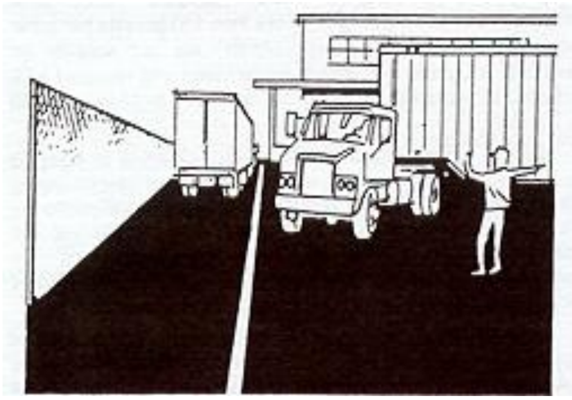
SECTION 2.3
PAVEMENT FOR HEAVY TRUCK USE

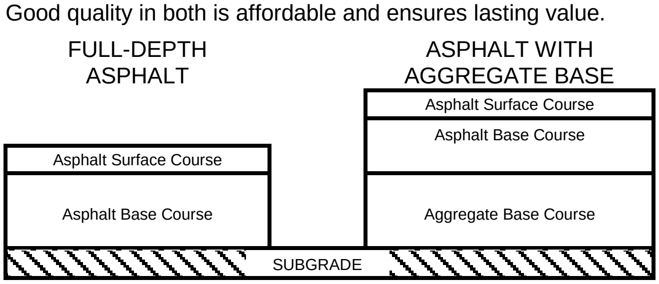


Case studies of public records spanning nearly 60 years have shown that heavy duty asphalt concrete pavements have an outstanding record for good performance and economy on Ohio's Interstate and other major highways (1 thru 7).

These studies confirm that asphalt pavements properly designed and constructed for heavy truck traffic do not have to be dug up and patched periodically because of structural breakdown. The studies show that only low cost surface maintenance at 10 to 15 year intervals has been required to keep these pavements in good, smooth condition.

The elements of proper design and construction are discussed in the following paragraphs. Special attention is given to those where oversight or neglect can lead to less than satisfactory performance. Sample specifications are provided for reference in Section 3 of this guide.

Either a full-depth asphalt or an asphalt with aggregate base design may be chosen. One may be more economical than the other depending upon, the size, nature, or location of a project. Good quality in both is affordable and ensures lasting value.



RECOMMENDED MINIMUM THICKNESS DESIGNS
INCHES AND (MILLIMETERS)

SUBGRADE SUPPORT	FULL-DEPTH ASPHALT	WITH AGGREGATE BASE AGGREGATE	ASPHALT
500,000 DESIGN AXLE LOADS (EALs)			
POOR (CBR 3)	9.5 (240)	6.0 (150)	7.5 (190)
FAIR (CBR 5)	8.5 (215)	6.0 (150)	6.5 (165)
GOOD (CBR 7)	8.0 (205)	6.0 (150)	5.5 (140)
1,000,000 DESIGN AXLE LOADS (EALs)			
POOR (CBR 3)	10.5 (265)	6.0 (150)	8.5 (215)
FAIR (CBR 5)	9.5 (240)	6.0 (150)	7.0 (180)
GOOD (CBR 7)	8.5 (215)	6.0 (150)	6.5 (165)
1,500,000 DESIGN AXLE LOADS (EALs)			
POOR (CBR 3)	11.0 (280)	6.0 (150)	9.0 (230)
FAIR (CBR 5)	10.0 (255)	6.0 (150)	8.0 (205)
GOOD (CBR 7)	9.0 (230)	6.0 (150)	7.0 (180)

The table gives the recommended minimum pavement thickness for a range of subgrade support capacities and design ESALs (equivalent 18,000 pound single axle loads).

DESIGN AXLE LOADS

ESAL Determination. The Ohio DOT conducts truck load studies on a continuing basis at various locations in the State. Both conventional and weigh-in-motion scales are used. Axle weight data is used to determine truck coefficients for Type B (multiple unit) and Type C (single unit) trucks.

