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A GUIDELINE FOR THE DESIGN & CONSTRUCTION OF ASPHALT PARKING LOTS IN OKLAHOMA

OKLAHOMA ASPHALT PAVEMENT ASSOCIATION

This publication is provided by the Members of the Oklahoma Asphalt Pavement Association (OAPA), who are the state's leading asphalt producer/contractor firms and those furnishing equipment and services for the construction of quality asphalt pavements.

OAPA Members are dedicated to providing the highest quality asphalt paving materials and pavements, and to increasing the knowledge of quality asphalt pavement design, construction, maintenance and rehabilitation. OAPA also strongly supports the development and dissemination of research, engineering and educational information that meets Oklahoma's needs in transportation, recreational and environmental pavements.

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This publication is intended to be used as a resource in the the design and construction of asphalt parking lots in Oklahoma. OAPA cannot 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 Oklahoma Asphalt Pavement Association cannot accept any responsibility for the consequences of any inaccuracies which it may contain.

A Guideline for the Design & Construction of Parking Lots in Oklahoma

Introduction

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 asphalt mixes that are used for paving parking lots can vary from fine graded mixes to coarse graded mixes and can be produced as Hot-mix Asphalt (HMA) or as Warm-mix Asphalt (WMA). 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 asphalt 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 storm water 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 presented 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 minimum slope guidelines.** 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 under drain system to carry water away from the pavement substructure. Any soft or spongy area encountered during construction should be immediately evaluated for under drain 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. Poor quality soil may be improved by adding granular materials, soil stabilization, or other mixtures to stabilize the existing soils. Laboratory tests are recommended to evaluate the load supporting characteristics of the subgrade soil and determination of soil type. Based on this determination, the applicability for stabilization or modification due to the presence of sulfate should be considered.

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. Proof rolling is recommended prior to application of the base layer.

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 557) 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.

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 ODOT Type A (3/4") material**. **The minimum thickness should be increased for larger ODOT Type B (1½" - 3") material.** The aggregate material should be of a type approved and suitable for paving applications.

> **The area to be paved should have all rock, debris and vegetation removed.**

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; otherwise, other types of under drain 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 a prime coat.

Hot Mix Asphalt (HMA)/ Warm Mix Asphalt (WMA) 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. The tack coat may be eliminated if the previous coat is freshly placed and thoroughly clean.

Hot Mix Asphalt (HMA)/ Warm Mix Asphalt (WMA)Surface Course

Material for the surface course should be an HMA or WMA 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 Hot or Warm Mix Asphalt. Warm Mix Asphalt is a relatively new technology whereby production and construction temperatures of asphalt concrete mixtures are significantly reduced (50-100°F) via foaming of the asphalt binder or chemical additive. In either case, fumes and emissions are significantly reduced. From a design perspective, current recommendations are to conduct the asphalt mixture design in accordance with established procedures for HMA and then verify the WMA mixture properties during production. More detail regarding WMA is presented later.

For most applications, the finished asphalt 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

Traffic Level[1] (ESAL)		Subgrade Class			
		Poor[2] CBR < 5 R < 28	Fair CBR = 6–9 R = 33–41	Good CBR = 10–19 R = 33–41	Excellent CBR > 20 R > 53
		HMA or WMA / Aggregate Base Course (inches)			
Light	< 10,000	2.5 / 13.0	2.5 / 8.5	2.5 / 6.0	2.5 / 4.0
	10,000-50,000	3.5 / 16.0	3.5 / 11.0	3.5 / 6.0	3.5 / 6.0
Moderate	50,000-100,000	4.0 / 17.0	4.0 / 12.0	4.0 / 6.0	4.0 / 6.0
	100,000-250,000	5.0 / 18.0	4.5 / 13.0	4.5 / 6.0	4.5 / 6.0
Heavy	250,000-500,000	5.5 / 21.0	5.5 / 14.5	5.5 / 6.5	5.5 / 6.0
	> 500,000	6.0 / 23.0	6.0 / 15.5	6.0 / 7.0	6.0 / 6.0
		Full Depth Asphalt[3] (inches)			
Light	< 10,000	6.0	5.0	4.0	4.0
	10,000-50,000	7.5	5.5	4.5	4.0
Moderate	50,000-100,000	8.0	7.0	5.5	4.5
	100,000-250,000	9.0	7.5	6.0	5.5
Heavy	250,000-500,000	10.5	8.5	7.0	6.0
	> 500,000	11.5	9.5	7.5	6.5

[1]Traffic Levels/Categories

- Light – Passenger Cars
- Moderate – Passenger Cars and Light Trucks
- Heavy – Heavy Industrial

[2]Poor subgrade should be addressed and repaired prior to paving.

