Asphalt Paving Design Guide

Mississippi Asphalt Pavement Association, Inc.

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History Of Asphalt

The story of asphalt begins thousands of years before the founding of the United States. Asphalt occurs naturally in both asphalt lakes and in rock asphalt (a mixture of sand, limestone and asphalt).

The ancient Mesopotamians used it to waterproof temple baths and water tanks. The Phoenicians caulked the seams of their merchant ships with asphalt. In the days of the Pharaohs, Egyptians used the material as mortar for rocks laid along the banks of the Nile to prevent erosion, and the infant Moses' basket was waterproofed with asphalt.

625 B.C.

The first recorded use of asphalt as a roadbuilding material in Babylon. The ancient Greeks were also familiar with asphalt. The word asphalt comes from the Greek" asphaltos," meaning "secure." The Romans used it to seal their baths, reservoirs and aqueducts.

Early 1800's

Thomas Telford built more than 900 miles of roads in Scotland, perfecting the method of building roads with broken stones. His contemporary. John Loudon McAdam, used broken stone joined to form a hard surface to build a Scottish turnpike. Later, to reduce dust and maintenance, builders used hot tar to bond the broken stones together, producing "tarmacadam" pavements.

1900

Frederick J. Warren filed a patent for "Bitulithic" pavement, a mixture of bitumen and aggregate ("bitu" from "bitumen" and "lithic" from "lithos," the Greek word for rock). The first modern asphalt facility was built in 1901 by Warren Brothers in East Cambridge, Mass.

1942

During World War II, asphalt technology greatly improved, spurred by the need of military aircraft for surfaces that could stand up to heavier loads.

1956

Congress passed the Interstate Highways Act, allotting $51 billion to the states for road construction. Contractors needed bigger and better equipment. Innovations since then include electronic leveling controls, extra-wide finishers for paving two lanes at once and vibratory steelwheel rollers.

1960's

Founded in 1968, the Mississippi Asphalt Pavement Association, Inc. is a 501-C6 educational and technical trade association representing the asphalt pavement producers of Mississippi. The mission has changed over the life of the association as needed. The need for public support of highway construction and maintenance neccesitated the primary focus be on legislative issues affecting the industry. It is our wish this manual will serve you well and we thank you for your interest in quality pavements.

1970's

The national energy crisis underscored the need for conservation of natural resources. Since that time, an increasing amount of recycled asphalt has been incorporated in mixes. Today, asphalt pavement is America's most recycled material with more than 70 million metric tons of asphalt paving material is recycled each year.

1986

NAPA established the National Center for Asphalt Technology (NCAT) at Auburn University, Alabama, providing a centralized, systematic approach to asphalt research. NCAT recently opened a new research center and test track and is now the world's leading institution for asphalt pavement research.

MAPA partnered with the Mississippi Department of Transportation (MDOT) in the implemention of the SUPERPAVE Design Processs which is one of the design procedures featured in this manual. This has been a long untraveled process that culminated in the superior pavements we produce today. Mississippi was the first state in the nation to adopt the system which is now the standard in most all states. No state has been more on the cutting edge of asphalt technology than Mississippi. We are very proud of being recognized as a National Leader in Asphalt Technology advancements.

2002

The EPA announced that asphalt plants are no longer on its list of industries considered major sources of hazardous air pollutants.

Asphalt design has evolved in recent years to the point that we can provide a pavement structure that will perform in any condition.

Ultimately, the goal of this publicaton is to provide you the customer with enough information to develop your own best practices guide and to share practical experience to further improve the performance of your pavements.

Aspects perceived by users as needing refinement. This manual summarizes what changes have been made to the Superpave system and the rationale for those changes.

2017

47,000,000 ESAL's (equivilent single axle loadings) of Mississippi's 4.75 mm low volume mix placed in 2003 at the National NCAT Test track, in Auburn, AL has proven to be unparalled in performance.

Mississippi Rides On Us!

Asphalt Pavement - The Ideal Choice

The parking lot is the first - and the last - part of a building complex to be viewed by the user. It is the gateway through which all customers, visitors, and employee's pass. This first impression is very important to the overall feeling and atmosphere conveyed to the user.

Developers want their new facilities to be attractive, well designed, and functional. Though many hours are spent on producing aesthetically pleasing building designs, the same design consideration for the parking area is often overlooked. Pavements in parking areas that are initially under-designed can experience excessive maintenance problems and a shortened service life.

When properly designed and constructed, parking areas can be an attractive part of the facility that is also safe, and most important, usable to the maximum degree. Parking areas should be designed for low maintenance costs and easy modification for changes in use patterns.

This design guide provides general information for proper parking area design, construction, and facility layout. The Superpave Hot Mix Asphalt (Asphalt) mixes that are recommended for paving parking lots can vary from fine graded mixes to coarse graded mixes. Each mix type requires that the paving contractor pay special attention to the plant produced mix properties and the methods that are used during placement and compaction. Two important components of this document are the section on controlling the volumetric properties of the mix during construction and the section on construction recommendations for Asphalt paving.

Nothing in this manual is to be construed or interpreted as a replacement for a qualified Engineer. Knowledge of the site geology is vital to proper construction design. The soil conditions of Mississippi are varied and can often change within the confines of a paving project. A soil survey of the property by a Geotechnical Engineer is a money savings for the owner. All too often proper safeguards are established for the facility and ignored in the parking areas.

General Planning

In developing the parking area plan, several important details should be considered. First and foremost in the mind of the developer may be providing the maximum parking capacity in the available space while ensuring convenience and safety. On the other hand, the user will be concerned about sidewalk traffic flow, pedestrian visibility, obstructions and signs. Consideration must also be given to handicap parking. Additionally, areas need to be set aside for bicycle and motorcycle parking. When completed the parking area should be functional, fit into the overall theme for the building, and aesthetically pleasing in its overall appearance.

Criteria have been developed for optimizing parking area space. Among these are the following:

- ♻ *Use rectangular areas where possible.*
- ♻ *Make the long sides of the parking areas parallel.*
- ♻ *Design so that parking stalls are located along the lot's perimeter.*
- ♻ *Use traffic lanes that serve two rows of stalls.*
- ♻ *Special attention should be given to the flow of traffic in and out of the parking lot as well as circulating routes inside the parking lot.*
- ♻ *Keep entrances far away from busy street intersections and from lines of vehicles stopped at a signal or stop sign. Be sure that the entering vehicles can move into the lot on an internal aisle, thereby avoiding entering congestion caused by involvement with turning vehicles.*
- ♻ *A pedestrian traffic-flow study is important to provide information about both safety and convenience.*
- ♻ *Parking lot markings are a very important element of a good parking lot.*
- ♻ *The parking area should be clearly marked to designate parking spaces and to direct traffic flow. As specified in the Manual on Uniform Traffic Control Devices (MUTCD), parking on public streets should be marked out by using white traffic paint, except for dangerous areas, which should be marked in yellow. However, yellow lines are commonly used in off-street parking lots.*
- ♻ *All pavement striping should be four inches in width.*

♻ *New asphalt surfaces can be marked with either traffic paint, thermoplastic, or cold-applied marking tape. For best results with paint application, allow the Hot Mix Asphalt (Asphalt) to cure for several days or up to two weeks depending on aggregate size in the Asphalt used.*

Description

This work shall consist of clearing and grubbing, installation of drainage structures, grading and construction of the project exclusive of the base material and pavement structure, in accordance with these specifications and in reasonably close conformity with the lines, grades and typical section established in the plans or contained in the contract. All regular excavation, minor structure excavation, borrow, removal and disposal of unsuitable material, embankment construction, shaping, compaction and incidentals thereto shall be included in the preparation of the subbase.

Clearing and Grubbing

All vegetation and debris within the limits of the construction, except such objects as are designated to remain, shall be cleared, grubbed, removed and disposed of. All vegetation and objects to remain shall be protected from injury. The contractor shall not damage trees, shrubs, vegetation, fences, structures or other items outside the construction limits. In embankment areas of less than five feet (5'), all stumps, whether sound, unsound or decayed, shall be cleared to a minimum depth of two feet (2') below the original ground level.

Grading

All clearing and grubbing shall be completed prior to beginning grading operations. Topsoil shall be removed from the area of construction, stockpiled within the project right of way for later use. Any surplus topsoil remaining after completion of the project topsoil operations shall be removed or shaped and seeded as directed on the plans or in the contract.