ODOT established coefficients as of July 2014 reported for trucks on principal arterial routes are:

	Type B	Type C
Rural	1.06	0.33
Urban	1.04	0.41

A coefficient multiplied by the number of trucks of each type expected during the design period equals the number of ESALs to use in pavement thickness design.

Where heavier than average loads are expected, axle load equivalence factors should be used to determine design ESALs. Factors for loads on single, tandem and triple axles are in Section 4.1.2. An example is where all trucks using the pavement for a facility are expected to have full Ohio legal loads. A five axle, 18 wheel tractor and semi-trailer with an 80,000 lb gross load would convert to ESALs as follows:

Two tandem axles
(34,000 lb. each) = 1.08 x 2 = ...2.16
One single axle
(12,000 lb.) =..0.18
Total ESALs for the fully loaded truck = 2.34

The axle load equivalency factors are 1.08 for each of the two tandems and 0.18 for the single.

SUBGRADE SUPPORT CAPACITY

The subgrade is the prepared soil foundation for the pavement structure. Pavement thickness design starts with a realistic value for the load support capacity of the subgrade. The pavement then is made thick enough so that load pressures transmitted to the subgrade are reduced to a level consistent with subgrade support capacity.

Values in the table represent the support capacity of the range of fine grained soils often encountered in Ohio. Coarse grained soils (very sandy or gravely soils), will have higher support capacities. The descriptions indicate the relative firmness the soil retains after it has been compacted and then exposed to the influx of moisture. The CBR (California Bearing Ratio) value is a laboratory test measure of that quality. The CBR values were used for the designs.

A professional site investigation of soils and moisture conditions is recommended. The purpose is to identify conditions that may affect the overall design as well as to determine soil support capacity for pavement thickness design. The importance of adequate subgrade characterization, preparation and drainage cannot not be over-emphasized for a heavy duty pavement. An inadequate treatment of the subgrade can lead to very early pavement failure that can only be corrected by total reconstruction.

PAVEMENT THICKNESS AND MATERIALS

THICKNESS--The recommended minimum pavement thickness designs in the table were made using the AASHTO Guide flexible pavement equation. Designs for other numbers of axle load applications can be obtained by use of the design protocols in the AASHTO 1993 Pavement Guide or the similar procedure in the ODOT Pavement Design Manual or use of the free, on-line design tool, PaveXpress, which can be accessed through the FPO webpage, Pavement Design Resources .

Because of its unique flexible quality, asphalt concrete pavement can be designed for construction in stages. For example, a first stage can be designed for the number of ESAL applications that will accumulate during a period of say five years. Construction of the second stage must be done promptly at the end of that period even though the pavement should still be in good condition.

MATERIALS--Asphalt concrete mixtures recommended for use are ODOT Items 301 or 302 Asphalt Concrete Base and Item 441 or 442 Asphalt Concrete Surface Course designed for heavy traffic. These Items are described and some suggestions for specifying them are given in The FPO Technical Bulletin, specifying Asphalt pavements in Ohio, which can be found on the FPO webpage, Technical Bulletins.

For full-depth designs, the total required asphalt thickness can be composed of a 1.5 inch (38 mm) Item 441 or 442 surface course on an Item 301 or 302 base course.

For aggregate base designs the total required asphalt thickness also can be composed of a 1.5 inch (38 mm) Item 441 or 442 surface course on an Item 301 or 302 base course.

In stage construction and in applications where high resistance to surface displacement is needed, a surface course using Item 442 may be used.

The aggregate base recommended for use is ODOT Item 304. The material is a high quality, dense graded, crushed aggregate. The particle size gradation should be uniform from coarse to fine and the upper limit on the very fine fraction (passing the No. 200 sieve) should not be exceeded. An excess of that fraction will weaken the base under wet conditions.

METRIC LAYER THICKNESS--Layer thickness in millimeters was converted from inches and then indicated according to the practice adopted by the Ohio DOT. That practice is to specify layer thickness less than 45 millimeters to the nearest millimeter and thickness greater than 45 millimeters to the nearest 5 millimeters.

