Colorado Asphalt
Pavement Association

A GUIDELINE FOR THE DESIGN AND CONSTRUCTION OF ASPHALT PARKING LOTS IN COLORADO

Final – 1st Edition
January 2006

This document was developed by the Colorado Asphalt Pavement Association (CAPA). It is intended to be used as a resource in the design and construction of asphalt parking lots in Colorado. CAPA can not accept any responsibility for the inappropriate use of these documents. Engineering judgment and experience must be used to properly utilize the principles and guidelines contained in this document, taking into account available equipment, local materials and conditions. All reasonable care has been taken in the preparation of this guideline; however, the Colorado Asphalt Pavement Association can not accept any responsibility for the consequences of any inaccuracies which it may contain.

For more information, contact .....

Colorado Asphalt Pavement Association
6880 South Yosemite Ct., Suite 110
Centennial, Colorado 80112
P: (303) 741-6150 F: (303) 741-6146
e-mail: office@co-asphalt.com
website: www.co-asphalt.com

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 employees pass. This first impression is very important to the overall feeling and atmosphere conveyed to the user.

Developers and property owners want their 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. In addition, selecting the right materials for the asphalt pavement can assure a pleasing and attractive surface.

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 guide provides general information for proper parking area design and construction. This includes asphalt mixture and pavement design and guidance on selecting the right asphalt mixture. Also included is information on construction best practices and general guidance on facility layout.

The Superpave Hot Mix Asphalt (HMA) mixes that are used 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 HMA paving.

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 or cold-applied marking tape. For best results with paint application, allow the Hot Mix Asphalt (HMA) to cure for several days.

In areas where permeable subgrade material exists, Porous Asphalt pavement can offer a unique opportunity that reduces storm water runoff. This can eliminate the need for detention basins and, in most cases will perform better than detention basins in reducing the quality of runoff and pollutants. A properly designed porous asphalt pavement under the right conditions will provide one solution to stormwater runoff problems as well as groundwater table recharge. Because of the unique design and construction features of this product, information on Porous Asphalt Pavement is found toward the end of this document.

PAVEMENT 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, **parking area surfaces should have a minimum slope of 2 percent (2%) or *1/4* inch per foot.** 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 HMA 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 to stabilize the existing soils. 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 section based on the pavement design, 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** for Class 6 (3/4”) material. The minimum thickness should be increased for larger (1½” or 3”) material. 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 HMA 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.

Hot Mix Asphalt (HMA) 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 HMA 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.

Hot Mix Asphalt (HMA) Surface Course ~ Material for the surface course should be an HMA 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.

For most applications, the HMA surface should not vary from established grade by more than one-quarter inch in ten feet when measured in any direction. This requirement may not be attainable when matching curb, gutter, and V-pans. 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 Colorado Roadways***, by the Colorado 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 HMA pavement, full depth HMA design and also with aggregate base course, for various subgrade CBR/R values and traffic levels.

Table -1
Suggested Thickness Design - Parking Lots

Traffic Level [1]		Subgrade Class			
		Poor CBR $\leq$ 5 R $\leq$ 28	Fair CBR 6-9 R 33-41	Good CBR 10-19 R 43-52	Excellent CBR $\geq$ 20 R $\geq$ 53
		Hot Mix Asphalt over Aggregate Base Course, inches			
Light	Up to 10,000 ESALs	2.5/13.0	2.5/8.5	2.5/6.0	2.5/4.0
	10-50,000 ESALs	3.5/16.0	3.5/11.0	3.5/6.0	3.5/6.0
Moderate	50-100,000 ESALs	4.0/17.0	4.0/12.0	4.0/6.0	4.0/6.0
	100-250,000 ESALs	5.0/18.0	4.5/13.0	4.5/6.0	4.5/6.0
Heavy	250-500,000 ESALs	5.5/12.0	5.5/9.5	5.5/6.5	5.5/6.0
	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]			
Light	Up to 10,000 ESALs	6.0	5.0	4.0	4.0
	10-50,000 ESALs	7.5	5.5	4.5	4.0
Moderate	50-100,000 ESALs	8.0	7.0	5.5	4.5
	100-250,000 ESALs	9.0	7.5	6.0	5.5
Heavy	250-500,000 ESALs	10.5	8.5	7.0	6.0
	500-1,000,000 ESALs	11.5	9.5	7.5	6.5

[1] Light- Passenger Cars Moderate- Passenger Cars and Light Trucks Heavy- Heavy Industrial

1. inch = 25 mm
2. Excellent subgrade conditions are ideal for full depth asphalt; However, a minimum of 100 (4 inches) of HMA 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 loading. 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 HMA 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 HMA 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 a 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 be 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: The parking lot construction costs can be minimized by reducing the number of project mobilizations by the contractor. 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. Cautionary Notice to the designer: If using staged construction (or if the placement of the top lift will be delayed), the pavement section placed should be established so adequate depth of asphalt is provided for construction traffic.