Excavation and embankment construction shall be confined to the minimum area necessary to accommodate the contractor's equipment and work force engaged in the earth moving. Earthwork shall be shaped in such a manner as to permit the runoff of rainwater. Other erosion control methods shall be employed on the project as are necessary to reasonably protect the project and surrounding area for erosion and contamination from on site material. All slopes shall be shaped, topsoiled where specified, seeded and mulched. Extra care shall be taken to prevent contamination of previously seeded and mulched areas.

Regular excavation shall consist of the removal and satisfactory disposal of materials located within the limits of construction, including widening of cuts and shaping of slopes necessary for the preparation of paving area, removal of root mat, stripping of topsoil, cutting of ditches, channels, waterways, intersections, approaches, entrances and other work incidental thereto.

Where rock or boulders are encountered, the contractor will excavate and backfill. Loose rock three inches (3") or greater in diameter shall be removed from slopes prior to topsoil and seeding operations.

Borrow excavation shall consist of approved material required for the construction of embankments or other portions of the work. The contractor shall make his own arrangements for obtaining borrow and pay all cost associated with its acquisition and hauling. Borrow shall not be used until all excavation has been placed in the embankments unless otherwise authorized by the architect or engineer.

All unstable, yielding and unsuitable materials shall be removed from within the limits of construction and disposed of as directed on the plans or the contract. In the event the finished subgrade reveals unsuitable material the contractor shall excavate such material below the grade shown on the plans or as directed. Areas excavated in this manner shall then be backfilled with approved material and shaped to the required grade.

Project embankment construction shall consist of constructing the required embankments, including preparation of the areas on which they are placed and placing and compacting embankment material in undercuts, holes, pits, utility trenches and other depressions within the project limits. No muck, roots, sod or other deleterious material shall be permitted in embankments. Placement and compaction will not be permitted on frozen ground.

Drainage Structures - All drainage structures such as pipe culverts, box culverts, storm drains and sewers and the removal and relaying of existing structures shall be constructed in accordance with the specifications for that structure and in reasonably close conformity with the lines and grade shown on the plans or as established by the architect or engineer. All minor excavation associated with the construction of the drainage structure shall be included in the drainage structure price with the exception of undercutting or unless otherwise noted.

Compaction

All embankment material consisting predominately of earth shall be placed in successive uniform layers not to exceed eight inches (8") in thickness prior to compaction. Each layer shall be compacted to a minimum density of ninety-five percent (95%) maximum theoretical density. Construction equipment shall be uniformly routed over the entire embankment surface of each layer to insure the proper, uniform density is achieved. The best materials shall be reserved for finishing and dressing the embankment surface.

Tolerance

When complete the prepared subgrade surface shall not deviate from the required grade and cross section by more than one inch (1″). Any depression collecting water shall be corrected and properly leveled. All excavation and embankment slopes shall not deviate from the theoretical plane surface by more than six inches (6″) unless otherwise noted on the plans or in the contract.

Soil Sterilant

All off-street paving projects shall have the area under the pavement treated with a high quality commercial sterilant that will prevent the germination of weed seeds in the subgrade. Manufacturers regulations for storage, handling, application and application rate shall be followed. All federal, state and local laws, ordinances and regulations governing the use of such chemicals shall be obeyed.

Method Of Measurement

Clearing and grubbing shall be measured on a lump sum basis with no measurement of the area to be cleared and grubbed. Any adjustments to this area shall be made on the basis of acreage, computed to the nearest one tenth (1/10) acre.

The method of measurement for all grading, including regular excavation, embankment borrow undercutting and unsuitable material shall be in cubic yards. Quantities of regular excavation and borrow shall be measured in their original position by cross-sectioning the area of material. Embankment shall be considered and measured as regular excavation. Undercutting and unsuitable material shall be considered unsuitable material and shall be measured by cross-sectioning the area of unsuitable material and computing quantities using the average-end-area method.

The contractor shall be responsible for determining the effect of the shrinkage or swell factor of the material. No adjustment will be made to any quantities for the factor.

Drainage structures will be measured in accordance with the method(s) established in the specifications governing each structure as will minor structure excavation and backfill.

Soil sterilants will be measured in square yards or as a lump sum.

All seed, straw and fertilizer required in the seeding operation shall not be measured but will be on the lump sum basis at the rate of application shown on the plans or in the contract.

Basis of Payment

The quantities measured or specified in the plans will be paid for at the following unit price for each of the items listed. These prices shall be full compensation for all materials, labor, tools, equipment and incidentals necessary to complete the work.

Clearing and Grubbing .... **Lump Sum**
Regular Excavation (Including Embankment) .... **Price Per Cubic Yard**
Borrow .... **Price Per Cubic Yard**
Unsuitable (Including Undercut Excavation) .... **Price Per Cubic Yard**
Drainage Structures .... **Square Yards or Lump Sum**
As Specified Soil Sterilant .... **Square Yards or Lump Sum**
Seeding .... **Lump Sum**

Temporary erosion control items shall be considered incidental to the preparation of the subbase and shall not be included as a bid item unless otherwise noted on the plans or in the contract. Any permanent erosion control devices shall be listed separately and be paid for on the basis of payment established in the contract.

Sample Specifications Aggregate Base Course

Description

This work shall consist of furnishing and placing one or more courses of aggregates and additives if required, on a prepared subbase in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses and typical cross-section shown on the plans or established by the architect or engineer.

Materials

All aggregate materials shall conform to Mississippi Department of Transportation Standards and Specifications.

Equipment

Any machine, combination of machines or equipment capable of completing the construction in accordance with these specifications without excessive segregation will be permitted. All equipment used in the construction of aggregate base courses should be approved by the architect or engineer prior to use.

Construction

The subbase shall be prepared in accordance with the specifications governing subbase preparation and be true to line and grade.

Aggregate material shall be delivered to the construction site in required gradation. The depth of anyone layer of aggregate material shall not exceed six inches (6″) in compacted thickness when static compaction equipment is used and eight inches (8″) when vibratory rollers are employed. If the material to be spread will exceed these limitations the aggregate should be placed in approximately equal layers.

Compaction

After the aggregate material has been uniformly spread, leveled and shaped to the required grades and elevations, it shall be thoroughly compacted using vibratory, steel wheel or pneumatic-tired type self propelled rollers. The number, type and weight of rollers shall be sufficient to achieve the required density without detrimentally affecting the compacted material.

Any irregularities in the surface shall be corrected by scarifying, remixing, reshaping and recompacting until a smooth surface is secured. If necessary, the contractor shall be required to add sufficient water to the aggregate base course material to insure specified density during compaction.

Aggregate Base Tolerances

After compaction has been completed the base shall be tested for uniformity of aggregate depth and grade. Variances in aggregate base depth or grade shall not exceed one inch (1").

Method of Measurement

Aggregate base courses will be measured in square yards or tons as specified in the contract.

Basis of Payment

Compensation for the construction of the aggregate base course shall be paid for at the contract unit price for the accepted quantities of aggregate base material. That price shall include full compensation for preparing and shaping the subgrade and constructing the base course thereon. This shall include furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

Asphalt Pavement Sample Specifications

Base Course Description

The work shall consist of constructing one or more courses of bituminous concrete base material on the prepared subbase or subgrade in accordance with these specifications. The base course shall be constructed to the lines, grades, thicknesses and typical sections specified in the plans or established by the architect or engineer.

Materials

All Bituminous concrete mixtures shall conform to the Georgia Department of Transportation Standards and Specifications for the type of bituminous concrete specified on the plans or in the contract. The mixture shall be produced in a Plant mix asphalt plant capable of producing Georgia Department of Transportation approved bituminous concrete mixtures.

Tack Coat

When a tack coat is required and specified on the plans or in the contract the bituminous material used shall conform to Georgia Department of Transportation Standards and Specifications for the type and grade specified. Unless otherwise specified in the contract or on the plans the rate of application for tack shall be between 0.03 and 0.10 gallons per square yard.

Placing Limitations

Bituminous mixtures shall not be placed when weather or surface conditions are such that the material cannot be properly handled, transported, furnished or compacted. The surface upon which~ bituminous mixtures are to be placed shall be reasonably free of standing water at the time such materials are spread.

Construction

The Bituminous Concrete base shall be placed on a subbase or subgrade prepared in accordance with the specifications governing subbase preparation.

