANT MIX BITUMINOUS PAVEMENTS. Hot mix plants may be batch or drier-drum type plants (with not less than four aggregate bins).

4.5.13.1 STORAGE. The various natural and manufactured aggregates shall be stored separately. The various aggregate sizes shall be placed in bins which allow the material to be properly and evenly fed to the dryer to ensure a uniform flow of properly combined aggregates. When placing materials in storage bins, or when moving them from storage to the feeder, no method will be used which may cause segregation, degradation or the intermingling of different size aggregates. Materials not meeting the gradation requirements shall be reprocessed to comply with the requirements. All scales and meters shall be certified and sealed by the

Utah Department of Agriculture, Division of Weights & Measures, annually and when the plant has been moved.

4.5.13.2 BATCH PLANT METHOD. The aggregates shall be dried and heated for sufficient time in the dryer so that the moisture content of the aggregate will not be greater than one percent (1%). The dryer shall be equipped with a calibrated thermometer to determine the temperature of the aggregate leaving the dryer. The thermometer shall be accurate to the nearest 10°F (5.5°C), and shall be installed in such a manner that a fluctuation of 10°F (5.5°C) in the aggregate temperature will be indicated within one minute and be clearly read from the operator's platform.

After drying, the aggregates shall be evenly fed to screens having clear square openings to separate, classify and quantify materials for hot storage bins. The aggregate passing these screens shall be separately stored in individual bins until proportioned into the mixer.

Each bin shall be provided with an opening to prevent overflow into adjacent bins. All overflow material shall be returned to an appropriate storage area for reprocessing.

If a substantial change is made in the cold feed to accommodate the demands of a different type of mixture, the hot storage bins shall be emptied and recharged with the correct materials.

All materials shall be proportioned by weight. The aggregate scales shall be fully automatic, solid-state digital strain-gage transducer with a capacity exceeding one and one-quarter times the total amount of materials to be weighed in one operation. Asphalt binder shall be weighed by a fully automatic scale having a capacity of not more than five hundred pounds (227kg) with one pound (0.45kg) resolution for mixers with a manufacturer's rated capacity of four thousand pounds (1814kg) or less, and a capacity of not more than one thousand pounds (454 kg) with one pound (0.45kg) resolution for mixers with a manufacturer's rated capacity over four thousand pounds (1814kg).

When bag house fines or mineral filler is used, it shall be proportioned by weight or volume. The method used shall uniformly feed the material within ten percent (10%) of the required amount.

Mixing shall be done with a twin shaft pug mill-type mixer and shall be operated at the speed recommended by the manufacturer. The paddles shall be of sufficient size and quantity to deliver a uniform mixture.

The weight of the material that may be mixed per batch shall not exceed the manufacturer's rated capacity of the mixer, nor exceed an amount that will permit complete mixing of all the materials. Dead areas in the mixer, in which the material does not move or is not sufficiently agitated, shall be corrected by reduction in the volume of materials or by repairs to the mixing equipment before any further production will be allowed.

The entire batch shall be mixed until all the materials are thoroughly blended. The batch mixing time will begin on the charging stroke of the weight hopper dump mechanism and conclude when discharge from the mixer has started. The mixer shall be equipped with a time lock which locks the mixer discharge gate for the mixing period and actuates an indicator light visible from the operator's platform.

The aggregate and liquid asphalt drop time into the mixer shall not exceed ten seconds and the time for mixing materials will not be less than thirty seconds per batch. If the City's Representative determines that the mixture is not thoroughly blended, and all aggregate properly coated with asphalt cement, the mixing time will be increased to produce a homogeneous material.

The weight-box housings and mixer platform shall provide safe and convenient access with properly sized gates and tracks for sampling the discharged materials.

4.5.13.3 DRIER-DRUM METHOD. When a drier-drum is used, aggregate shall be fed directly to the mixer drum at a uniform rate, and monitored for combined aggregate moisture and gradation by taking belt cut samples. A minimum of one moisture content check and gradation test per day and one moisture and gradation test per five hundred tons (551 tonne), or as conditions require, shall be made. The results of these tests shall be kept on logs for review by the City's Representative. Sampling and testing may be performed by the manufacturers properly trained and equipped staff or by an approved testing lab. If sampling is performed by the manufacturer, five percent of the samples shall be split and a testing firm approved by the City shall verify that the test results accurately represent the product being tested by the manufacturer. The

sample to be split may be selected at random by the manufacturer's quality control team, or the City's Representative.

