

Tenth Edition 2008

# HOT MIX ASPHALT PAVEMENT DESIGN GUIDE



The Maryland Asphalt Association, Inc.

# **Requirements for Successful Asphalt Pavement Construction**

**1 GOOD PLANNING**

**2 GOOD DESIGN**

**3 GOOD CONSTRUCTION**

**A) Materials**

**B) Subgrade**

**C) Workmanship**

**4 GOOD MAINTENANCE**

published for  
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# INTRODUCTION

This guide is provided by the Maryland Asphalt Association as a tool for owners, architects, engineers and developers when preparing plans and specifications for pavements to be constructed in Maryland.

The guide is not intended to be used as a substitute for professional asphalt pavement design by competent engineers using specific traffic and soils information. By necessity this manual uses generalizations and simplifications; however, the use of these designs and specifications, together with proper construction controls, will provide users with economic and satisfactory pavements that will provide good performance with relatively little maintenance.

The tenth edition of this guide has been prepared in order to bring designers information on the current Maryland State Highway Administration Specifications and to incorporate the latest knowledge, techniques and technology that have been developed in asphalt pavement construction over the past several years. This publication is not intended to set standards or regulations. ***The roadway typical sections are Perpetual Pavements and have been verified using the Per Road Flexible Perpetual Design & Analysis Software.***

## HOT MIX ASPHALT

### WHAT IS HOT MIX ASPHALT?

Hot mix asphalt may be referred to by several names. In different sections of the state it may also be referred to as bituminous concrete, hot plant mix, asphalt concrete, blacktop or Superpave.

Hot mix asphalt is composed of aggregate bound together into a solid mass by asphalt cement. The aggregates total ninety-three (93) to ninety-seven (97) percent by weight of the total mixture and are mixed with three (3) to seven (7) percent asphalt cement. It is manufactured in a central mixing plant where the asphalt and aggregates are heated, properly proportioned, and mixed. The completed paving mixture is hauled by trucks to the mechanical spreader where it is placed in a smooth layer and compacted by rollers while still hot. (Hot mix asphalt may be placed by hand when it is impractical to use a paver.)

Asphalt pavements are constructed of one or more courses of hot mix asphalt placed directly on the subgrade or on a subbase.

### HOT MIX ASPHALT SPECIFICATIONS

All work involving hot mix asphalt pavements and resurfacing can be covered by using the Maryland State Highway Administration July 2008 Standard Specifications for Construction and Materials in conjunction with the typical sections that follow.

### HOT MIX ASPHALT RESURFACING

Resurfacing is the placing of one or more courses of hot mix asphalt over an existing hard surface pavement. This is the most often used means for salvaging and extending the service life of older deteriorating pavements.

### ADVANTAGES OF HOT MIX ASPHALT

#### 1. Versatility

Hot mix asphalt pavements can be designed to handle virtually any traffic loading, soils and materials, and can be used to salvage old pavements as well as to build new ones. Phased construction can easily be incorporated.

#### 2. Economy

Hot Mix Asphalt Pavements are:

- economical to construct
- may be constructed rapidly and are immediately ready for use
- may be recycled
- require minimal maintenance
- provide outstanding performance

#### 3. HMA pavements are not affected by ice control chemicals.

#### 4. Building and site esthetics are enhanced.

#### 5. Traffic noise is minimized when HMA pavement is used.

#### 6. Pavement striping is highly visible on the dark colored surface.

#### 7. HMA is a flexible-type pavement.

# ***SUPERPAVE***

Superpave is a state of the art paving system which our industry and the state of Maryland embraced in the late 1990's. Marshall mixes are no longer readily available and should be replaced with the appropriate Superpave specifications.

There are four important Superpave parameters which the owner must specify in order to insure the proper design. These parameters include the type of liquid asphalt which, in all but the most unusual circumstances should be PG 64-22; the compaction level should be "N Design 50" or Level 1 for all applications except minor or principal arterial streets. The next two parameters go hand in hand and should always be considered together. Aggregate size and lift thickness are inseparable. All mix selections should allow for at least 4 times the nominal maximum aggregate size for the desired lift thickness. This means 9.5mm aggregate surfaces should be a minimum of 1-1/2" thick.

Please consult with the Maryland Asphalt Association for guidance in specifying the proper superpave specification for your individual project.

## **SPECIFICATIONS FOR HOT MIX ASPHALT**

There are a wide variety of hot mix asphalt compositions used in Maryland that vary from fine to coarse in size and gradation. Furthermore, Maryland hot mix asphalt mixtures utilize different aggregates or combinations of aggregates, the principal types being crushed stone, sand, gravel, bank run gravel, roofing shingles and recycled asphalt pavement. Economics require the use of locally available aggregates.

The most widely used hot mix asphalt specifications in Maryland are those contained in the State Highway Administration Standard Specifications for Construction and Materials dated July 2008 including revisions and additions.

The Maryland Asphalt Association recommends the use of these specifications.

## **BASE DESIGNATIONS**

### **19 MM Superpave**

Generally a minimum lift thickness of 3" is recommended. Aggregate sizes of the mix design should be checked prior to use in thinner lifts.

### **12.5 MM Superpave**

Generally a minimum lift thickness of 2" is recommended. Aggregate sizes of the mix design should be checked prior to use in thinner lifts.

## **SURFACE DESIGNATIONS**

### **9.5 MM Superpave**

This surface mix is recommended for most surface applications. Recommended minimum lift thickness 1 1/2".

### **4.75 MM Superpave**

This mix is designed primarily for thin lift leveling or correcting minor deviations. It is a fine mix that can be placed in lifts as thin as 1/2". It should not be placed in lifts exceeding 1" and should not normally be specified as a final wearing course for structural repairs or resurfacings.

### **SMA (Stone Matrix Asphalt)**

This is a high stability mix designed for specific conditions such as high volume Interstate Highways.

## ASPHALT PAVING MIXTURES

The pavement design requires the proper hot mix asphalt paving mixtures for the base and surface pavements.