Hauling Equipment

Trucks used for hauling bituminous mixtures shall have tight, clean smooth metal bodies equipped with a positive locking metal tailgate. Metal surfaces which are to be placed in contact with bituminous mixtures shall be given a thin coat of lime solution or other environmentally approved material to prevent the mixture adhering thereto. Truck bodies shall be drained to prevent an accumulation of excess release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather.

Bituminous Pavers

Bituminous pavers shall be self-contained, power propelled units with an activated screed or strike-off assembly, heated if necessary, and shall be capable of spreading and finishing courses of bituminous plant mix material which will meet the thickness, smoothness, and grade specified on the plans or in the contract. 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 or specified in the contract.

The paver shall have a receiving hopper of sufficient capacity to permit 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 strikoff assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture. The paver shall be capable of operating at a forward speed consistent with satisfactory laying of the mixture.

Rollers

Rollers may be of the vibratory, steel wheel or pneumatic-tired type. They shall be in good condition, capable of reversing without backlash, and operating at slow speeds to avoid displacement of the bituminous mixture. The number, type and weight of rollers shall be sufficient to achieve the required density without detrimentally affecting the compacted material.

Transport, Spread, & Finish

The mixture shall be transported from the mixing plant to the point of use in vehicles conforming to the requirements of the section on Hauling Equipment. Hauling over freshly placed asphalt shall not be permitted until the material has been compacted, as specified and allowed to cool at atmospheric temperature. The mix shall be placed at a temperature consistent with the Asphalt viscosity that will permit required compaction, and have a maximum moisture content of 0.5 per cent. The mixture shall be spread to full width and struck off in a uniform layer of such depth that when compacted shall have the required thickness and shall conform to the grade and contour indicated.

Bituminous concrete base courses shall be placed in approximately equal layers not exceeding four inches (4″) in depth after compaction, except when mixes having a maximum size aggregate of one inch (1″) are used as a base course, the thickness of the layers shall not exceed two inches (2″), unless otherwise authorized.

The speed of the paver shall be regulated to eliminate pulling and tearing of the bituminous mat. Unless otherwise directed, placing shall begin along the centerline of areas to be paved on a crowned section or on a high side of areas with a one-way slope.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread, raked and luted by hand tools. COMPACTION - After spreading, the mixture shall be thoroughly and uniformly compacted with power rollers. Rolling of the mixture shall begin as soon after spreading as it will bear the roller with undue displacement or hair cracking. The speed of the roller shall at all times be sufficiently slow to avoid displacement of the hot mixture. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause shall be corrected at once. The number, type and weight of rollers shall be sufficient to achieve the required density without detrimentally affecting the compacted material. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers or plate compactors.

Pavement Tolerances

The variation of the surface shall not exceed one-half inch (112″) as measured with a ten-foot (10′) straight edge. The base course shall be constructed in accordance with the thickness shown on the plans or outlined in the contract.

Method Of Measurement

Asphalt concrete pavements shall be measured in tons of the type specified as evidenced by plant delivery trucks or in square yards of the specified design thickness. Asphalt cement used in the mixture shall not be a separate item, but will be included in the cost per ton or per square yard of the paving mixture. The asphalt prime or tack coat when shown as a separate item shall be measured in square yards, gallons or as a lump sum.

Basis Of Payment

The Bituminous Concrete will be paid for at the contract price per ton for the type of Bituminous Concrete specified. When a tack coat is required it shall be a separate bid item and will be paid for at the contract price per square yard, per gallon, or as a lump sum. These prices and payments shall be full compensation for the Bituminous Concrete including all materials, additives, labor, tools, equipment, maintenance of traffic and all other incidentals necessary to complete the work.

Sample Specifications Asphaltic Concrete Surface Course

Description

This work shall consist of constructing one or more courses of bituminous concrete on prepared base 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 Architect or Engineer.

Placing Limitations

Bituminous mixtures shall not be placed when weather or surface conditions are such that the material cannot be properly handled, finished or compacted. The surface upon which bituminous mixtures are to be placed shall be reasonably free of standing water at the time such materials are spread.

Hauling Equipment

Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal bodies equipped with a positive locking metal tailgate. Metal surfaces which are to be placed in contact with bituminous mixtures shall be given a thin coat of lime solution or other environmentally approved material to prevent the mixture from adhering thereto. Truck bodies shall be drained to prevent an accumulation of excess release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather.

Bituminous Pavers

Bituminous pavers shall be self-contained, power-propelled units with an activated screed or strike-off assembly, heated if necessary, and shall be capable of spreading and finishing courses or bituminous plant mix material which will meet the thickness, smoothness, and grade specified on the plans or in the contract. 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 or specified in the contract.

The paver shall have a receiving hopper of sufficient capacity to permit 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 strikeoff assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture. The paver shall be capable of operating at forward speed consistent with satisfactory laying of the mixture.

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Removing Depressions & Elevating Curves

Where local irregularities in the existing surface would otherwise result in a course more than three inches (3”) thick after compaction, the surface shall be brought to uniform profile by patching or leveling with bituminous concrete and thoroughly tamping or rolling until it conforms with the surrounding surface. The mixture used shall be the same as that specified for the course to be placed.

In superelavating curves, the mixture shall be placed in courses of such depth as will permit proper compaction. The bitumen content of mixtures used for this purpose may be reduced when approved.

Transporting, Spreading & Finishing

The mixture shall be transported from the mixing plant to the point of use in vehicles conforming to the requirements of the section on Hauling Equipment. Hauling over freshly placed asphalt shall not be permitted until the material has been compacted, as specified and allowed to cool at atmospheric temperature. The mix shall be placed at a temperature consistent with the Asphalt viscosity that will permit required compaction, and have a maximum moisture content of 0.5 per cent. The mixture shall be spread to the full width and struck off in a uniform layer of such depth that when compacted shall have the required thickness and shall conform to the grade and

Overview

The parking lot is the first - and the last - part of a building complex to be viewed by the user. It is the gateway through which all customers, visitors, and employee’s pass. This first impression is very important to the overall feeling and atmosphere conveyed to the user.

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General Planning

In developing the parking area plan, several important details should be considered. First and foremost in the mind of the developer may be providing the maximum parking capacity in the available space while ensuring convenience and safety. On the other hand, the user will be concerned about sidewalk traffic flow, pedestrian visibility, obstructions and signs. Consideration must also be given to handicap parking. Additionally, areas need to be set aside for bicycle and motorcycle parking. When completed the parking area should be functional, fit into the overall theme for the building, and aesthetically pleasing in its overall appearance.

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- Special attention should be given to the flow of traffic in and out of the parking lot as well as circulating routes inside the parking lot. Keep entrances far away from busy street intersections and from lines of vehicles stopped at a signal

or stop sign. Be sure that the entering vehicles can move into the lot on an internal aisle, thereby avoiding entering congestion caused by involvement with turning vehicles. A pedestrian traffic-flow study is important to provide information about both safety and convenience.

- ♻ Parking lot markings are a very important element of a good parking lot. The parking area should be clearly marked to designate parking spaces and to direct traffic flow. As specified in the ***Manual on Uniform Traffic Control Devices (MUTCD),*** parking on public streets should be marked out by using white traffic paint, except for dangerous areas, which should be marked in yellow. However, yellow lines are commonly used in off-street parking lots. All pavement striping should be four inches in width.
- ♻ New asphalt surfaces can be marked with either traffic paint or cold-applied marking tape. For best results with paint application, allow the Asphalt to cure for several days.

Design Considerations

Drainage Provisions – Drainage problems are frequently a major cause of parking area pavement failures. This is especially the case with irrigation sprinkler systems located in parking lot islands and medians. It is critical to keep water away from the subgrade soil. If the subgrade becomes saturated, it will lose strength and stability, making the overlying pavement structure susceptible to breakup under imposed loads.

Drainage provisions should be carefully designed and should be installed early in the construction process. As a general guideline, <u>parking area surfaces should have a minimum slope of 2 percent (2%) or ***1/4*** inch per foot.</u> This guideline may not be realistic when matching curb, gutter, v-pans, planters, ramps, etc. The parking lot should be designed to provide for positive drainage.

Pavement cross slopes of less than 2 percent are hard to construct without the formation of "bird baths", slight depressions that pond water. They should also be constructed so water does not accumulate at the pavement edge. Runoff should be collected in curb and gutters and gutter pans and channeled off of the parking lot. Curb and gutter cross sections should be built so that water flows within the designed flow line and not along the interface between the asphalt pavement and curb face.