If the cold feed material gradation is outside the allowable mean of deviations of the approved mix design as determined in Section 4.5.24, production shall be stopped until the necessary corrections are made. If the moisture content of the cold feed reaches five percent, production shall be stopped until certified by an approved independent materials testing firm under the direction of a Registered Professional Engineer, licensed in the state of Utah. This firm shall then be employed to provide continuous plant quality control and testing, and production may be resumed.

All production shall be prohibited if the cold feed material reaches seven percent moisture, without exception. During lay down operations, if in the opinion of the City's Representative excess moisture is present in the asphalt material, it shall be sampled and tested for moisture under AASHTO T-164-94 Note-6 or ASTM D 2172-93 Note 3. Asphalt found to contain excess moisture shall be removed in its entirety and properly disposed of.

The drier-drum shall be equipped with a calibrated thermometer to determine the temperature of the mixed materials leaving the drum. The thermometer shall be accurate to the nearest 10°F (5.5°C), and shall be installed in such a manner that changes of 10°F (5.5°C) in temperature of the mixed material will be shown within one minute and be clearly read from the operators station.

Asphalt cement shall be measured through a meter under constant pressure with a gage indicating the pressure and temperature at all times. This metering system shall be calibrated and certified for accuracy every six months, or whenever the plant is moved.

During any day's run, the temperature of asphalt cement shall not vary more than 50°F (10°C). If the meter loses pressure the operator's computer shall be equipped to warn the operator or automatically shut down the system.

The aggregate feeders for each material in the mixture and for the combined aggregates shall be equipped with devices by which the rate of feed can be determined while the plant is in full operation. The combined aggregate shall be weighed on a belt scale. The scale shall be of such accuracy that, when the plant is operating between thirty

percent and one hundred percent of belt capacity, the average difference between the indicated weight of the material delivered and the actual weight delivered will not exceed one percent of the actual weight for three two-minute runs. For any of the three individual two-minute runs, the indicated weight of material delivered shall not vary more than two percent from the actual weight delivered.

The belt scale for the combined aggregate, the other proportioning devices for additives and the asphalt cement proportioning meter shall be interlocked so that the rates of feed will be automatically adjusted to maintain the proper material ratios as designated by the approved mix design. The plant shall not be operated unless this automatic system is operable and in good working condition.

The asphalt cement meters, additive feeders and aggregate belt scales used for metering the aggregate additives and asphalt cement into the mixer shall be equipped so that the actual quantities of asphalt cement, additives and aggregate introduced into the mixture can be determined.

Mixing shall be performed for sufficient time, and at a sufficiently high temperature, so that at discharge from the mixer, the sizes of aggregates are uniformly distributed throughout the completed mixture and all particles are thoroughly and uniformly coated with asphalt cement.

Temperature of the completed mixture at discharge from the drum shall not exceed 325°F (163°C) for all dense-graded mixes using AC-10, AC-20 and AC-30 grades of asphalt cements. Maximum temperatures for open-graded mixes using AC-20 and AC-30 shall not exceed 275°F (135°C). Open-graded mixes using AC-20R shall not exceed 325°F (163°C).

The mixed material shall be discharged from the drum into a surge silo of not less than forty tons in capacity. The manufacturer shall also provide a means of diverting the flow of material away from the silo, when starting and stopping the plant production, to prevent incompletely or improperly mixed portions of the mixture from entering.