ASPHALT MAT-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 HMA 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 HMA 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.

HOT MIX ASPHALT MIXTURE DESIGN [1]

MIXTURE DESIGN ~ The Superpave Mix Design Method has been incorporated into Colorado practice starting in 1997. Today, nearly all asphalt pavements in Colorado are designed using the Superpave mixture design method. It is the recommended design method for determining the appropriate job mix formula, or "recipe" for combining aggregates and binder into Hot Mixed Asphalt (HMA) pavement material for paving.

[1] Cautionary Notice to the designer: If using staged construction (or if the placement of the top lift will be delayed), the pavement section placed should be established so adequate depth of asphalt is provided for construction traffic.

The major features of 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 (PG) asphalt 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 asphalt binder content is increased up to the point where additional increases in binder 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

Test Property	Traffic Levels		
	Light Cars only	Moderate Light truck Traffic	Heavy Industrial
Design Period ESALs	<100.000	< 3 million	> 3 Million
Initial Gyrations	6	7	8
Design Gyrations	50	75	100
Hveem Stability	NA	28 min.	30 min.
Air Voids, %	3-5	3-5	3-5
Voids Filled w/Asphalt, %	70-80	65-78	65-75
Lottman, TSR, % retained, min.	80 min.	80 min.	80 min.
Lottman, Dry Tensile Strength, psi	30 min.	30 min.	30 min.

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 Pavement.

Table – 4
Master Range Table for Superpave Pave Hot Mix Asphalt Pavement

Sieve Size	Percent by weight Passing Square Mesh Sieves		
	Grading SX (1/2")	Grading S (3/4")	Grading SG (1")
37.5 mm (1 ½")			100
25.0 mm (1")		100	90 – 100
19.0 mm (3/4")	100	90 – 100	
12.5 mm (½")	90 – 100	*	*
9.5 mm (3/8")	*	*	*
4.75 (#4)	*	*	*
2.36 (#8)	28 – 58	23 – 49	19 – 45
1.18 (#16)			
600μm (#30)	*	*	*
300μm (#50)			
150μm (#100)			
75μm (#200)	2 -10	2 -8	1-7

* 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.

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 aggregate 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" and 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. "SG" mixes should be restricted in use to "Special Use" parking lots.

The Superpave system requires high quality aggregates. Table – 5 summarizes the aggregate quality requirements.

Table – 5
Aggregate Properties for Superpave HMA 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	Recommended Gyrations	Non Modified Asphalt Binder	Modified Asphalt Binder[2]
< 300,000 ESALs (Light Traffic/Loading)	50	PG 58-28	PG 58-34
.3 – 3 Million ESALs (Moderate Traffic/Loading)	75	PG 58-28 or PG 64-22	PG 64-28
< 3 Million ESALs (Heavy/Traffic/Loading)	100	PG 64-22	PG 64-28 or 76-28

[1] Environmental and loading conditions need to be considered when selecting the appropriate PG asphalt binder. The use of modified asphalt binders are more suited for severe climate (e.g. mountainous) and severe loading areas.

[2] **Non-Modified asphalt binders (PG 58-28 and PG 64-22) are recommended for standard use in parking lots in Colorado. Modified asphalt binders are 20% to 40% higher in cost than non-modified asphalts and should only be used in parking lots under unique loading or climate conditions.** 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 HMA Mixes are shown in Table – 7

Table – 7
Superpave HMA Mixture Temperatures

Asphalt Binder Grade	Mixing Temperature	Minimum Mix Delivery Temperature*
PG 58-28	260-310° F	235° F
PG 58-34	260-310° F	235° F
PG 64-22	265-320°F	280° F
PG 64-28	265-320°F	280° F
PG 76-28	280-330°F	280° F
*Delivered mix temperature shall be measured behind the screed.		

SELECTING THE RIGHT HOT MIX ASPHALT (HMA) FOR YOUR PROJECT

In the Front Range of Colorado, fine graded mixes are most common. This mixes tend to have a “tight” dense appearance and if combined with adequate asphalt binder, will result in a very good parking lot appearance.