[3]Excellent subgrade conditions are ideal for full depth asphalt; however, a minimum of four (4) inches of asphalt is recommended. In some areas, aggregate base may be needed to provide material for fine grading and to provide a smooth surface on which to pave. In these cases, a minimum of four (4) inches of aggregate is recommended.

TABLE 1
Suggested Pavement Thickness Designs for Parking Lots

The thickness of the asphalt pavement section for parking lots should be determined using the information presented in ***Design of Hot Mix Asphalt Pavements for Commercial, Industrial and Residential Areas (IS 109***), published by the National Asphalt Pavement Association. It is highly recommended that a qualified pavement design consultant be retained to design the pavement structure and layout of the parking lot. The pavement design consultant can design the pavement structure using the methods described in this guide in accordance with established pavement design procedures which will provide for the most economical pavement structural section.

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

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 biweekly 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 accommodate heavy trucks will cost more in the long run due to the cost of repairs to the pavement resulting from damage by heavy trucks.

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 plants, 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. An asphalt sub floor 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

Mixture Design

The Superpave Mix Design Method has been incorporated into Oklahoma practice starting in 1997. Today, nearly all asphalt pavements in Oklahoma 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 Mix or Warm Mix Asphalt (HMA/WMA) pavement material for paving. However, the pre-Superpave ODOT methodology, procedures and mix criteria specifications have also been included in this manual.

SUPERPAVE
What is it?

SUPERIOR PERFORMING ASPHALT PAVEMENT

- Refers collectively to the products of SHRP Asphalt Research Program
- A System for overcoming rutting, low temperature cracking and fatigue cracking

The major features of the Superpave Mix Design Method are:

- Utilization of the Superpave Gyratory Compactor to compact laboratory samples
- Criteria for the development of the design aggregate structure of the mixture
- 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 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. Regardless of the mix design approach, the optimum quantity of asphalt binder for the mixture is selected on the basis of the volume of air voids in the mixture. Once the level of asphalt binder is determined, mixture properties and criteria shown in Table 2 should be satisfied.

Superpave Gyratory Compactor Diagram

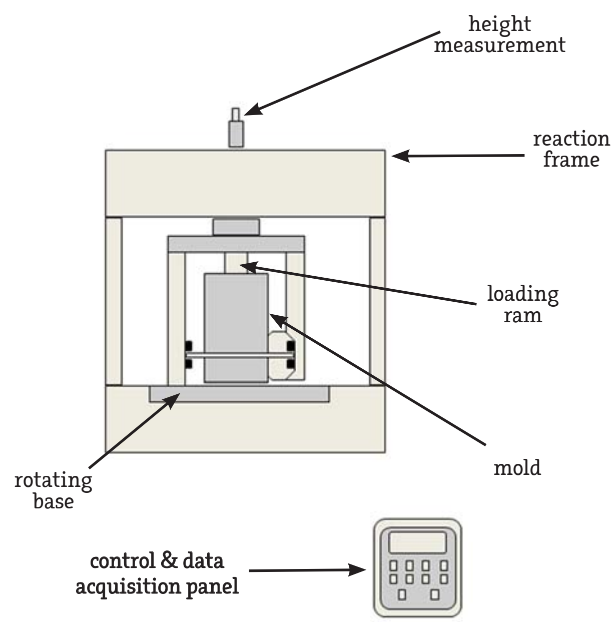


TABLE 2.
Asphalt Mixture Properties and Criteria for Parking Lot Mixtures

Mix Property	Traffic Levels		
	Light	Moderate	Heavy
Design Period ESAL	< 100,000	< 3 million	> 3 million
Design Gyrations (Superpave)	50	75	100
Air Voids, %	3-5	3-5	3-5
Voids in Mineral Aggregate (VMA), %	**VMA Criteria shown in TABLE 3**		
Voids Filled w/ Asphalt (VFA), %	70-80	65-78	65-75
Hveem Stability	28 min.	30 min.	40 min.
Tensile Strength Ratio (TSR), %	80 min.	80 min.	80 min.
Unconditioned Tensile Strength, psi	70 min.	70 min.	70 min.