It is important that a Job Mix Formula for the paving mixture be established for and approved by the engineer. A reputable hot mix asphalt producer, providing standard mixes, can readily furnish the engineer with a written Job Mix Formula.

The asphalt mixtures referred to in this manual are Maryland State Highway Administration Job Mix Designs which are readily available throughout Maryland and have proven through extensive use to have all of the desirable characteristics of good asphalt pavements.

## TACK COAT

A tack coat of asphalt (usually emulsified asphalt) is applied to ensure bond between the existing surface and the asphalt overlay. It should be applied in an even, thin coat at a rate of application of .05 gallons per square yard with a tolerance of .01 gallons per square yard. Excessive tack coat can cause slippage or can flush to the surface. All longitudinal and transverse joints shall be properly tacked.

## SUBGRADE SPECIFICATIONS

Topsoil, large rocks and other types of low quality, unsuitable soil shall be removed and replaced. The subgrade must be properly shaped to the desired sections and elevation and shall be compacted so that it is firm, hard and unyielding. A firm and unyielding subgrade is essential for good pavement construction. The Subgrade shall be compacted to 95% of dry weight density as determined by AASHTO Designation T-180, Method C or D as applicable. (Note: There are areas in Maryland where, due to the type of soil, it is not possible to attain 95% of dry weight density using the T-180 Method. In these areas the compaction requirements shall be 95% of the dry weight density as determined by AASHTO Designation T-99 Method.) To prevent growth of weeds, the subgrade should be treated with an approved herbicide. (See NAPA Publication IS-51)



## SPECIFICATIONS

Maryland State Highway Administration Standard Specifications for Construction and Materials, dated July 2008, including revisions and additions, contain the following sections for Hot Mix Asphalt Pavement and Asphalt Cements and Hot Mix Asphalt:

Section 504	—Hot Mix Asphalt Pavement
Section 505	—Hot Mix Asphalt Patches
Section 508	—Milling Existing Hot Mix Asphalt Pavement
Section 901	—Aggregates
Section 904	—Performance graded asphalt bin & HMA
Section 915	—Production Plants
Section 915.02	—Hot Mix Asphalt Plants

## ENGINEERING SERVICES

The Maryland Asphalt Association welcomes the opportunity to work with architects, consulting engineers, public agency officials, owners, and industry engineers in the preparation of pavement specifications, construction details and construction controls toward the end of quality asphalt pavement installations. The Association has professional engineering services available for this purpose. The Associations address and telephone number appear on the back cover. Other sources where information and guidance on asphalt pavement construction may be obtained are:

*National Asphalt Pavement Association  
5100 Forbes Boulevard  
Lanham, Maryland 20706-4413  
(301) 731-4748 FAX(301) 731-4621*

*The Asphalt Institute  
Carlos Rosenberger  
PO Box 337  
2 E. Harrisburg St.  
Dillsburg, PA. 17019  
717-432-5965*

*The Asphalt Institute  
PO. Box 14052  
Lexington, Kentucky 40512-4052  
859-288-4960*

## ESTIMATING QUANTITIES

For a cursory estimate of the quantity of material required, use—1 ton of hot mix asphalt covers 17 square yards, 1" thick.

*A modern hot mix asphalt facility provides high production, good quality mixes (including recycled asphalt pavement if desired) while meeting stringent air quality standards.*

# Recommended Mix Designs

## MAA Chart 1

Low Volume Design Level				
Surface	Aggregate Size	Binder Type	Compaction Level	Recommended Compacted Thickness
Surface	9.5mm	PG64-22	50 gyrations	1.5"
Base	12.5mm	PG64-22	50 gyrations	2"
	19mm	PG64-22	50 gyrations	3"
Minor Arterial Design Level				
Surface	Aggregate Size	Binder Type	Compaction Level	Recommended Compacted Thickness
Surface	9.5mm	PG64-22	50 gyrations	1.5"
Base	12.5mm	PG64-22	50 gyrations	2"
	19mm	PG64-22	50 gyrations	3"
High Volume Design Level				
Surface	Aggregate Size	Binder Type	Compaction Level	Recommended Compacted Thickness
Surface	9.5mm	PG64-22	65 gyrations	1.5"
	9.5mm	PG76-22	65 gyrations	1.5"
Base	9.5mm SMA	PG76-22	80 gyrations	1.5"
	12.5mm SMA	PG76-22	80 gyrations	2"
Base	12.5mm	PG64-22	65 gyrations	2"
	19mm	PG64-22	65 gyrations	3"

Chart 1: Recommended Mixes for Normal HMA Applications (Proposed compaction levels based on NCHRP 9-9 levels @ 4% Per Voids)



# MAA Chart 2

Traffic Designation	Equivalent Single Axle Loadings	Typical Roadway Applications
<b>Low</b>	< 300,000 ESAL's	<ul style="list-style-type: none"> <li>Roadways with very light traffic volumes such as local roads, county roads, and city streets where truck traffic is prohibited or at minimum.</li> <li>Traffic considered local in nature, not regional, or interstate.</li> <li>Special purpose roadways serving recreational sites or areas.</li> </ul>
<b>Moderate</b>	300,000 to < 10,000,000 ESAL's	<ul style="list-style-type: none"> <li>Most local roadways.</li> <li>Two-lane, multilane, divided, and partially or completely controlled access roadways.</li> <li>Medium to highly trafficked city streets, state routes, U.S. highways, and some rural interstates.</li> </ul>
<b>High</b>	> 10,000,000 ESAL's	<ul style="list-style-type: none"> <li>Two-lane, multilane, divided, and partially or completely controlled access roadways.</li> <li>Medium to highly trafficked city streets, state routes, U.S. highways, and some rural interstates.</li> <li>Truck-weighing stations or truck-climbing lanes on two-lane roadways.</li> </ul>

Chart 2: Traffic Volumes

## PAVEMENT DESIGN

The design of a hot mix asphalt pavement requires some knowledge of the following:

- TRAFFIC
- DRAINAGE
- SUBGRADE SOILS SUPPORT

### TRAFFIC

Asphalt pavements must be designed using the proper number and weight of axle loads expected during a given period of time to insure adequate pavement performance. Of primary concern is heavy truck traffic. Pavement life can be significantly affected by truck traffic, therefore, the weight and volume of the heaviest traffic is a principal factor in pavement design. The following traffic assumptions have been made for the purposes of providing typical pavement sections for the following:

- TYPICAL PAVEMENT SECTION 2—Residential Drive**  
Essentially limited to passenger cars.
- TYPICAL PAVEMENT SECTION 3—Parking Lots & Residential or Light Duty Streets present and future traffic limited to passenger cars plus normal service trucks.**
- TYPICAL PAVEMENT SECTION 4—Minor Arterial & Light Industrial Streets present and future traffic limited to a medium duty classification which includes some heavy truck and bus traffic.**
- TYPICAL PAVEMENT SECTION 5—Principal Arterial, Commercial or Industrial Roads present and future traffic is a heavy duty classification.**

## DRAINAGE

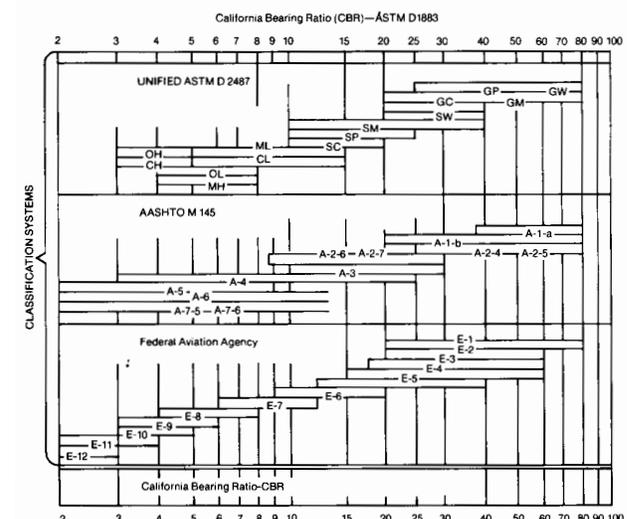
Proper drainage is imperative in the design and construction of hot mix asphalt pavements.

Where high water tables occur or where water may accumulate in low areas, consideration must be given to subsurface drainage. The installation of underdrains and/or interceptor drains may be required to prevent the accumulation of water beneath the pavement structure.

Good surface drainage is also essential. A minimum slope or crown of 1.5% per foot is recommended. The roadway shoulder or adjacent ground should be graded so that surface drainage runs away from the pavement and does not stand on the pavement's edge.

On large parking lots, sloped sections, catch basins, and storm drains may be necessary for proper drainage.

**TABLE I**  
Soil Classification Strengths:



## MAA Chart 3

Relative Quality	R Value	California Bearing Ratio	Highway Soil Classification	Unified Soil Classification
High Quality	Greater than 80	Greater than 70	A-1	GW, SW, GP, GM
Good	55 to 80	20 to 70	A-2, A-3	SW, SP, SM, SC
Weak	25 to 55	5 to 20	A-4, A-5	ML, OL, MH
Very Poor	Less than 25	Less than 5	A-6, A-7	OH, CH, CL

Chart 3: General Ratings of Soil Quality

### SUBGRADE SOILS

*A FIRM AND UNYIELDING SUBGRADE IS ESSENTIAL TO GOOD PAVEMENT CONSTRUCTION.*

For the designs recommended in this manual all soils are divided into three classes: Good (G), Medium (M) and Poor (P).

California Bearing Ratio (CBR) design values are assigned for each class.

It is desirable to use laboratory tests to evaluate the load-supporting characteristics of subgrade soils. However, if laboratory test equipment is not available, designs may be made on the basis of a careful field evaluation by an engineer who can assign the subgrade soils to one of the following categories:

(G) **GOOD SUBGRADE SOILS**—Good subgrade soils retain a substantial amount of their load bearing capacity when wet. Included are the clean sands and sandy gravels and soils free of detrimental amounts of plastic materials. A good subgrade will have a CBR value of 20 or higher.

(M) **MEDIUM SUBGRADE SOILS**—These retain a moderate degree of firmness under adverse moisture conditions. Included are such soils as loams, silty sands and sandy gravels containing moderate amounts of clay and fine silt. A medium classification will have a CBR value of 6 through 20.

(P) **POOR SUBGRADE SOILS**—These soils become quite soft and plastic when wet. Included are those soils having appreciable amounts of clay and fine silt. The coarser silts and sandy loams also may exhibit poor bearing properties in areas where frost penetration into the subgrade is a factor. A poor classification will have a CBR value of 5 or less. Soils with a CBR value of less than 5 should be stabilized or removed and replaced using suitable material. A stable subgrade is always required.

The addition of soil stabilizers such as Portland Cement or lime to the paving sub-grade alters the soil in several ways.

1. Reduction of plasticity of the soil
2. Promotes immediate structural changes in the soil
3. Adjusts the moisture - density relationship
4. Promotes sub-grade soil strength and increased CBR values

The end result is a sub-grade soil that provides an enhanced platform for placing new paving.

California Bearing Ratio (CBR) is a test used for evaluating bases, subgrades and subbases for pavement thickness design. The correlation chart above may be used when one of the system values indicated is known.

The Asphalt Institute's "Soil Manual for Design of Asphalt Pavement Structures" Series No. 10 (MS 10), describes in detail the commonly used soil evaluation systems and test procedures. Field evaluation of the soil involves visual inspection and simple field tests.