Areas of high natural permeability may require an underdrain system to carry water away from the pavement substructure. Any soft or spongy area encountered during construction should be immediately evaluated for underdrain installation or for removal and replacement with suitable materials.

In saturated areas, the use of asphalt base (compared to use of untreated aggregate base) will greatly reduce the potential for strength and stability problems.

Subgrade Preparations – All underground utilities should be protected or relocated before grading. All topsoil should be removed. Low-quality soil may be improved by adding granular materials, lime, asphalt, or other mixtures. Laboratory tests are recommended to evaluate the load-supporting characteristics of the subgrade soil. However, designs are sometimes selected after careful field evaluations based on experience and knowledge of local soil conditions.

The area to be paved should have all rock, debris, and vegetation removed. The area should be treated with a soil sterilant to inhibit future vegetative growth. Grading and compaction of the area should be completed so as to eliminate yielding or pumping of the soil.

The subgrade should be compacted to a uniform density of 95 percent of the maximum density. This should be determined in accordance with Standard or Modified Proctor density (ASTM D698 or ASTM D 1557) as appropriate to the soil type. When finished, the graded subgrade should not deviate from the required grade and cross section by more than one half inch in ten feet. If the subgrade is a fine-grained silt or clay, a separation fabric should be considered for use to prevent the finer material in the subgrade from inundating the more open-graded layers to be placed as a part of the pavement section.

Untreated Aggregate Base Construction – The untreated aggregate base course should consist of one or more layers placed directly on the prepared subgrade, with or without a separation fabric, depending on soil type. It should be spread and compacted with moisture control to the uniform thickness, density and finished grade as required on the plans. The minimum thickness of untreated aggregate base course is four inches. The aggregate material should be of a type approved and suitable for this kind of application.

It should be noted that an untreated aggregate base might be sensitive to water in the subgrade. Pavement failures associated with water in the subgrade are accelerated if an untreated base allows water to enter the pavement structure. Grading should be done to promote natural drainage or other types of underdrain systems should be included in the design.

Prime Coat – An application of low viscosity liquid asphalt may be required over untreated aggregate base before placing the asphalt surface course. A prime coat and its benefits differ with each application, and its use often can be eliminated. Discuss requirements with the paving contractor. If a prime coat is used, AEP (asphalt emulsified prime) should be specified as it is designed to penetrate the base material. The use of a tack coat is not recommended for use as prime coat.

Asphalt Base Construction – The asphalt base course material should be placed directly on the prepared subgrade in one or more lifts. It should be spread and compacted to the thickness indicated on the plans. Compaction of this asphalt base is one of the most important construction operations contributing to the proper performance of the completed pavement. This is why it is so important to have a properly prepared and unyielding subgrade against which to compact. The asphalt base material should meet the specifications for the mix type specified.

Tack Coat – Before placing successive pavement layers, the previous course should be cleaned and a tack coat of diluted emulsified asphalt should be applied if needed. The tack coat may be eliminated if the previous coat is freshly placed and thoroughly clean.

Asphalt Surface Course – Material for the surface course should be an Asphalt mix placed in one or more lifts to the finished lines and grade as shown on the plans. The plant mix material should conform to specifications for Superpave hot mix asphalt.

The Asphalt surface should not vary from established grade by more than one-quarter inch in ten feet when measured in any direction. Any irregularities in the surface of the pavement course should be corrected directly behind the paver. As soon as the material can be compacted without displacement, rolling and compaction should start and should continue until the surface is thoroughly compacted and roller marks disappear.

Thickness Design For Parking Lots

The thickness of the asphalt pavement section for parking lots should be determined using the information presented in Chapters Two and Three of the Guideline for the Design and Use of Asphalt Pavements for Mississippi Roadways, by the Mississippi Asphalt Pavement Association. It is recommended that a qualified design consultant be used to design the pavement structure and layout of the parking lot. The design consultant can design the pavement structure using the methods discussed in Chapters Two and Three, which would provide for the most economical pavement structural section.

Table 1 shows suggested thicknesses for asphalt pavement, full depth asphalt design and also with aggregate base course, for various subgrade CBR values and traffic levels.

#1 Suggested Thickness Design - Parking Lots

Traffic Level	ESALs	Subgrade Class			
		Poor CBR< 5	Fair CBR 6-9	Good CBR 10-19	Excellent CBR>20
Hot Mix Asphalt Over Aggregate Base Course, inches					
I	Up to 10,000 ESALs	2.5/13.0	2.5/8.5	2.5/6.0	2.5/4.0
II	10-50,000 ESALs	3.5/16.0	3.5/11.0	3.5/6.0	3.5/6.0
III	50-100,000 ESALs	4.0/17.0	4.0/12.0	4.0/6.0	4.0/6.0
IV	100-250,000 ESALs	5.0/18.0	4.5/13.0	4.5/6.0	4.5/6.0
V	250-500,000 ESALs	5.5/12.0	5.5/9.5	5.5/6.5	5.5/6.0
VI	500-1,000,000 ESALs	6.0/23.0	6.0/15.5	6.0/7.0	6.0/6.0
Full Depth Asphalt, inches[3]					
I	Up to 10,000 ESALs	6.0	5.0	4.0	4.0
II	10-50,000 ESALs	7.5	5.5	4.5	4.0
III	50-100,000 ESALs	8.0	7.0	5.5	4.5
IV	100-250,000 ESALs	9.0	7.5	6.0	5.5
V	250-500,000 ESALs	10.5	8.5	7.0	6.0
VI	500-1,000,000 ESALs	11.5	9.5	7.5	6.5

1. Inch = 25 mm
2. Excellent subgrade conditions are ideal for full depth asphalt; however, a minimum of 100 (4 inches) of Asphalt is recommended. In some areas, aggregate is needed to provide material to fine grade and to provide a smooth surface to pave on. If needed, 100 mm (4 inches) of aggregate is recommended as a minimum thickness for this purpose.
3. Full Depth Asphalt can be built on poor and fail soils only in dry conditions and when the subgrade soils may be brought up to optimum conditions and compacted to specified density.

Special truck lanes are sometimes required to expedite traffic to loading areas, trash dumpster sites, and equipment areas. Design thicknesses for these lanes or pavement areas should be increased to accommodate the expected ESALs (heavy trucks). If a parking lot is small in size and has low traffic volume but has the weekly or bi-weekly trash truck, it would be more economical to construct the entire parking lot to handle the truck traffic than it would be to construct a heavy traffic lane just for trucks. A lot not constructed to handle heavy trucks will cost more in the long run because of continuing repairs to the pavement being destroyed by heavy trucks.

Planned Stage Construction

Planned stage construction is a means of providing fully adequate pavements with the effective use of funds, materials, and energy. As defined, it is the construction of an Asphalt parking lot or roadway in two or more stages, separated by a predetermined interval of time. In many situations, building pavements by stages makes good economical sense. It is a technique long used by city and highway engineers.

Stage Construction is not maintenance. It is the placement of a minimum depth of pavement during initial construction, and a final surface course placed at a planned future date. HMA paving lends itself to this kind of construction.

As an example, for financial reasons, the owner of a new department store with a 350-space car parking lot decides to stage construct the six and one half inch, full-depth asphalt parking lot. Stage 1 is constructed at the time the store is built. A total depth of four and one half inches of asphalt is placed. Stage Two, consisting of the final surface course of two inches, will be placed at a set time in the future. Consideration must be given to the nominal maximum size aggregate in the mix. The individual lift thickness for any one lift should be three times the nominal maximum size aggregate in the gradation. The truck loading zone and the dumpster-area are paved the full depth during initial construction.

Stage construction has the advantage of providing a thoroughly adequate, all weather pavement for the initial development of an area. Any damage to the Stage 1 pavement caused by traffic, settlements, or utility tear-ups can be repaired prior to placement of the final surface. With proper asphalt tack coat where needed, the Stage Two pavement bonds to the old surface and becomes an integral part of the entire pavement structure.

Where stage construction is planned and there are curb and gutter sections drainage can be a problem. Not all the water from the lower paved area may be able to get into the drainage system. When this is a problem, means for the water to get into the drainage system will have to constructed. Also, if asphalt curbs are used they are usually constructed on the paved surface. Careful planning is critical if stage construction is going to be used.

Note: **reducing the number of project mobilizations by the contractor can minimize the parking lot construction costs. The more times the contractor has to move in and move out of a project the higher the cost. Therefore, it is important for the property owner or its representative to plan the work so as to minimize the number of project mobilizations by the contractor.**

Asphalt Base - Platform

For Building Construction And Site Paving

Site paving is the recommended first step in many types of building construction projects. It offers several advantages as a working mat or platform before building construction begins for shopping centers, schools, manufacturing concerns, warehouses, and similar facilities.