MATERIALS FOR HIGH STRESS AREAS--The above materials will give satisfactory performance for the number of design axle loads in the table. However, special attention should be given to drainage, subgrade preparation and pavement construction requirements in areas where trucks stop or move slowly. The effect of loads in those areas is greater than loads moving at about 25 MPH or more.

For higher numbers of design axle loads the design procedures and materials in The ODOT Pavement Design Manual, Appendix B are recommended for high stress areas.

SUBSURFACE DRAINAGE

Failure to provide effective subsurface drainage is a common cause of poor pavement performance. Pipe underdrains with porous backfill always should be installed beneath the edges of pavement for traffic lanes and systematically beneath the pavement in loading and parking areas. The pipe often can be outletted into surface water inlet boxes.

The subgrade should be sloped toward the underdrains and the pipe flowline should be about a foot (300 mm) below the subgrade surface. There must be a clean connection with the porous backfill when an aggregate base is placed.

SURFACE DRAINAGE

Both the subgrade and the pavement surface should have a cross-slope not less than a quarter inch per foot (6 mm per 300 mm)

Large areas sometimes cannot be constructed in a single plane with that minimum slope. The solution then is to design the surface in a series of planes. Solving the problem by reducing the slope is not recommended because, at some point, ponding would become inevitable.

In the event that local requirements limit the rate of surface water run-off, a detention basin or other stormwater best management practice should be considered as an alternative to reducing the slope to less than the recommended minimum.

SUBGRADE PREPARATION

In the design process consideration should be given to preparing the subgrade soil according to Item 204 and chemical stabilization per Item 206 of the ODOT C&MS.

At a minimum, Top soil, roots, boulders and the like always should be removed before starting subgrade preparation. Other soils having a maximum dry weight of less than 100 pounds per cubic foot (1600 kilograms per cubic meter) are not suitable for pavement subgrade and should be removed and replaced with suitable soil or granular material to a depth of 6 to 12 inches (150 to 300 mm).

Suitable subgrade soil should be compacted to at least 95 percent of its maximum dry weight. The moisture content during compaction should be at or very near optimum for compaction of the soil. Either aeration or adding and mixing water into soil often is necessary to bring it to optimum moisture content. The test method commonly used for maximum dry weight and moisture-density determinations is AASHTO T-99.

Because appearance can be misleading, the degree of compaction should be determined by testing. Most fine grained soils are firm when dry whether compacted or not. If not well compacted, they become very soft when wet.

Specifying that proof rolling be done soon after compaction is a good practice. A heavy roller or other heavy equipment can be specified to locate soft, yielding areas that should be corrected before paving.

The subgrade surface should be at proper elevation and cross-slope before paving starts. There should be no loose material or low areas where water would accumulate and soften the subgrade beneath the pavement rather than flow to the underdrains.

AGGREGATE BASE CONSTRUCTION

Aggregate should be placed by means of a mechanical spreader taking care to avoid separation of particle sizes. The base should be compacted thoroughly with the moisture content at optimum for compaction. At optimum moisture content, the aggregate is quite damp but there is no free water.

HOT MIX ASPHALT CONSTRUCTION

Standard practice in Ohio is to place hot mix asphalt by weight per unit of area rather than to actual thickness. This makes it easy to check the rate of placing and the total quantity placed using load delivery ticket weights. For mixtures with gravel or stone aggregate, the specified weight to volume conversion is 4,000 pounds per cubic yard, or 111 pounds per square yard per inch of thickness (2370 kilograms per cubic meter or 2.37 kilograms per square meter per millimeter of thickness).

For consistently good results, spreading and rolling should proceed at a steady pace. The rate of delivery should be kept in balance with the rate of spreading which must not exceed the capacity of the rollers to achieve compaction. Compaction must be completed while the asphalt is hot and workable. The compaction requirements for ODOT Items 301, 441, and 442 are found in ODOT specification Items 401.13 and .16.

TACK COAT

Individual layers must be bonded together for the total thickness of asphalt to act as a structural unit. Unless a layer is placed upon a freshly placed layer, the surface of the previously placed layer should be cleaned of all foreign material and a liquid asphalt tack coat should be applied to it.