*The use of reclaimed material is less expensive than using all virgin aggregate and asphalt. Cold milling existing asphalt pavements allow desired section and grade to be established. It can also be used to maintain a desired height of curbs and bridge clearances when overlaying existing roadways. Existing pavements may be removed by the cold milling process.*

## **HOT MIX ASPHALT RECYCLING**

Hot mix asphalt recycling is a proven technology. It is cost effective, meets all specifications and the quality of the recycled asphalt pavement has been proven to be equal to conventional mixes. When using reclaimed asphalt pavement (RAP) in HMA, the virgin aggregate and asphalt are reduced, therefore a savings can be realized. In addition the use of rap or reclaimed asphalt materials aids the environment. Recycling may include the use of glass, plastic, asphalt, asphalt shingles, and paper.

Removal of badly deteriorated pavements, surface irregularities and maintaining curb reveal, etc. can be economically accomplished with minimal disruption to traffic using the cold milling or carbide grinding process. The RAP obtained through these processes can be recycled in a cost effective rehabilitation process. (Maryland State Highway Administration Standard Specifications for Construction and Materials—Section 508—Milling Existing Hot Mix Asphalt Pavement)

# SIDEWALKS, GOLF CART PATHS, BIKE PATHS

## SUBGRADE

Subgrade soils must be evaluated to determine the load-supporting characteristics. Refer to page 6. The subgrade must be properly shaped to the desired section and elevation and shall be compacted. Refer to page 6.

## DRAINAGE

Good subsurface and surface drainage is essential to quality hot mix asphalt pavements. Refer to page 5.

## HOT MIX ASPHALT CONSTRUCTION

A single course of 9.5 mm mixture is recommended due to the confined areas generally involved where constructing Sidewalk, Golf Cart Paths or Bike Paths except where poor subgrade is encountered. Hot mix asphalt shall be designed mixed and constructed in accordance with Maryland State Highway Administration Standard Specifications for Construction and Materials, July 2008 including revisions and additions.



### CONSTRUCTION DETAILS

Subgrade Class	Surface Course	Compacted Thickness	Design Level	Superpave Mix
Good Medium	Surface Course	3"	Low Volume 50 Gyration	9.5 MM
Poor	Surface Course	4"	Low Volume 50 Gyration	9.5 MM

9.5 mm Surface should be placed by a paver.  
Hand work should be restricted where feasible.

### MARYLAND ASPHALT ASSOCIATION



## RESIDENTIAL DRIVES, PLAY AREAS

### PAVEMENT WIDTH

Residential driveways for a single automobile, the pavement should be a minimum 10' in width. The minimum radius for a right angle where the driveway meets the street is 10'.

### SUBGRADE

Subgrade soils must be evaluated to determine the load-supporting characteristics. Refer to page 6. Top soil must be removed and subgrade properly shaped to the desired section and elevation and shall be compacted. Refer to page 5. Treat the subgrade with an approved herbicide to inhibit future weed growth.

### AGGREGATE BASE CONSTRUCTION

In certain situations graded aggregate base construction may be desirable. See "Pavement Base Course Equivalency" page 16 for recommended thickness.

### DRAINAGE

Good subsurface and surface drainage is essential to quality hot mix asphalt pavements. Refer to page 5.

### TACK COAT

Refer to page 3.

## HOT MIX ASPHALT CONSTRUCTION

Hot mix asphalt shall be designed, mixed and constructed in accordance with Maryland State Highway Administration Standard Specifications for Construction and Materials, July 2008 including revisions and additions.

The hot mix asphalt base may be placed in a single course to the required thickness. Small mechanical pavers are available for this type of construction. When ever possible, hand placement should be avoided. However, where access to the work area is limited, hand placement may be the only feasible method.



### CONSTRUCTION DETAILS

Subgrade Class		Compacted Thickness	Design Level	Superpave Mix
Good Medium	Surface Course	1½"	Low Volume	9.5 MM
	Base Course	2½"	Low Volume	12.5 MM
	Subgrade CBR or Greater than 20			
Poor	Surface Course	1½"	Low Volume	9.5 MM
	Base Course	3½"	Low Volume	12.5 MM
	Subgrade CBR 5			

### SUGGESTIONS FOR OBTAINING A QUALITY RESIDENTIAL DRIVEWAY PAVEMENT

Select contractors known for quality work and established reputations in the community. Ask for local references. Insist on a written contract or agreement. Specify materials and workmanship in accordance with Maryland State Highway Administration Specifications. Specify a minimum compacted thickness.

# PARKING LOTS, RESIDENTIAL OR LIGHT DUTY STREETS, STORAGE AREAS

## DESIGN CRITERIA <1000 ADT 1% TRUCKS SUBGRADE

Subgrade soils must be evaluated to determine the load-supporting characteristics. Refer to page 6.

The subgrade must be properly shaped to the desired section and elevation and shall be compacted. Refer to page 6.

### DRAINAGE

Good subsurface and surface drainage is essential to quality hot mix asphalt pavements. Refer to page 5.

### TACK COAT

Refer to page 3.

### HOT MIX ASPHALT CONSTRUCTION

Hot mix asphalt shall be designed, mixed and constructed in accordance with Maryland State Highway Administration Standard Specifications for Construction and Materials, July 2008 including revisions and additions.

The hot mix asphalt base may be placed in a single course. A total thickness of up to 4.5" of base mix may be placed in one lift. If several courses are desired or if job specifications require several courses, it is recommended that the first base course be 3" minimum depth.

An intermediate course of 9.5mm should be added to reduce permeability and increase durability during construction if the final surface is not scheduled until subdivision build out.



## CONSTRUCTION DETAILS

Subgrade Class		Compacted Thickness	Design Level	Superpave Mix
Good	Surface Course	1½"	Low Volume	9.5 MM
	Base Course	3½"	Low Volume	12.5 MM
	Subgrade CBR 20 or Greater			
Medium	Surface Course	1½"	Low Volume	9.5 MM
	Base Course	4½"	Low Volume	12.5 MM
	Subgrade CBR 6-20			
Poor	Surface Course	1½"	Low Volume	9.5 MM
	Base Course	5½"	Low Volume	19 MM
	Subgrade CBR 5			

# MINOR ARTERIAL AND LIGHT INDUSTRIAL STREETS

## DESIGN CRITERIA <2500 ADT 3% TRUCKS SUBGRADE

Subgrade soils must be evaluated to determine the load-supporting characteristics. Refer to page 6.