Paving grade asphalts shall be added to the aggregates, in both batch and drier-drum plants, at a temperature between 285°F (140°C) and 350°F (177°C). The temperature of the aggregates at the time of adding the asphalt cement shall not be less than 265°F (130°C), nor more than 325°F (163°C). A thermometer with a 500°F (260°C)

capacity, and accurate to 10°F (5.5°C) will be fixed in the asphalt cement feed line or storage tank at a suitable location to view when sampling the asphalt. The manufacturer will provide a suitable sampling outlet in the asphalt cement feed lines connecting the storage tank(s) to the asphalt cement meter. The sampling valve shall consist of a one-half inch (12.7 mm) or three-quarter inch (19 mm) valve constructed in such a manner that a one quart (.95 liter) sample may be withdrawn slowly at any time during plant operations. The sampling valve shall be placed in the least hazardous location that is readily accessible. A drainage receptacle shall be provided for flushing the valve prior to sampling. One gallon (3.8 liters) shall be drawn from the sampler prior to taking the sample.

4.5.14 ASPHALT CONCRETE SURGE AND STORAGE SILOS. The type of conveying equipment used to deliver the hot-mix asphalt from the discharge chute on the drier-drum mixer or from the hopper under the pugmill may be either a variable or constant speed - bucket elevator, drag slat conveyor or hot material belt conveyor.

The manner in which the mix exits from the conveyor or elevator and enters the top of the silo, shall be such as to prevent segregation of the completed asphalt mixture. Properly installed, maintained and operated systems such as rotating spreader chutes, batchers and gob hoppers are all acceptable segregation prevention systems. Splitter systems, or a series of baffles, may be used providing they are approved by the City's Representative.

Silos shall be cylindrical with conical bottoms providing a minimum angle of 55° and maximum angle of 70°. The gate opening in the bottom shall be sized to work with the angle of the cone to prevent center draw down resulting in material segregation.

Heated or insulated surge silos are not required, however, a heated discharge cone is preferred.

The asphalt mixture that develops lumps, hardening or chills below 250° (120°C) while the mix heats the silo and discharge cone shall not be used. All surge silos shall be emptied of mix at the end of each production day.

Storage silos shall be well insulated and equipped with heated discharge cones and well sealed discharge gates. Dense-graded asphalt may be stored up to forty eight hours in silos with heated cones, and seventy two hours with heating of the silo vertical walls and cone.

Storage silos may be used for storage or surge purposes, but under no circumstance may a surge silo be used for storage. Either silo must be equipped with high and low indicator systems.

4.5.15 SHIPPING ASPHALT MIXTURES. Trucks used for hauling mix shall have tight, clean, smooth beds which are treated to prevent the mix from adhering to the bed. Amounts of solution that form visible pools in the truck bed shall be removed prior to loading asphalt mix.

Asphalt mix shall be deposited in a mass into the haul truck or loading hopper from the silo. The gates on the bottom of the silo cone shall open and close quickly. To prevent segregation, it is also necessary for the gates to open completely so that the flow of mix is unrestricted. The mix shall be delivered in evenly divided drops into the length of the truck bed. In no case shall the truck be loaded continuously by the truck driver moving forward under the silo as the mix is being discharged. Multiple drops of small quantities or dribbling mix into the haul vehicle at the end of the main delivery should be avoided to prevent segregation.

4.5.16 SURFACE PREPARATION FOR ASPHALT OVERLAYS. Prior to placing asphalt overlays, all manholes, utility covers, monuments and other items affected by the paving operations shall be located, referenced and protected. The existing asphalt surface shall be thoroughly cleaned of all deleterious materials and brought to a uniform grade by spot leveling or by the application of a bituminous leveling course to the surface. A bituminous tack coat shall be applied to the existing prepared surface immediately prior to placing the finish asphalt course in accordance with Section 4.5.9 of these specifications.

4.5.17 ADJUSTMENT OF MANHOLE AND UTILITY COVERS. Prior to paving and after roadbase is placed, all manholes and utility covers shall be brought to the base grade. Damaged valve boxes, covers, grade rings, cones, flattops, risers, etc. replaced. Manhole cones or flattops that are more than eighteen inches below finish grade shall be raised by using risers etc. under the cone or flattop. Existing roadbase shall not be contaminated with soil or subbase. Backfill material around adjusted manholes and utilities shall comply with roadbase standards meeting Section 4.5.7 of these specifications, and be compacted to ninety five percent as determined by ASTM D-1557-78 or AASHTO T-180 Method D. When paving is complete, all manhole and utility covers shall be raised to finished grade, including concrete collars, in accordance with standard requirements.