In this technique, an asphalt base course is constructed on a prepared subgrade over the entire area that will become the parking areas, service roadways, and buildings. When building construction is completed, a final asphalt surface course is placed on the asphalt base.

Paving a building site before construction is completed has several benefits. These include the following:

It ensures constant accessibility and provides a firm platform upon which people and machines can operate efficiently speeding construction.

It provides a dry, mud-free area for construction offices, materials storage, and worker parking eliminating dust-control expenditures.

It eliminates the need for costly select material - the asphalt subfloor ensures a floor slab that is dry and waterproof.

Steel-erection costs can be reduced because a smooth, unyielding surface results in greater mobility for cranes and hoists.

The engineer can set nails in the asphalt pavement as vertical and horizontal control points, effectively avoiding the risk of loss or disturbance of this necessary survey work.

Excavation for footings and foundations and trenching for grade beams can be accomplished without regard for the asphalt base.

Superpave Asphalt

Superpave Mix Design –

The Superpave Mix Design Method is the most up to date method for determining the appropriate job mix formula, or "recipe" for combining aggregates and binder into Asphalt pavement material for paving. The mixes produced by the procedure generally have a gradation that is further away from the theoretical maximum density line than the dense graded mixes of the past. However, the new modified oils require higher mix temperatures for mixing and placement.

The major changes with the Superpave Mix Design Method are:

- *Utilization of the Superpave Gyratory Compactor to compact laboratory samples*
- *Composite gradations that tend not to be dense graded*
- *Performance graded binder specification requirements*

The Superpave Gyratory Compactor – The Superpave gyratory compactor was developed during the Strategic Highway Research Program (SHRP). The gyratory compactor better approximates the compactive effort of the vibratory rollers used by the contractor to compact the asphalt mix during construction. The mix designs that are produced with the gyratory compactor still produce an increase in density (pcf) as the oil content is increased up to the point where additional increases in oil start to displace the heavier aggregate particles and the density starts to drop. The number of design gyrations varies based on traffic loading and is similar to the number of blows required for the Marshall Method of Mix Design. Table – 2 shows the Superpave Mixture Properties

Table – 2 Superpave Mixture Properties

Sieve Size	Percent by weight Passing Square Mesh Sieves				
	1 inch	3/4 inch	1/2 inch	3/8 inch	(#4)
	25.0 mm	19.0 mm	12.5 mm	9.5 mm	4.75 mm
37.5 mm (1 ½")	100				
25.0 mm (1")	90 - 100	100			
19.0 mm (3/4")	89 max.	90 - 100	100		
12.5 mm (½")	-	89 max.	90 - 100	100	100
9.5 mm (3/8")	-	-	89 max.	90 - 100	95 - 100
4.75 mm (#4)	-	-	-	89 max.	90 - 100
2.36 mm (#8)	16 - 50	18 - 55	20 - 60	22 - 70	-
1.18 mm (#16)	-	-	-	-	30 - 60
75µm (#200)	4.0 - 9.0	4.0 - 9.0	4.0 - 9.0	4.0 - 9.0	TaTable Cells.0 - 12.0

* These additional screens will be established for the Contractor's Quality Control testing using values from the as used gradation shown on the Design Mix.

[1] For definition of mix aggregate size, see definitions below

Table – 3 shows the Voids in Mineral Aggregate requirements.

Table – 3 Voids In Mineral Aggregate

Nominal Maximum Particle Size [1]	Minimum VMA, % Design Air Voids %		
	3	4	5
½"	13	14	15
¾"	12	13	14
1"	11	12	13

The nominal maximum particle size is one sieve size larger than the first sieve to retain more than 10 percent

AGGREGATE PROPERTY REQUIREMENTS – Aggregate property requirements such as particle hardness, durability, shape; angularity and texture are important and should be followed. Table – 4 shows the Master Range for Superpave Hot Mix Asphalt PavementTable – 4 Master Range Table for SUPERPAVE Hot Mix Asphalt Pavement

Test Property	Traffic Levels Light Cars only	Moderate Light Truck	Heavy Industrial
Design Period ESALs	<100.000	< 3 million	> 3 Million
N Initial Gyrations	6	7	7
N Design Gyrations	50	65	85
N Maximum Gyrations	75	100	130
Air Voids, %	3-5	3-5	3-5
Voids Filled w/ Asphalt, %	65-78	65-78	75-78
Lottman, TSR, % retained, minimum	85%	90%	90%
Lottman, Dry Tensile Strength, psi	30 min	30 min	30 min

Superpave uses the following definitions for designing the aggregate mixture size for the various gradings shown in Table – 4:

1. *Maximum Size* – One sieve size larger than the nominal Maximum size.
2. *Nominal maximum Size* - One sieve size larger than the first sieve to retain more than 10 percent.

For commercial parking lots the "SX" grading should be used for the top mat. Both the "SX" or the "S" grading can be used for lower lifts. The "SG" grading is recommended for the lower lifts for industrial parking lots with heavy traffic. To add additional strength, the "S" grading, rather than the "SX" grading can be used for the top lift of industrial parking lots.

The Superpave system requires high quality aggregates.

Table – 5 summarizes the aggregate quality requirements.

Table – 5 Aggregate Properties for Superpave Asphalt Mixes

Aggregate Test Property	Coarse Retained on # 4	Fine Passing # 4
Fine aggregate Angularity, CP 5113, Method A		45% Minimum
Two Fractured Faces	60% Minimum	
L. A. Abrasion AASHTO T 96	40% Maximum	
Flat and Elongated Pieces, (Ratio 5:1) AASHTO M383	10% Maximum	
Sodium Sulfate Soundness, AASHTO T104	12% Maximum	12% Maximum
Sand Equivalent, AASHTO T176		45% Minimum
Plasticity Index, AASHTO T89 & T90		NP

PG Graded Binders – The Superpave performance Graded (PG) binders are listed in Table – 6.

Table – 6 Recommended PG Graded Asphalt Binders[1]

Traffic Levels	Non Modified Asphalt Binder	Modified Asphalt Binder[2]
< 300,000 ESALs (Light Traffic/ Loading)	PG 64-22	Not Recommended
.3 – 3 Million ESALs (Moderate Traffic/ Loading)	PG 64-22	PG 76-22
< 3 Million ESALs (Heavy/Traffic/ Loading)	PG 64-22 or PG 67-22	PG 76-22 or PG 82-22

1. Environmental and loading conditions need to be considered when selecting the appropriate PG asphalt binder. The use of modified asphalt binders is more suited for severe climate and severe loading areas.

2. Modified asphalt binders are 20% to 40% higher in cost than non-modified asphalts. The cost of modified asphalt binder mixes is dependent on their availability and quantity required. The local asphalt industry should be consulted prior to specifying the use of modified asphalts.

The recommended mixing and compaction temperature for the Superpave Asphalt Mixes are shown in Table – 7

Table – 7 Superpave Asphalt Mixture Temperatures

Asphalt Binder Grade	Mixing Temperature	Minimum Mix Delivery Temperature*
PG 64-22	265-320°F	240° F
PG 76-22	265-320°F	280° F
PG 82-22	280-330°F	280° F

*Delivered mix temperature shall be measured behind the screed.

Gradation – Volumetric Properties

Gradation requirements for Superpave mixes are different from the old dense graded mixes. This change to Superpave Mixes has made it possible to increase available room in the mix to allow for the required volumetric properties of the mix and for sufficient oil, which is necessary to make the mix workable when hot and to protect the aggregate from the effects of moisture when cold.

During the plastic stage, or when the mix is hot there needs to be enough oil present to lubricate the individual aggregate particles during placement and to allow for re-alignment during the compaction process. After compaction and the mix has cooled down and has been opened to traffic there needs to be enough oil present in the pavement to protect the aggregate from the effects of early oxidation and stripping in the presence of water. The allowable room within an aggregate mixture to be occupied by air voids and oil is determined by the percent Voids in Mineral Aggregate (VMA). VMA is a function of aggregate particle shape, texture, and gradation and how tightly the aggregate particles are compacted within the mix.

VMA can be raised by increasing the aggregate's angularity and surface texture and by gap grading the aggregate particle distribution or gradation of the mix. To increase VMA by adjusting the gradation one needs to increase the difference between the No. 4 and No. 8 sieve or do the same between the # 8 and # 40 sieve. When adjusting the gradation curve it is also important not to let the passing # 200 material get too high.