The subgrade must be properly shaped to the desired section and elevation and shall be compacted. Refer to page 6.

## DRAINAGE

Good subsurface and surface drainage is essential to quality hot mix asphalt pavements. Refer to page 5.

## TACK COAT

Refer to page 3.

## HOT MIX ASPHALT CONSTRUCTION

Hot mix asphalt shall be designed, mixed and constructed in accordance with Maryland State Highway Administration Standard Specifications for Construction and Materials, July 2008 including revisions and additions.

The hot mix asphalt base may be placed in a single course. A total thickness of up to 4.5" of base mix may be placed in one lift. If several courses are desired or if job specifications require several courses, it is recommended that the first base course be 3" minimum depth.



### CONSTRUCTION DETAILS

Subgrade Class		Compacted Thickness	Design Level	Superpave
Good	Surface Course	2"	Minor Arterial	9.5 MM
	Base Course	4"	Minor Arterial	12.5 MM
	Subgrade CBR 20 or Greater			
Medium	Surface Course	2"	Minor Arterial	9.5 MM
	Base Course	5"	Minor Arterial	12.5 MM
	Subgrade CBR 6-20			
Poor	Surface Course	2"	Minor Arterial	9.5 MM
	Base Course	6½"	Minor Arterial	19 MM
	Subgrade CBR 5			



**PRINCIPAL ARTERIAL,  
COMMERCIAL OR  
INDUSTRIAL ROADS  
DESIGN CRITERIA <4 LANES, 10,000 ADT,  
6% TRUCKS  
SUBGRADE**

Subgrade soils must be evaluated to determine the load-supporting characteristics. Refer to page 6.

The subgrade must be properly shaped to the desired section and elevation and shall be compacted. Refer to page 6.

**DRAINAGE**

Good subsurface and surface drainage is essential to quality hot mix asphalt pavements. Refer to page 5.

**TACK COAT**

Refer to page 3.

**HOT MIX ASPHALT CONSTRUCTION**

Hot mix asphalt shall be designed, mixed and constructed in accordance with Maryland State Highway Administration Standard Specifications for Construction and Materials, July 2008 including revisions and additions.

The hot mix asphalt base may be placed in a single course. A total thickness of up to 4.5" of base mix may be placed in one lift. If several courses are desired or if job specifications require several courses, it is recommended that the first course be 3" minimum depth.

<b>CONSTRUCTION DETAILS</b>				
Subgrade Class		Compacted Thickness	Design Level	Superpave
Good	Surface Course	2"	High Volume	12.5 MM
	Base Course	7"	High Volume	19 MM
	Subgrade CBR 20 or Greater			
Medium	Surface Course	2"	High Volume	12.5 MM
	Base Course	8"	High Volume	19 MM
	Subgrade CBR 6-20			
Poor	Surface Course	2"	High Volume	12.5 MM
	Base Course	9"	High Volume	19 MM
	Subgrade CBR 5			

\* **Mix Selection:** Please refer to NAPA publication "IS 128" for further design assistance.

# TENNIS & MULTI-USE COURTS, RUNNING TRACKS

## SUBGRADE

Subgrade soils must be evaluated to determine the load-supporting characteristics. Refer to page 6.

The subgrade must be properly shaped to the desired section and elevation and shall be compacted. Refer to page 6.

## TACK COAT

Refer to page 3.

## HOT MIX ASPHALT CONSTRUCTION

Hot mix asphalt shall be designed, mixed and constructed in accordance with Maryland State Highway Administration Standard Specifications for Construction and Materials, July 2008 including revisions and additions.

The hot mix asphalt may be placed with a mechanical paver or by hand, if the contractor elects. In either case, for tennis court construction, the finished course must not vary from line, grade or cross-section more than 1/8" in 10' when measured in any direction. For running tracks, the finished course must not vary more than 1/4" in 10'.

Proprietary surfacing is available for tennis courts and running tracks. Most members of The Maryland Asphalt Association are familiar with the various materials and can provide information on them or it may be necessary to contact the manufacturer directly.

## DRAINAGE

The finished tennis court surface should slope 1" in 10', 0.83%, on a true plane from end to end, corner to corner, or side to side. Side to side is preferable for a playing surface and for construction. The surface should not slope to the net or away from the net in more than one direction.

### CONSTRUCTION DETAILS

Subgrade Class		Compacted Thickness	Design Level	Super Pave
Good Medium	Surface Course	1.5"	Low Volume	9.5 MM
	Leveling Course	1.5"	Low Volume	9.5 MM
	Base Course	2"	Low Volume	12.5 MM
	Subgrade CBR 6 or Greater			
Poor	Surface Course	1.5"	Low Volume	9.5 MM
	Leveling	1.5"	Low Volume	9.5 MM
	Base Course	2"	Low Volume	12.5 MM
	Subgrade CBR 3-5			

*A special mix other than 9.5 mm may be used for the surface course for running tracks. There are several resilient hot mixes available which combine rubber aggregate with regular aggregate plus a high asphalt content. Specifications and technical assistance are available from the firms that furnish the special aggregate.*

# HOT MIX ASPHALT RESURFACING

Asphalt overlays are the most common, practical and economical way to salvage, strengthen and modernize old pavements.

Properly designed, constructed and maintained hot mix asphalt pavement resurfacings offer the following advantages:

1. Strengthen existing pavement structurally
2. Reduce maintenance appreciably
3. Extend service life appreciably
4. Allows use of roadway while improvements are in progress
5. Provides safer pavements
6. Improve ride quality and appearance
7. Reduced energy costs
8. 100% Recyclable
9. Provides noise reduction

## RESURFACING CONSIDERATIONS

The key to successful resurfacing is careful evaluation of the existing pavement and the selection of an adequate pavement design. The following information should be considered: 1. Physical condition including surface condition and structural adequacy. 2. Type of construction of existing pavement 3. Drainage of existing pavement 4. Load and traffic use (weight and volume of heaviest traffic) of present and future traffic.