4.5.18 ASPHALT PAVING EQUIPMENT. A self-propelled paver with a screed unit that provides a smooth, steady pull on the screed arms shall be used. The

screed unit shall strike off, partially compact, and iron the surface of the mat at least twelve feet (3.7 m) wide. The screed unit shall be equipped with automatic controls and heaters and vibrators. The screed plate must be smooth and not excessively worn. All screed extensions shall be ridged, or hydraulically extendable. The screed extensions shall maintain the proper elevation and angle of attack to the main screed at all times and shall also be heated and provide vibration. Augers shall adequately feed all areas of the extended screed.

The automatic screed controls shall be full contact electronic or non-contact ultrasonic grade control systems. These systems shall be adaptable to a floating-beam system a minimum of thirty feet long. The floating-beam shall be equipped with shoes that are allowed to rotate and can be individually displaced by isolated disruptions in the existing surface without changing the height of the whole beam. The automatic grade sensor shall be set at the midpoint of the floating beam.

Ultrasonic grade control systems may be used without the floating beam on all Traffic Category II streets unless otherwise directed. The ultrasonic grade control system must meet the following conditions in order to be used without the floating beam.

4.5.18.1 The system shall be equipped with a "self diagnostic" function that continuously monitors all system functions and shuts the system down if an error in the system occurs. It shall also be equipped with a "reference bail" to electronically compensate for differences in air and ground temperature with a minimum operating range not less than zero to 160 degrees F. (-18 to 71 degrees C.).

4.5.18.2 The system shall perform to a minimum of the following specifications:

Ultra sonic grade controller:

- On-grade tolerance ±0.01 foot
- Resolution 0.001 foot
- Operating range 10 in. to 42 in.
- Mat thickness control - 0.01 foot

Slope controller:

- Correction window - 1.0%
- On-grade tolerance - 0.1%
- Resolution - 0.01%
- Operating range ±0.0% to 100%.

The systems meeting the above requirements must be properly installed on a "tight," properly maintained self-propelled paver with a screed unit. A "tight" system shall meet the equipment manufacturer's service specification tolerances for all controlling surfaces and connecting points that affect the ability of that specific type of equipment to provide proper grade control.

The City's Representative has the right to prohibit the use of such equipment if in his opinion the equipment has not been properly maintained or is not being properly operated.

If the automatic grade control becomes inoperative, the Contractor may finish the day's work using manual controls provided the required grade, thickness and smoothness tolerances are met. Paving shall not continue on the project, or any new project, until the automatic control system has been repaired.

4.5.19 ROLLERS. Rollers shall be vibratory, steel-wheeled double-drum with a static weight of not less than 10 tons (9.10 tonnes) for breakdown rolling. Pneumatic-tired rollers with a minimum operating weight of two thousand pounds (907 kg) per tire shall be used for intermediate rolling and leveling course compaction. The roller shall be in good condition, and capable of reversing without backlash. The number of rollers shall be sufficient to compact the asphalt mixture before it cools below 175°F (80°C). Finish rolling may be performed with the breakdown roller in the static mode, or with a steel-wheeled roller of sufficient size to remove the roller marks in the finished surface. If a roller breaks down and a back-up roller is not available, paving operations shall stop until adequate rollers are available.

4.5.20 WEATHER AND DATE LIMITATIONS. Asphalt shall not be placed during the period from December 1st through February 15th unless otherwise approved by the City Engineer. Paving approved during this time shall conform to winter paving requirements and policies. Minor repairs and patching will be allowed during winter months.

The asphalt mixture shall not be placed upon any wet surface, or when the air and surface temperature of the underlying course is less than specified in Table 4.8. The temperature requirements may be modified, but only when so approved and directed by the City Engineer. Open-graded asphalt mix shall be placed only when the air temperature is 70°F (21°C) and rising, and the surface temperature is a minimum of 60°F (16°C). Air and roadbed temperature shall be measured in the shade. Asphalt mixtures shall not be placed during adverse weather conditions such as rain, wind, hail, etc.