To accomplish this, and to meet the requirements for Superpave, there are basically three alternatives for combining fine and coarse aggregate into a composite gradation:

1. Superpave "Fine" gradations - (Blend – 1, Red)
2. Superpave "S" shaped gradations - (Blend – 2, Blue)
3. Superpave "Coarse" gradations - (Blend – 3, Green)

Where the producer does not have the luxury of a wash plant and or multiple storage capacity the "S" shaped gradation curve has been the choice of most contractors. While not as open graded as the Superpave "Coarse" gradation the "S" gradation still appears coarse. Without special care during placement segregation can be a problem. The more open coarse gradations cool faster, are harder to place and handwork into tight areas where the paver won't fit. When the binders are modified the mixes are much more sticky and harder to move around by hand. Placing these types of mixes in parking lots takes longer and requires special skills.

When the same "S" shaped gradation mix is placed by two different paving crews there can be a noticeable difference in appearance. Crews that are experienced in parking lot paving can usually make the mix look much smoother and tighter looking (less open graded in appearance) than crews that are more experienced in highway paving. Parking lot paving that was placed during cool fall weather can also be much rougher and open graded in appearance than when the same mix is used to pave parking lots during the hotter summer months.

The mixes that are more uniformly graded resulting in smooth shaped gradation curves have higher VMA and higher optimum oil content. These mixes look better in finished pavement. The smooth gradation curves accommodate more oil allowing for better lubrication during placement. The smooth gradation curves, even though they are coarse, can be placed with less voids showing on the surface.

Construction Recommendations

When asphalt mixes designed by Superpave are used for paving parking lots there are some key issues that need to be considered. Initial mix selection is important. Also important is the detail to construction practices, which must be followed when placing the Superpave mixes.

Providing enough compaction effort at sufficient temperatures when paving parking lots can be a problem. Using small parking lot rollers in areas where the placement of the mix is slowed by the need for hand working and stop-and-go short runs with the paver often result in low densities and rough finishes. Also, there is often a problem with mix setting in trucks for long periods of time or even worse, mix that is placed, and then not compacted for long periods of time. The contractor needs to consider these potential problems and make adjustments to his method of paving to minimize the potential for having to compact the mix when it has cooled below the recommended temperatures.

When gradations are on the coarse side the mixes can be a challenge to place on parking lots and other areas where hand working and short run stop-and-go paving is required. Coarse graded mixes also cool faster then fine graded mixes.

Without exception, the Superpave "Fine" gradation mixes are the best looking mixes for parking lots. When available, these mixes would be preferable to either Superpave "Coarse" or "S" shaped gradation mixes.

When the Superpave "Fine" gradation mix is not available for parking lot paving the Superpave "S" shaped curve is the next best choice. When using the "S" shaped asphalt mixes special attention needs to be paid to mix selection as well as field management during paving. What ever mix is used for paving the following things will help make for a better-looking, more durable parking lot pavement.

Make sure that the surface to be paved is properly prepared; both grade and density should be checked. Pay special attention to areas around valve boxes, manholes and other obstructions where it is not easy to get construction equipment.

Try to select a mix that has a smooth gradation curve with low percent passing the #200 sieve and a high VMA.

Select oil contents that will result in mix design voids in the 3 to 4 percent range rather than the 4 to 5 percent range.

Spend time laying out the sequence of paving to minimize the number of passes and set backs required by the paver.

Have a tailgate meeting with the paving crew to exchange ideas, discuss special problems and consider alternatives.

During compaction, follow the temperature recommendations for the new PG graded binders.

Individual lift thickness should be at least 3 times the nominal maximum size aggregate in the gradation, four times is better.

During brake down rolling keep the roller as close to the paver as possible and use extra rollers as required.

Try to minimize hand placement of the mix and limit hand raking as much as possible.

When possible use hot longitudinal joints.

Schedule delivery of the asphalt mix to the project so that it doesn't stay in the trucks longer than necessary. However, remember that the mix will stay much hotter if it remains in the trucks so don't place the mix faster than it can be compacted.

Consider postponing paving if inclement wet or cold weather is pending.

During paving use nuclear gauges to monitor the compaction process. Remember that nuclear gauges often read deeper than the lift thickness being placed. Without a core correction, which will probably not be obtainable for small parking lots, the gauge readings can be misleading.

Upon completion of laydown and compaction the finished grade of the asphalt pavement should be even with or slightly higher than the edges of adjoining gutter pans and curb faces. Also make sure that curb and gutter and cross pan flow lines are properly constructed so that water runs in the gutter portion and not along the interface between the asphalt pavement and concrete.

Summary

Paved parking lots can be constructed so that they serve as a centerpiece for the building they serve. Paving parking lots with the Superpave asphalt mixes can be done so that they are cost effective, structurally competent, and esthetically pleasing. All it takes is a little preplanning and an understanding of how to modify the paving process to accommodate the special challenges of the performance graded (PG) binders and the Superpave Gyratory Mix Design process.

Glossary

A

AASHTO—The American Association of State Highway and Transportation Officials-An organization of highway engineers from the fifty states which develops guides and standards.

AGGREGATE—Any hard, inert, mineral material used for mixing in graduated fragments. It includes sand, gravel, crushed stone, or slag.

ASPHALT—A dark brown to black cementious material, solid, semisolid or liquid in consistency; in which the predominating constituents are bitumens which occur in nature as such or which are obtained as residuem in refining petroleum. Asphalt is a constituent in varying proportions of most crude petroleums. The difference between light and heavy crude oil is the amount of asphaltines, sulpher, and paraffin.

ASPHALT BASE COURSE—A foundation course consisting of mineral aggregate, bound together with asphaltic material.

ASPHALT BINDER COURSE—An intermediate course between a base course and an asphalt surface course. The binder course is usually a coarse-graded aggregate asphalt concrete containing little or no mineral matter passing through the No. 200 sieve.

ASPHALT BLOCKS—Asphalt concrete molded under high pressure. The type of aggregate mixture composition, amount and type of asphalt, and the size and thickness of the blocks may be varied to suit usage requirements.

ASPHALT BLOCK PAVEMENTS—Pavements in which the surface course is constructed of asphalt blocks. These blocks are laid in regular courses as in the case of brick pavements.

ASPHALT CEMENT—Asphalt that is refined to meet specifications for paving, industrial, and special purposes. Its penetration is usually between 40 and 300. The term is often abbreviated AC.

ASPHALT CONCRETE—High quality, thoroughly controlled hot mixture of asphalt cement and well graded, high quality aggregate, thoroughly compacted into uniform dense mass typified by Georgia Department of Transportation Type A, B, E, F & H mixes.

ASPHALT INTERMEDIATE COURSE—(sometimes called Binder Course) A course between a base course and asphalt surface course.

ASPHALT JOINT FILLER—An asphaltic product used for filling cracks and joints in pavement and other structures.

ASPHALT OVERLAY—One or more courses of asphalt construction on an existing pavement. The overlay generally includes a leveling course, to correct the contour of the old pavement, followed by uniform course or courses to provide needed thickness. When overlaying rigid type pavements the overlay should be not less than 4 inches thick to minimize reflection of cracks and joints through the overlay. Greater thickness of overlay may be required depending upon conditions of the old pavement and the traffic to be served.

ASPHALT PAVEMENTS—Pavements consisting of a surface course of mineral aggregate coated and cemented together with asphalt cement on supporting courses such as asphalt bases; crushed stone, slag, or gravel; or on portland cement concrete, brick or block pavement.

ASTM—The American Society for Testing and Materials - a national organization of users and producers of materials that establish standards.

ASPHALT SOIL STABILIZATION—(soil treatment) Treatment of naturally occurring non-plastic or moderately plastic soils with liquid asphalt at normal temperatures. After mixing, areation and compaction provide water resistant base and sub-base courses of improved load bearing qualities.

ASPHALT SURFACE TREATMENTS—Applications of asphaltic materials to any type of road or pavement surface, with or without a cover of mineral aggregate which produce an increase in thickness of less than one inch.

B

BASE COURSE - The layer of material immediately beneath the surface or intermediate course. It may be composed of crushed stone, crushed slag, crushed or uncrushed gravel and sand, or combinations of these materials. It also may be bound with asphalt (Asphalt Base Course).