The thickness of the overlay is designed to improve a lower-than-average pavement condition, but not to provide the extra strength needed for localized, structurally weak areas. Should the overlay thickness be based on the weakest condition in the section, it would be overdesigned for the rest of the section, and more costly. The proper procedure is to correct the weaker areas. Removal of structurally weak areas and patching with full-depth hot mix asphalt to ensure strength equal to or exceeding the surrounding pavement is an economical means of preparing for overlays.

A minimum thickness of 4½" of hot mix asphalt is recommended for rigid pavement overlays.

## PAVING FABRIC

Paving fabrics are available for use with HMA overlays. When placed between the original pavement and the HMA overlay or between two courses of an HMA overlay it becomes an integral part of the roadway section. When properly used, fabrics reduce water infiltration and reflective cracking. There are several proprietary fabrics available which should be installed in accordance with the manufacturer's instructions.

The addition of the correct fabric into a pavement overlay reduces the effect of mechanisms which deteriorate pavements and increases the life of the overlay pavement section.

## Paving Fabrics Should:

- Meet AASHTO M288 guidelines for paving fabrics
- Provide a waterproof barrier for subgrade protection
- Improve the fatigue resistance of the new overlay by providing a stress relieving interface

- Retard the propagation of an existing crack through the new overlay (reflective cracking)
- Extend the useful life of the overlay
- Be able to withstand the high temperature of asphalt
- Strengthen the entire pavement section
- Can be used over milled surfaces and are millable & recyclable once installed

A Certificate of Compliance for the paving fabric used on any project should be furnished by the manufacturer to the engineer. The paving fabric shall be supplied in a protective cover that is capable of protecting the fabric from ultraviolet rays, abrasion and water. Paving fabric should meet or exceed AASHTO M288 guidelines.

**Asphalt Sealant:** The engineer shall approve the asphalt cement. A grade of asphalt of the same type used in the manufacture of the hot mix asphalt for the overlay should be acceptable.

## EQUIPMENT:

**Asphalt Distributor:** The distributor must be suitably metered and capable of spraying the asphalt cement uniformly and at the prescribed application rate.

**Fabric Handling Equipment:** A tractor or similar mechanical device with mounted laydown equipment that is capable of handling full rolls of fabric shall be used. The equipment shall be capable of laying the paving fabric smoothly without excessive wrinkles and/or folds.

**Miscellaneous Equipment:** Stiff bristle brooms used to smooth, and scissors (or blades used to cut the paving fabric shall be provided by the installer.

## INSTALLATION PROCEDURE:

**Surface Preparation:** The surface on which the paving fabric is to be placed shall be free of dirt, water, vegetation and other foreign materials. Open cracks 3/8 inch or larger shall be filled with sand mixed asphalt as directed by the engineer. Cracks larger than 3/8 inch or holes shall be filled with cold or hot mix asphalt. The use of a leveling course may be required prior to placing the paving fabric in severe cases.

**Application of Sealant:** The asphalt cement and binder must be uniformly spray-applied at the specified rate. The quantity required may vary with the surface condition of the existing pavement (e.g. degree of porosity), but shall be applied at a nominal rate of 0.25 gallons per square yard of residual asphalt.

Application of asphalt cement will be performed by truck-mounted distribution equipment whenever possible, with hand spraying kept to a minimum.

**Paving Fabric Placement:** The paving fabric shall be placed onto the asphalt cement with a minimum of wrinkles before the asphalt can cool or lose its tackiness.

The paving fabric shall be placed so that the non-heat treated (bearded or fuzzy) side is placed downward into the sealant, thus providing optimum bond between fabric and pavement during the construction process. As directed by the engineer, wrinkles severe enough to cause "folds" shall be slit and laid flat in the direction of paving operations. Brooming the paving fabric will assist in making intimate contact with the pavement surface.

Any overlap of the paving fabric should be minimized, although an overlap of 1 to 3 inches is recommended to insure full closure of overlapping layers. Transverse joints should be shingled (overlapped) in the direction of paving operations to prevent edge pick-up by the paver.

**NOTE:** In the event that asphalt cement should bleed through the paving fabric before the hot mix asphalt is placed, it may be necessary to absorb any visible sealant by spreading sand or hot mix asphalt over those areas. This

should minimize the tendency for construction equipment tires to lift the paving fabric when driving over it. Turning of paving equipment and other vehicles on the paving fabric must be kept to a minimum to avoid movement or damage to the fabric.

## TACK COAT

Refer to page 3

A tack coat of asphalt (usually emulsified asphalt) is applied to ensure bond between the existing surface and the asphalt overlay. It should be applied in an even, thin coat at a rate of application .05 gallons per square yard. Excessive tack coat can cause slippage or can flush to the surface.

All longitudinal and transverse construction joints shall be properly tacked.

### MULTIPLE LIFT RESURFACING CONSTRUCTION DETAILS

	Average Compacted Thickness	Design Level	Superpave
Surface Course	1½"	Refer to MAA Chart 1	9.5 MM
Base Course	Design Thickness	Refer to MAA Chart 1	19.5MM
Leveling (when required)	1" = (variable)	Refer to MAA Chart 1	9.5 MM*
Old Pavement			
Surface Course	1½"	Refer to MAA Chart 1	9.5 MM
Leveling Course	1" = (variable)	Refer to MAA Chart 1	9.5 MM
Old Pavement			

\* If Wedge and Level course exceeds 3" you may consider going to 12.5 mm W/C course.

### HIGH VOLUME SINGLE LIFT RESURFACING CONSTRUCTION DETAILS

	Average Compacted Thickness	Design Level	Superpave
Surface Course	2"	Refer to MAA Chart 1	12.5 MM
Old Pavement			
Surface Course	1½"	Refer to MAA Chart 1	9.5MM
Old Pavement			

## HOT MIX ASPHALT CONSTRUCTION

Hot mix asphalt shall be designed, mixed and constructed in accordance with Maryland State Highway Administration Standard Specifications for Construction and Materials, July 2008 including revisions and additions.