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 and may be more challenging to achieve the required compaction.

Without exception, the Superpave “Fine” gradation mixes (SX) are the best looking mixes for parking lots. It is recommended ½” Mixes (nominal maximum particle size) be used for standard parking lots. These mixes would be preferable to either Superpave “Coarse” or “S” shaped gradation mixes.

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

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

CONSTRUCTION RECOMMENDATIONS

There are several keys to quality construction when placing hot mix asphalt in parking lots. 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.

- 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, man holes and other obstructions where it is not easy to get construction equipment.

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

- Have a "tail gate" meeting with the paving crew to exchange ideas, discuss special problems and consider alternatives.

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

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

- During (initial) break down rolling, keep the roller as close to the paver as possible and use extra rollers as required. Roller distance from the paver and sequence will be affected by the weather conditions and should be adjusted based on the weather conditions.

- 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 remains in the delivery trucks for the shortest duration possible. 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. The HMA should be placed on properly constructed surfaces that are free from water, snow, or ice. Follow published guidelines for cold weather paving when ever possible.

Table 1
Placement Temperature Guidelines

Compacted Layer Thickness in inches (MM)	Minimum Air and Surface Temperature, °F (C)	
	Top Layer of Note [1]	Layers Below Top Layer Note [1]
1 (25) or less	60 (15)	50 (10)
>1-3 (25 -75)	50 (10)	40 (5)
>3 (75)	-	30 (0)

Notes: Air Temperature is taken in the shade. Surface is defined as the existing base on which the new pavement is to be placed.

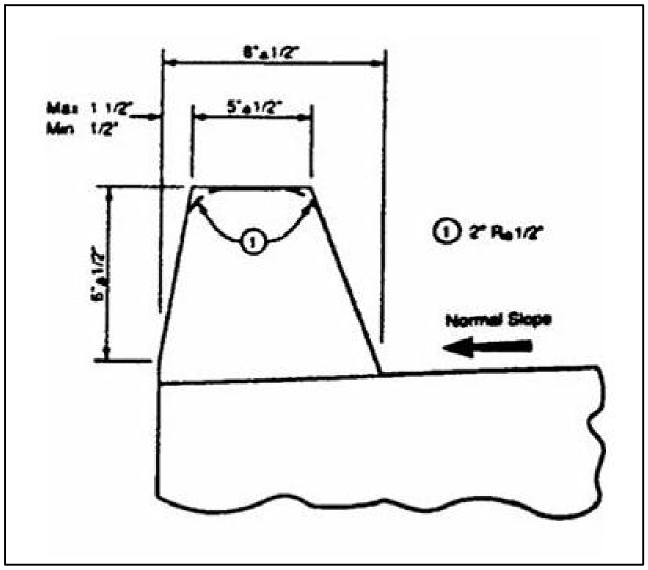
[1] Temperatures to be used when mix contains unmodified asphalt binder (PG 58-28, PG 58-22, PG 64-22). Temperatures to be used with PG 76-28, Pg 70-34, PG 64-28 and PG 58-40.

- 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.
- Warranty – It is standard industry practice to provide a limited 1 year workmanship and materials warranty for asphalt parking lot construction. The warranty is generally limited to premature distress caused by poor workmanship and/or poor quality materials.

HOT MIX ASPHALT (HMA) CURB (OPTIONAL)

Asphalt curbs have become increasingly popular as accessories to paving because they are:
- Economical and easy to construct
- Can be built much faster than other types
- Aren't affected by ice-and snow-melting chemicals
- Able to be laid on an existing pavement using a slip form paver.

Many parking facilities have some form of curbing around the perimeter for both functional and aesthetic reasons. The curbs control drainage, delineate the pavement edge, prevent vehicular encroachment on adjacent areas, and enhances the esthetics of the parking lot. A typical HMA curb cross section is shown in Figure 1.



The asphalt binder content and gradation should be modified as necessary to produce a suitable mixture for HMA curb construction. Curb mixes that are proportioned using aggregate mixture sizes of three eights (3/8") or one half inch (1/2") have proven to be most satisfactory and are recommended for curb construction in Colorado.

Before curb construction begins, the placement area should be cleaned thoroughly. A tack coat should be applied to the pavement surface at a maximum rate of 0.10 gallons per square yard.

The HMA curb should be laid true to the specified line, profile, and cross section with an approved self-propelled curb-laying machine. The mixture should be fed to the hopper of the machine directly from the truck with a chute, conveyor, or by shoveling into the hopper.