TABLE 3.
Minimum VMA Criteria for Parking Lot Mixtures

Nominal Maximum Aggregate Size (NMAS) of Mixture[1]	Design Air Voids,%		
	3	4	5
	VMA		
25 mm (1”)	11	12	13
19 mm (3/4”)	12	13	14
12.5 mm (1/2”)	13	14	15
9.5 mm (3/8”)	14	15	16
4.75 mm (#4)	15	16	17

[1]The nominal maximum aggregate size (NMAS) 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 to the performance of the asphalt concrete pavement. Recommended aggregate property criteria are shown in Table 2. Aggregate master grading requirements for Superpave and ODOT designed mixes are shown in Tables 5A and 5B respectively.

The following definitions for determining the aggregate mixture size for the various gradings shown in Table 5 are as follows:

1. Maximum aggregate size (MAS) – One sieve size larger than the nominal maximum size.
2. Nominal maximum aggregate size (NMAS) – One sieve size larger than the first sieve to retain more than 10 percent.

TABLE 4
Mix Thickness Table

Asphalt Mix	Minimum Recommended Lift Thickness	Maximum Recommended Lift Thickness
S-3[1]	3"	5"
S-4	2"	3.5"[2]
S-5	1"	2.5"[2]
Type A[1]	3"	5"
Type B	2"	3.5"[2]
Type C	1"	2.5"[2]

[1]Base Course Mix Only, **NEVER** use as a Surface Course

[2]Surface course paving should not exceed 2.5”. Surface course paving in excess of 2.5” will suffer from smoothness deviations.

For commercial parking lots, the “S-4”, “S-5”, Type “B” or Type “C” should be used for the top (surface) lift. The “S-3”, “S-4”, Type “A” or Type “B” can be used for lower (base) lifts. The “S3” or “Type A” grading is recommended for the lower lifts for industrial parking lots with heavy traffic. For additional strength, the “S4” or “Type B” grading, rather than the “S5” or “Type C” grading can be used for the top lift of industrial parking lots. “S3” or “Type A” mixes should be restricted in use to “Special Use” parking lots.

TABLE 5A.
Superpave Master Grading Criteria for HMA/WMA Parking Lot Mixtures

Sieve Size	Percent by Weight Passing Square Mesh Sieves		
	S3	S4	S5
37.5 mm (1.5”)			
25.0 mm (1”)	100		
19.0 mm (3/4”)	90-100	100	
12.5 mm (1/2”)	<90	90-100	100
9.5 mm (3/8”)	*	<90	90-100
4.75 mm (#4)	*	*	<90
2.36 mm (#8)	31-49	34-58	37-67
1.18 mm (#16)	*	*	*
0.600 mm (#30)	*	*	*
0.300 mm (#50)	*	*	*
0.150 mm (#100)	*	*	*
0.075 mm (#200)	2-8	2-10	2-10
*Limits for these sieves should be established for the Contractor’s quality control testing.			

TABLE 5B.
ODOT Master Grading Criteria for HMA/WMA Parking Lot Mixtures

Sieve Size	Percent by Weight Passing Square Mesh Sieves		
	Type A	Type B	Type C
1.5” (37.5 mm)	100		
1” (25.0 mm)	90-100		
3/4” (19.0 mm)	*	100	
1/2” (12.5 mm)	70-90	90-100	100
3/8” (9.5 mm)	*	70-90	90-100
#4 (4.75 mm)	40-65	45-70	60-80
#10 (2.00 mm)	25-45	25-50	35-60
#40 (0.425 mm)	10-26	12-30	15-35
#80 (0.180 mm)	6-18	7-20	8-22
#200 (0.075 mm)	1-7	2-8	2-10
*Limits for these sieves should be established for the Contractor’s quality control testing.			