# EQUIVALENCES

Consideration may be given to a pavement section using a graded aggregate base course with a hot mix asphalt binder and surface course. Maryland has several excellent aggregate sources that may make locally available aggregate an economic alternative. All graded aggregate base should meet Maryland State Highway Administration Specifications for Construction and Maintenance, July 2008 including revisions and additions.

Paving materials have different abilities to sustain the loads to which they are subjected. Relative strength values of the various materials used in asphalt pavements have been evaluated so that it is possible to develop designs with different components to give comparable pavement performance. The AASHTO Design Committee from road test findings established a list of coefficients of pavement components for surface, base and subbase courses. The use of these coefficients permits equating materials into inches of one component to inches of another in the asphalt pavement structures.

The criteria established in the AASHTO Guide for Design of Pavement Structures, The Asphalt Institute's "Thickness Design Manual" MS-1, The National Asphalt Paving Association's IS-129 and IS-132, and The Maryland Asphalt Association's experience with millions of square yards of pavements constructed in Maryland were considered and utilized in part to develop the pavement designs and material equivalences used in this manual.

Asphalt pavements must retain a minimum thickness of hot mix asphalt surfacing (including binder courses) when used on granular bases. Minimum surface thicknesses should be increased with increased weight and volume of traffic and when used on poor subgrades.

## PAVEMENT BASE COURSE EQUIVALENCY

ONE INCH HOT MIX ASPHALT BASE COURSE EQUALS 2½" CRUSHER RUN OR GRADED AGGREGATE BASE. RCR-6 (CRUSHED CONCRETE OR RCR-6 (MILLED HMA)).

## OTHER USES FOR HOT MIX ASPHALT

There are a wide variety of uses for hot mix asphalt mixes and/or pavements that are not listed or shown elsewhere in this guide. The same basic principles used for constructing successful pavements would apply to installing pavements for other uses. Some pavement or mix modifications might be required, but are generally, minor in nature. Some of the other uses for the product follow:

### AIRFIELDS

Runways	Holding Areas
Taxiways	Heliports

## MOTOR SPORTS RACE TRACKS

Specialty mixes not included in MAA's "Recommended mixes for normal HMA applications" (Chart 1) may be required. NAPA, The Asphalt Institute and automotive sanctioning bodies should be consulted during the design process.

## DRAINAGE FACILITIES

- Ditches & Gutters
- Curbs
- Berms
- Slope Protection
- Porous Pavements

## EROSION CONTROL

- Jetties & Groins
- Grout for Jetties
- Storm water management ponds

## FARM

- Barnyards
- Feed lots
- Stable Floors
- Silage Storage

## HYDRAULICS

- Reservoir Linings
- Pond Linings
- Dam Faces
- Canal Linings
- Sewage Lagoons
- Leachate facilities

## INDUSTRIAL-COMMERCIAL

- Dock Surfaces
- Building Floors
- Material Storage Areas

## PATCHING

- Maintenance For All Types of Pavements

## RAILROADS

- HMA Ballast Underlayment
- Full Depth Hot Mix Asphalt

## RECREATION

- Boat Ramps
- Athletic Fields
- Skate board and roller blade facilities

NAPA and The Asphalt Institute publications are available for specialized mix design and placement techniques.

## ASSOCIATE MEMBERS

Company	Location	Phone No.	Fax No.
Advanced Asphalt Technologies, L.P.	Sterling, VA	703-444-4200	703-444-4368
Alban Tractor Company, Inc.	Baltimore, MD	410-686-7777	410-686-3729
American Paving Fabrics, Inc.	Hanover, MD	410-379-2209	410-796-0272
Associated Asphalt	Greensboro, NC	336-294-0025	336-297-3316
Astec, Inc.	Chattanooga, TN	423-867-4210	423-867-3570
Bitumar USA, Inc.	Baltimore, MD	410-370-0360	410-757-1471
BP Lubricants USA, Inc.	Baltimore, MD	800-777-1466	410-682-9485
Carroll Independent Fuel Co.	Baltimore, MD	410-235-1066	410-235-1941
Chesapeake Ford & Sterling Truck Sales	Baltimore, MD	410-682-4000	410-391-4357
Constellation New Energy-Gas Division	Baltimore, MD	410-230-4783	410-230-4679
CreaFill Fibers Corporation	Chestertown, MD	800-832-4662	410-810-0793
Financial Benefit Services	Kensington, MD	301-949-1000	301-949-7038
Fleet Transit, Inc.	Baltimore, MD	410-355-7910	410-355-2372
George Associates, Inc.	Silver Spring, MD	301-589-9490	310-588-6605
Hi Tech Asphalt Solutions	Mechanicsville, VA	804-730-4871	804-730-7789
HMS Insurance Associates, Inc.	Brooklandville, MD	410-337-9755	410-337-0551
Humbolt Manufacturing Co.	Raleigh, NC	919-833-3190	919-833-5283
L&J Construction Service, Inc.	Baltimore, MD	410-243-3844	410-243-2309
Luck Stone Corporation	Leesburg, VA	703-777-3177	703-779-4774
Martin Marietta Aggregates	Boonsboro, MD	301-739-0846	301-739-4718
Maryland Materials, Inc.	North East, MD	410-287-8177	410-287-3654
Meeker Equipment Co., Inc.	Lansdale, PA	215-361-2900	215-361-1725
E. Stewart Mitchell, Inc.	Baltimore, MD	410-354-0600	410-354-3029
Nustar Energy LC	West Deptford, NJ	856-224-7200	856-224-7201
Patuxent Materials, Inc.	Crofton, MD	410-793-0181	410-793-0741
QPR a div. of Lafarge	Chester, CT	800-388-4338	678-746-2238
Recon Construction Services, Inc.	York, PA	717-779-0663	717-779-0724
Rifkin, Livingston, Levitan & Silver, LLC	Greenbelt, MD	301-345-7700	301-345-1294
Roadtec, Inc.	Chattanooga, TN	423-265-0600	423-265-7521
Seaboard Asphalt Products Co.	Baltimore, MD	410-355-0330	410-355-5864
Siemens, WT-Hydrocarbon Services	Alexandria, VA	703-370-7306	703-370-8067
Stonetech, LLC	Salisbury, MD	410-742-2851	410-749-7411
Valero Services	Lafayette Hill, PA	888-207-3727	610-567-3291
Volvo Construction Equipment	Elkridge, MD	410-796-3200	410-796-3350
Vulcan Materials Company	Manassas, VA	703-631-9690	703-368-2139
York Building Products Co., Inc.	York, PA	717-848-2831	717-854-9156