HMA curbs should be backed with earth fill or by constructing a double line of curb and filling the median with compacted asphalt mix.

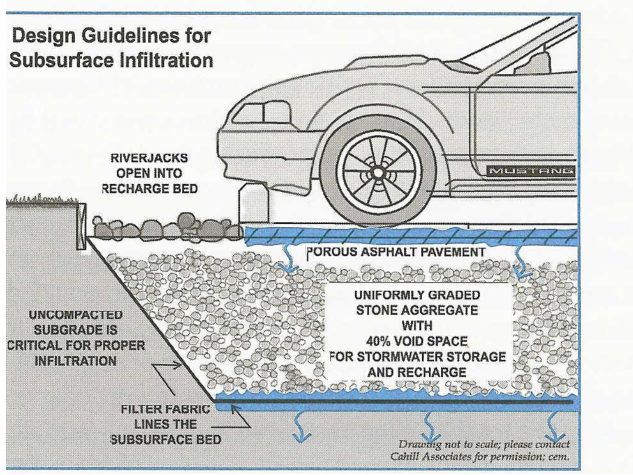
Porous Asphalt Parking Lot Pavements

Background - Porous asphalt parking areas can provide cost effective, attractive parking lots with a life span of 20 years or more. At the same time, this unique pavement design can give stormwater management systems that promote infiltration, improve water quality managements that promote infiltration, improve water quality, and eliminate the need for a detention basin. Water from rainstorms quickly runs off these pervious surfaces. Porous asphalt pavement is comprised of a permeable asphalt surface placed over a granular working platform on top of a reservoir of large stone.

Design Applications - It is recommended that porous asphalt pavement should only be used on sites with gentle slopes, permeable soils (typically 0.50 in/hr) and relatively deep water table and bedrock levels. Soils should be well to moderately drained. Lack of well draining soil may prevent the use of porous asphalt pavement without significant additional site work and drainage features. In arid areas, large quantities of blowing dust will tend to clog the pores of the porous asphalt surface, thereby restricting or even eliminating percolation through the top layer of the system.

A typical porous asphalt pavement consists of a porous asphalt top course, a top filter course, a reservoir course an optional bottom filter course, filter fabric, and existing soil or subgrade material. The porous asphalt course consists of open graded asphalt concrete approximately 2 to 4 inches thick. The pavement should be a mix containing little sand or duct, with a void space of approximately 16% or more. A top filter course, 2 inches thick using 0.5 inch crushed stone aggregate is typically recommended. The reservoir course is a base course of crushed stone of a depth determined by the storage volume, structural capacity, or frost depth, which requires the greater thickness. The minimum thickness for this course is often 8 to 9 inches. This reservoir must not only provide stormwater storage and passage, but it must also carry vehicle traffic loadings. Storage requirements may often be a factor in determining reservoir depth only when the porous pavement system is required to accept stormwater from an area larger than the paved surface. With soils with marginal permeability, the reservoir course thickness would be increased to provide additional storage. With soils composed primarily of clay or silt, the infiltration capacity may be so slow that a porous pavement system may not be appropriate for the site. Below the optional filter course or reservoir course, a filter fabric must be placed to prevent fines from migrating into the reservoir. Below the fabric, the subgrade soil should be undisturbed with minimal use of equipment to prevent soil compaction which may affect permeability.

Typical Porous Pavement Schematic



Construction – It is often best to install the porous pavement towards the end of the construction period. Then, in the later stages of the project, workers can excavate the bed to final grade and install the porous pavement system. Carelessness in compacting the subgrade soils, poor erosion control, and poor quality materials are all causes of failure. Detailed specifications on site preparation, soil protection, and system installation are required. A pre-construction meeting should be held to discuss the need to prevent heavy equipment from compacting soils, the need to prevent sediment-laden waters from washing on to the pavement, the need for clean stone, etc.

Porous Pavement Summary – Because of the unique features of porous pavement it is strongly suggested that these design and other factors be evaluated by a registered Professional Engineer. Detailed design, construction, and maintenance guidelines, as found in the National Asphalt Pavement Association, Information Series 131, “Porous Asphalt Pavement”, should be closely followed.

SUMMARY

Hot Mix Asphalt paved parking lots can be constructed so that they serve as a center piece for the building they serve. Best practices can be followed to ensure that the parking lots using Superpave asphalt mixes can be done so that they are cost effective, structurally competent, and esthetically pleasing. Pre-planning, proper design, and construction are essential to ensure a long lasting asphalt parking lot.