BINDER COURSE - A transitional layer of bituminous paving between the crushed stone base and the surface course.

BORROW-Suitable material from sources outside the roadway prism used primarily for embankments.

BITUMINOUS CONCRETE—A designed combination of graded crushed stone, filler and bituminous cement mixed in a central plant, laid and compacted while hot.

C

CAPILLARY ACTION—The rise or movement of water in the voids of a soil due to capillary forces.

CBR—(California Bearing Ratio) A measurement of the strength and support value of a crushed stone base or subgrade soil.

CEMENT TREATED BASE—Cement treated base consists of specified soil aggregates and portland cement concrete mixed in pug mill and deposited on the subgrade to the specified thickness.

CHERT — A hard, dark to white, opaque rock composed of silica (chalcedony) with an amorphous or microscopically fine-grained texture. It occurs as nodules (flint) or, less often, in massive beds.

COARSE AGGREGATE—Aggregate particles retained on the NO.8 sieve.

COARSE GRADED AGGREGATE—One having a continuous grading in size of particles from coarse through fine with a predominance of coarse sizes.

COMPACTION—The densification of crushed stone base, subgrade solid or bituminous material by means of vibration or rolling.

CONTRACT—The written agreement executed between the contractor and other parties, setting forth the obligations of the parties thereunder, including, but not limited to the performance of the work, the furnishing of labor and materials, and a basis of payment.

CONTRACTOR—The individual, partnership, corporation or joint venture contracting for performance of prescribed work.

CRUSHED STONE—The product resulting from the artificial crushing of rocks, boulders or large cobblestones with the particles resulting from the crushing operation having all faces fractured.

CRUSHER RUN—Aggregates that have received little or no screenings after initial crushing operations. Crusher run aggregates are generally more economical than screened aggregates.

CUL-DE-SAC—An area at the terminus of a dead-end street or road constructed for the purpose of allowing a vehicle to turn around. Literal – French meaning "bottom of the bag."

CULVERT—Any structure not classified as a bridge which provides an opening under any roadway. CUT-The portion of the roadway formed by excavation below the surface of the earth.

CUTBACK ASPHALT—Asphalt Cement which has been liquified by blending with petroleum solvents. Upon exposure to the atmospheric conditions the solvents evaporate, leaving the asphalt cement to perform its function.

D

DEEP LIFT ASPHALT PAVEMENT—A pavement in which the asphalt base course is placed in one or more lifts of 4 or more inches compacted thickness.

DESIGN CBR—Two-thirds the average of all CBR tests taken on the subgrade of an asphalt paving project. This manual uses design CBR rather than average CBR values for determining pavement thickness to compensate for the CBR test values that fall below the average.

DESIGN THICKNESS—The total pavement structure thickness above the subgrade.

DENSE GRADED AGGREGATE —A mineral aggregate uniformly graded from the maximum size down to and including sufficient mineral dust to reduce the void space in the compacted aggregate to exceedingly small dimensions approximating the size of voids in the dust itself.

DRAINAGE—Structures and facilities for collecting and carrying away water.

E

EARTHWORK—The work consisting of the construction of the roadway excluding the following: Bridges, Pavement Structure and Selected or Capping Material.

EMBANKMENT—A structure of soil, soil-aggregate or broken rock between the embankment foundation and the subgrade.

EMULSIFIED ASPHALT—An emulsion of asphalt cement and water which contains a small amount of an emulsifying agent, a heterogenous system containing two normally immiscible phases (asphalt and water) in which the water forms the continuous phase of the emulsion. and minute globules of asphalt from the discontinuous phase. Emulsified asphalts may be of either the anionic. electro-negatively charged asphalt globules or cationic. electro-positively charged asphalt globules types. depending upon the emulsifying agent.

EQUIPMENT—All machinery, tools and other apparatus, together with the necessary supplies for upkeep and maintenance, necessary for the proper construction and acceptable completion of the work.

EROSION—Removal and transportation of soil by the action of water or wind.

F

FINE AGGREGATE—Aggregate particles passing the NO.8 sieve.

FINE GRADED AGGREGATE— One having a continuous grading in sizes of particles from coarse through fine with predominance of fine sizes.

FLEXIBLE PAVEMENT—A pavement structure which maintains intimate contact with and distributes loads to the subgrade and depends on aggregate interlock, particle friction, and cohesion for stability. Asphalt or Bituminous Concrete pavements are flexible pavements. Concrete is not.

FOG SEAL—A light application of liquid asphalt without mineral aggregate cover. Slow setting asphalt emulsion diluted with water is the preferred type.

FREE WATER (GROUND WATER)—Water that is free to move through a soil mass under the influence of gravity.

FRENCH DRAIN—A trench loosely backfilled with stones, the largest being placed on the bottom and the size decreasinq toward the top.

FULL DEPTH ASPHALT PAVEMENT—An asphalt pavement in which asphalt mixtures are employed for all courses above the subgrade or improved subgrade. A full depth asphalt pavement is laid directly on the prepared subgrade.

G

GRAVEL—A coarse granular material (usually larger than '/4" in dia.) resulting from the natural erosion and disintegration of rock. Crushed gravel i's the result of artificial crushing with most fragments having at least one face resulting from fracture.

H

HMA —Hot Plant Mix Asphalt

HYDROSTATIC PRESSURE—The pressure in a liquid under static conditions; the product of the unit weight of the liquid and the difference in elevation between the given points and the free water elevation

I

IMPROVED SUBGRADE—Any course or courses of select or improved material between the foundation soil and the subbase is usually referred to as the improved subgrade. The improved subgrade can be made up of two or more courses of different quality materials.

L

LEVELING COURSE—An asphalt/aggregate mixture of variable thickness used to eliminate irregularities in the contour of an existing surface prior to superimposed treatment or construction.

LIQUID ASPHALT—An asphalt material having a soft or fluid consistency that is beyond the range of measurement by the normal penetration test, the limit of which is 300 maximum. Liquid asphalts include cutback asphalt and emulsified asphalts.

M

MATERIALS—Any substances specified for use in the construction of the project and its appurtenances.

MEDIUM CURING ASPHALT (MC)—liquid asphalt composed of asphalt cement and a kerosene type diluent of medium volatility.

MICRO-SURFACING) — Micro-Surfacing is a polymer modified cold-mix paving system. Very similar to slurry treatment in appearance and application rates. The similarity ends there. Micro-surfacing uses polymers and other propriatary additives that provide more strength.

MINERAL DUST—The portion of the fine aggregate passing the No. 200 sieve.

MINERAL FILLER—A finely divided mineral product at least 65% of which will pass a No. 200 sieve. Pulverized limestone is the most common manufactured filler. although other stone dust, hydrated lime, portland cement, and certain natural deposits of finely divided mineral matter are also used.

N

NATURAL ASPHALT—Asphalt occurring in nature which has been derived from petroleum by natural processes of evaporation of volatile fractions leaving the asphalt fractions. The native asphalts of most importance are found in the Trinidad and Bermudez Lake deposits. Asphalt from these sources is called Lake Asphalt.

O

OPEN GRADED AGGREGATE— One containing little or no mineral filler or in which the void spaces in the compacted aggregate are relatively large.

OPEN GRADED FRICTION COURSE (OGFC) — Open graded friction course (OGFC) is a specialty hot mix asphalt that contains an open aggregate grading having a large percentage of coarse aggregate with low percentages of mineral matter that is designed as wearing surface to improve frictional resistance, reduce splash and spray, improve nighttime visibility, reduce hydroplaning and/or reduce tire/pavement noise levels.

P

PAVEMENT STRUCTURE (COMBINATION OR COMPOSITE)—All courses of selected material placed on the foundation or subgrade soil, other than any layers or courses constructed in grading operations. When the asphalt pavement is on an old portland cement concrete base, or other rigid-type base, the pavement structure is referred to as a combination-or composite-type pavement structure.

PERCOLATION—The movement of free water through soil.

PERMEABILITY— A measure of the rate or volume of flow of water through a soil.

PERPETUAL PAVEMENT—The standard

PETROLEUM ASPHALT Asphalt refined from crude petroleum.

PLANS—The standard drawings current on the date bids are received, and the official approved plans, profiles, typical cross sections, electronic computer output listings, working drawings and supplemental drawings, or exact reproductions thereof, current on the date bids are received, and all subsequent approved revisions thereto, which show the location, character, dimensions and details of the work to be done.

PLANT MIX—mixture produced in an asphalt mixing plant, which consists of mineral aggregate uniformly coated with asphalt cement or liquid asphalt.