***HOT MIX ASPHALT***

***SAFE, SMOOTH, QUIET, DURABLE AND 100% RECYCLABLE***

# MARYLAND ASPHALT ASSOCIATION, INC.

## PRODUCERS

Company	Location	Phone No.	Fax No.
Aggregate Industries Mid-Atlantic	Greenbelt, MD	301-982-1400	301-513-0016
American Infrastructure	Malvern, PA	610-560-7913	610-560-7955
American Paving Corporation	Salisbury, MD	410-742-8484	410-742-0504
David A. Bramble, Inc.	Chestertown, MD	410-778-3023	410-778-3427
Francis O. Day Company, Inc.	Rockville, MD	301-652-2400	301-424-4443
Edgemoor Materials of Maryland, Inc.	North East, MD	410-287-5555	410-287-3481
P. Flanigan & Sons, Inc.	Baltimore, MD	410-467-5900	410-467-3127
C. William Hetzer, Inc.	Hagerstown, MD	301-733-7300	301-733-0812
IA Construction Corp.	Cumberland, MD	301-724-1760	301-724-0864
Keystone Lime Co.	Springs, PA	814-662-2711	814-662-4421
Richard F. Kline, Inc.	Frederick, MD	301-662-8211	301-662-2083
Lafarge North America	Towson, MD	410-847-3300	410-847-3308
Laurel Sand & Gravel, Inc.	Laurel, MD	301-953-7650	301-470-4075
Maryland Paving, Inc.	Aberdeen, MD	410-879-6970	410-879-5478
C J Miller, LLC	Hampstead, MD	410-239-8006	410-239-4204
Fort Myer Construction Corporation	Washington, DC	202-636-9535	202-635-0575
Pennsy Supply Inc./Tilcon Delaware	Dover, DE	302-735-9950	302-678-3379
Reliable Contracting Company, Inc.	Millersville, MD	410-987-0313	410-987-8020
River Asphalt, LLC	Dover, DE	302-342-3137	302-342-3160
Valley Quarries	Chambersburg, PA	717-267-2244	717-267-2521
LW Wolfe Enterprises, Inc.	Myersville, MD	301-293-2351	301-293-3578

## CONTRACTORS

Asphalt General	Beltsville, MD	301-937-3900	301-937-3893
Asphalt & Concrete Services, Inc.	Frederick, MD	301-682-5690	301-682-5695
Melvin Benhoff Sons, Inc.	Baltimore, MD	410-477-5650	410-477-5091
Central Maintenance Corp.	Baltimore, MD	410-355-8800	410-355-4847
College Park Paving Co., Inc.	Beltsville, MD	301-937-1447	301-937-6971
Comer Construction Co.	Forest Hill, MD	410-879-6094	410-638-0289
Dixie Construction Co., Inc.	Churchville, MD	410-879-8055	410-836-2029
Frank J. Goettner Construction Co., Inc.	Kingsville, MD	410-592-7700	410-592-5968
Gray & Son, Inc.	Butler, MD	410-771-4311	410-771-8125
Jacoboni Site Specialists	Baltimore, MD	410-686-2100	410-686-8559
Kinsley Construction, Inc.	Timonium, MD	410-453-6707	410-453-6709
M.T. Laney Co., Inc.	Eldersburg, MD	410-795-1761	410-795-9546
Pleasants Construction, Inc.	Clarksburg, MD	301-428-0800	301-428-3922
Priceless Industries, Inc.	Baltimore, MD	410-285-1900	410-282-8347
Quarry Ridge Asphalt Co.	Cumberland, MD	301-777-8825	301-777-8274
Ross Contracting, Inc.	Mt. Airy, MD	301-831-5500	301-831-5900

## CONSULTING ENGINEERS

Avalon Consulting Services	Baltimore, MD	410-945-9553	410-945-9554
The Robert B. Balter Company	Owings Mills, MD	410-363-1555	410-363-8073
CNA, Inc.	Forest Hill, MD	410-879-7200	410-838-1811
Constellation Design Group, Inc.	Timonium, MD	410-252-1884	410-560-3632
Development Facilitators, Inc.	Millersville, MD	443-308-2100	443-308-2108
EBA Engineering, Inc.	Baltimore, MD	410-358-7171	410-358-7213
Greenhorne & O'Mara, Inc.	Baltimore, MD	410-583-6700	410-583-6704
Greenman-Pedersen, Inc.	Jessup, MD	410-880-3055	301-490-2649
Indam Engineers, Inc.	Ellicott City, MD	410-461-0001	410-461-0006
Johnson, Mirmiran & Thompson	Sparks, MD	410-329-3100	410-472-2200
KCI Technologies, Inc.	Hunt Valley, MD	410-316-7970	410-316-7972
PB Americas, Inc.	Gaithersburg, MD	703-742-5833	703-742-5789
Progressive Engineering Consultants, Inc.	Columbia, MD	410-715-0390	410-715-1745
URS Corporation	Hunt Valley, MD	410-785-7220	410-785-6818
Rummel, Klepper & Kahl	Baltimore, MD	410-728-2900	410-728-2834
Specialized Engineering	Hanover, MD	410-768-4800	410-768-4803
Wallace Montgomery & Associates	Towson, MD	410-494-9093	410-825-5714

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