Performance Graded Binder Requirements

In most cases, the grade of binder is specified according to climate and level of traffic for a particular application. The performance grade (PG) binder system allows the selection of asphalt cement according to the high and low service temperatures and the level of equivalent single axle loads (ESAL).

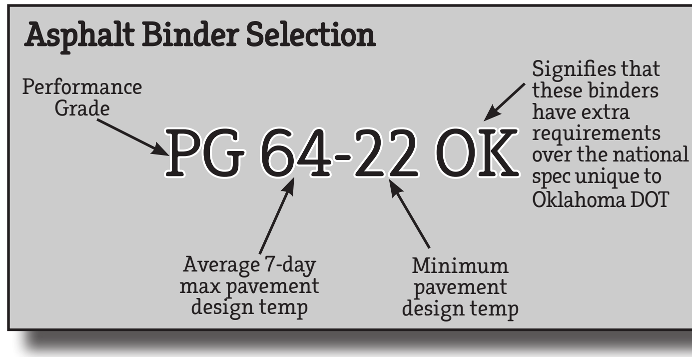


TABLE 6.
Performance Graded Binder Recommendations for Parking Lot Mixtures

Traffic Levels / Loading	Unmodified
Light: < 300,000 ESAL	PG 64-22 OK
Moderate: 0.3-3 Million ESAL	PG 64-22 OK
Heavy: > 3 Million ESAL	PG 64-22 OK
1. Environmental and loading conditions need to be considered when selecting the appropriate Performance Grade asphalt binder. 2. Unmodified asphalt binders (PG64-22) are recommended for standard use in parking lots in Oklahoma.	

Warm Mix Asphalt (WMA)

Warm Mix Asphalt is a relatively new technology whereby production and construction temperatures of asphalt concrete mixtures are significantly reduced by (50-100°F) via foaming of the asphalt binder or chemical additive. In either case, fumes and emissions are significantly reduced. From a design perspective, current recommendations are to conduct the asphalt mixture design in accordance with established procedures for HMA and then verify the WMA mixture properties during production.

WMA requirements are the same as for HMA. The supplier's recommended temperatures for plant mixing and roadway compaction should be reported on the mix design. Likewise, the supplier's recommended temperatures for laboratory mixing and compaction should also be reported on the mix design. For WMA using additives, the mix design should be performed using the additive. For WMA using a plant process, the mix design should be performed as a HMA mix design except for moisture susceptibility testing. Plant-produced WMA should be used for these tests. Prior to molding moisture susceptibility specimens, plant produced WMA should be oven aged at the recommended compaction temperature for four (4) hours. The additive or process used should be reported by name, supplier source, and application rate (if applicable) on the mix design.

The recommended mixing and compaction temperature for the HMA and WMA mixes are shown in Table 7.

TABLE 7.
Recommended Mixing Compaction Temperatures HMA and WMA Parking Lot Mixtures

Binder Grade	HMA Mixing Temp., °F	Minimum HMA Delivery Temp., °F	WMA Mixing Temperature, °F		Minimum WMA Delivery Temperature, °F	
			Foam	*Additive*	*Foam*	*Additive*
PG 64-22 OK	< 350	280	270 min	*	240	*
*Follow manufacturer's recommended temperature criteria.						

Reclaimed Asphalt Pavement (RAP)

Recycling reclaimed asphalt pavement (RAP) is an excellent way to reuse asphalt concrete pavement that has reached the end of its service life. Recycling RAP in new asphalt concrete mixes reduces demand for virgin materials and in the case of parking lots minimizes early susceptibility to scuffing. Any RAP used in asphalt mixes should be processed to a maximum size equal to or smaller than the maximum aggregate size for the mix specified and it should be used in a proportion that does not impact the gradation requirements. RAP should be processed in accordance with ODOT Standard Specifications for Highway Construction, Section 708.04. If available, RAP should be considered for all asphalt paving mixtures including the final surface. The maximum allowable percentage of RAP should be determined in accordance with the project's quality control procedures.

Reclaimed Asphalt Shingles (RAS)

As with RAP, reusing reclaimed asphalt shingles (RAS) is an excellent way to reduce the demand for virgin materials, particularly the asphalt binder. "Post-manufactured RAS" are processed manufacturer's shingle scrap by-product. "Post-consumer RAS," or "tear-offs," are processed shingle scrap removed from residential structures. Both manufacturer waste and "tear-offs" should be considered when available. RAS should be processed by ambient grinding or granulating such that 100% of the particles pass the ½" sieve. As with the RAP, the maximum allowable percentage of RAS should be determined in accordance with the project's quality control procedures.