POLYMER— A substance that has a molecular structure consisting chiefly or entirely of a large number of similar units bonded together.

POLYMERIZED LIQUID ASPHALT— Higher traffic counts and heavier loads have placed an ever-increasing demand on asphalt pavements. This has spurred transportation officials to look for new ways to add strength and durability to the pavement. One method that has gained worldwide acceptance is the use of polymer-modified asphalt binders. This product is particularly useful for road intersections and heavy truck traffic areas. Styrene butadiene styrene (SBS) and styrene butadiene rubber (SBR) are the standard polymers specifiers choose. New propriatary products continue to be devoloped and will undoubetedly produce additional benefits such as sound absorbtion, and enhansed skid resistance.

PORTLAND CEMENT CONCRETE—A composite material which consists essentially of portland cement and water as a binding medium within which is mixed coarse and fine particles of crushed stone.

PRIME COAT—An application of low viscosity liquid asphalt to an absorbent surface. It is used to prepare an untreated base for an asphalt surface. The prime penetrates into the base and plugs the voids, hardens the top and helps bind it to the overlying asphalt course. It also reduces the necessity of maintaining an untreated base course prior to placing the asphalt pavement.

PROPOSAL—The offer of a bidder, submitted on the approved official form, to perform the work and to furnish the labor and material at prices set forth therein, valid only when properly signed and guaranteed.

R

RAPID CURING ASPHALT (RC)— Liquid asphalt composed of asphalt cement and a naphtha or gasoline-type diluent of high volatility.

REHABILITATION—The renewal of an existing surface by scarifying and remixing with or without additional material and relaying.

RESURFACING—(also called overlays) - Existing surfaces may be improved by resurfacing (or overlaying) with a plant mix asphalt mat of varying thicknesses. It may be considered in two categories. ' (1) Overlays to provide smooth, skid and water' resistant surfaces or to make improvements in grade and/or cross section. (2) Overlays to strengthen existing pavements to handle heavier loads or increased traffic.

RIGID PAVEMENT—A pavement structure which distributes loads to the subgrade, having as one course a portland cement concrete slab of relatively high bending resistance.

ROAD—A general term denoting a public way for purpose of vehicular travel including the entire area within the right-of-way.

ROADBED—The graded portion of a highway within top and side slopes, prepared as a foundation for the pavement structure and shoulders.

ROCK—From which crushed stone, sand and gravel are made and most suitable for making good aggregates.

S

SAND ASPHALT—A mixture of sand and asphalt cement or liquid asphalt prepared with or without special control of aggregate grading with or without mineral filler. Either mixed-in-place or plant mix construction may be employed. Sand asphalt may be used in construction of both base and surface courses.

SEAL COAT—A thin asphalt surface treatment used to waterproof and improve the texture of an asphalt wearing surface. Depending on the purpose, seal coats mayor may not be covered with aggregate. The main types of seal coats are aggregate seals, fog seals, emulsion slurry seals, and sand seals.

SELECT MATERIAL—Suitable material obtained from roadway cuts, borrow areas, or commercial sources and designated or reserved for use as foundation for the subbase, for subbase material, should surfacing or other specific purposes.

SHEET ASPHALT—A hot mix of asphalt cement with clean angular, graded sand and mineral filler. Its use is ordinarily confined to surface course, usually laid on an intermediate or leveling course.

SHOULDER—The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use and for lateral support of base and surface courses.

SHRP—Strategic Highway Research Program, the Federal Research Program responsible for the development of the Superpave Design Process.

SLOW CURING ASPHALT (SC)— Liquid asphalt composed of asphalt cement and oils of low volatility. SLAG - The air cooled, non-metallic by-product of a blast furnace operation consisting essentially of silicates and aluminosilicates of lime and other bases which is developed simultaneously with iron in a blast furnace. Naturally it is only available in those localities where pig iron is produced. Crushed slag weighs about 80 lbs. per cubic foot.

SLURRY SEAL—A mixture of slow-setting emulsified asphalt, fine aggregate and mineral filler, with water added to produce slurry consistency.

SOIL AGGREGATE—Natural or prepared mixtures consisting predominately of hard, durable particles or fragments of stone, slag, gravel or sand and containing some soil-clay or stone dust conforming to the requirements of specifications.

SOIL CEMENT BASE—Consists of a mixture of the natural subgrade material and portland cement in the proper amounts. After thoroughly mixing, the proper amount of water is added and the material compacted to the required thickness.

STONE MATRIX ASPHALT (SMA)—Sometimes referred to as stone mastic asphalt. A gap graded mixture used in severe loading applications. Stone matrix asphalt (SMA) is a hot mix asphalt consisting of two parts, an aggregate skeleton and an asphalt binder rich mortar. The philosophy of SMA mixtures is, therefore, twofold. First, the mixture must have an aggregate skeleton with particle on particle contact (generally called stone-on-stone contact). Secondly, sufficient mortar of the desired consistency must be provided. Satisfactory mortar consistency and, thus, a durable SMA requires that a relatively high asphalt binder content be used. When used with polymerized asphalt it is the strongest of all asphalt mixtures. SMA should only be utilized on high volume roads.

SOIL SUPPORT—A term expressing the ability of the roadbed material, or subgrade soil, to support the traffic loads transmitted through a flexible pavement structure.

SPECIAL PROVISIONS—Special directions, provisions or requirements peculiar to the project under consideration and not otherwise thoroughly or satisfactorily detailed or set forth in the specifications. They set forth the final contractual intent as to the matter involved.

STAGE CONSTRUCTION—The construction of roads and streets by applying successive layers of asphalt concrete according to design and a predetermined time schedule.

STREET—A general term denoting a public way for purpose of vehicular travel, including the entire area within the right-of-way.

SUBBASE—The course in the asphalt pavement structure immediately below the base course is the subbase. If the subgrade soil is of adequate quality it may serve as the subbase.

SUBCONTRACTOR—Any individual, partnership or corporation to whom the contractor sublets part of the contract.

SUBDRAIN—A structure placed beneath the ground surface to collect and carry away underground water.

SUBGRADE—The uppermost material placed in embankments or unmoved from cuts in the normal grading of the roadbed. It is the foundation for the asphalt pavement structure. The subgrade soil sometimes is called Basement Soil or Foundation Soil.

SUBGRADE STABILIZATION—Modification of roadbed soils by admixing with stabilizing or chemical agents that will increase load bearing capacity, firmness and resistance to weathering or displacement.

SUBSURFACE DRAINAGE—Removal of free water from various structural components of the pavement or the surrounding soil.

SUPERPAVE— The Superpave (SUperior PERforming Asphalt PAVEments) system is a design process developed to give highway engineers and contractors the tools they need to design asphalt pavements that will perform better under extremes of temperature and heavy traffic loads. Asphalt pavements account for more than 90 percent of all paved highways in the United States, and annual expenditures for asphalt pavements top $10 billion. If asphalt pavements can be designed to last longer we stand to reap the substantial benefits.

The Superpave system primarily addresses two pavement distresses: permanent deformation, which results from inadequate shear strength in the asphalt mix; and low temperature cracking, which is generated when an asphalt pavement shrinks and the tensile stress exceeds the tensile strength.The Superpave system consists of three interrelated elements:

- ♻ Asphalt binder specification.
- ♻ Volumetric mix design and analysis system.

- Mix analysis tests and a performance prediction system that includes computer environmental and performance models.

SURFACE COURSE—One or more layers of a pavement structure designed to accomodate the traffic load, the top layer of which resists skidding, traffic abrasion and the disintegrating effects of climate. The top layer is sometimes called “wearing course.”

T

THIN OVERLAY—A single course of #8 down asphalt or sand asphalt with no more than 10% of ¼” stone, manufactured in an asphalt concrete plant in accordance with specified gradations and specified amount of a specified penetration asphalt.

U

UNDERDRAIN—A perforated or porous-walled pipe placed with suitable pervious backfill beneath the ground surface to collect and carry away underground water.

V

VISCOSITY—This is a measure of the resistance to flow. The term is used as “high viscosity” or “low viscosity”. A high viscosity material would mean a heavy or stiff material which will not flow easily. A low viscosity material would be the opposite. Viscosity is measured in absolute units called poises. It was formerly measured in imperical values of time, distance and temperature. This method was called Saybolt Furol Viscosity.

W

WEARING COURSE— The top course of asphalt pavements, also called the surface course.