For most commercial parking lot applications, 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 that should be long lasting.

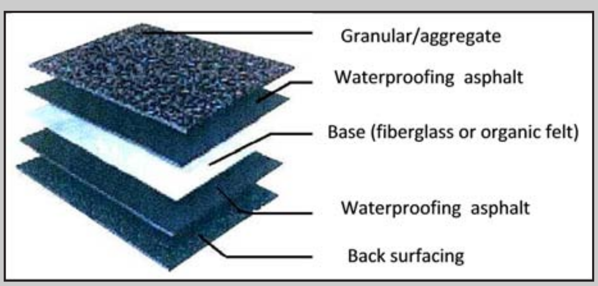
When gradations are on the coarse side the mixes can be a challenge to place on parking lots and other areas where hand work and short run stop and go paving is required. Coarse graded mixes also cool faster than fine graded mixes and may be more challenging to achieve the required compaction.

Without exception, the Superpave "Fine" gradation mixes (S4 & S5) are the best looking mixes for parking lots. It is recommended that ½" mixes (Nominal Maximum Aggregate 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.

There is a lot of asphalt in those shingles!



Component	Organic Felt	Fiberglass Mat
Asphalt Cement	30 - 36%	19-22%
Felt (Fiber)	2-15%	2-15%
Mineral Aggregate (#30)	20-38%	20-38%
Mineral Filler/Stabilizer	8-40%	8-40%

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 sitting 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 the 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.

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

TABLE 8.
Placement Temperature Guidelines

Compacted Layer Thickness, inches (mm)	Minimum Air/Surface Temperature, °F	
	Top Layer	Layers Below Top Layer
< 1	60	50
1 - 3	50	40
> 3	NA	30
NOTE: Air temperatures should be taken in the shade.		

● 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.

● 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.

● During paving, nuclear or electrical impedance density gauges should be used to monitor the compaction process. It is important to remember that nuclear gauges often read deeper than the lift thickness being placed. Without a core correlation, which will probably not be obtainable for small parking lots, the gauge readings can be misleading.

Quality Control/Quality Assurance Recommendations

Quality control should take place at three points: before materials enter the plant, the mix after production, and the final pavement. It is important to identify potential material problems early so that timely corrective action can take place.

Quality control at the plant for producing small NMAS mixtures is the same as any other asphalt mixture. Aggregate gradation and moisture content should be monitored throughout production at normal rates. Aggregate gradation from single stockpile sources will be more difficult to control than those coming from two or more stockpiles. Moisture content measurements will have a direct impact on asphalt content in drum plants. As such, frequent monitoring of moisture content for fine aggregate stockpiles is advisable, and the asphalt content should be adjusted as necessary to compensate for moisture changes.

During production, the mixture should be sampled and volumetric properties should be checked. The sampling may take place at the plant from the back of the truck or at the paving site either from the paver hopper or behind the paver. Volumetric properties may be checked by compacting the field samples at the same level as used in mix design and measuring the bulk specific gravity of the sample. The maximum specific gravity can be measured on the loose mix. Using combinations of the measurements along with the bulk specific gravity of aggregate, the air voids and VMA can be checked. A portion of the loose sample should be used to determine the asphalt content of the mix and the gradation through the plant. The asphalt content, VMA, and air voids should be tracked with time and a control chart should be developed showing warning limits and action limits.

Density in the final mat is very important. The minimum accepted in-place density should be determined in accordance with ODOT Specification 411.04 Construction Methods.

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 storm water 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 0.5inch 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 storm water 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 storm water 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.

Construction

It is often best to install the porous pavement toward 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 preconstruction 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

Parking lots paved with asphalt concrete can be constructed so that they function as a center piece for the facility and users they serve. Best practices can be followed to ensure that parking lots using quality asphalt mixes can be produced and constructed so that they are cost effective, structurally competent, and aesthetically pleasing. Preplanning, proper design, and construction are essential to ensure a long lasting asphalt parking lot.

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