

**CHAPTER VI
PAVEMENT STRUCTURE DESIGN**



SECTION 6-07

**BITUMINOUS
CONSTRUCTION MATERIALS**

6-07.1 GENERAL. Payment for asphaltic concrete by the square yard [m²] should only be used for full depth asphaltic concrete pavements on alternate bid projects. All other payment for asphaltic concrete should be by the ton [Mg].

For preliminary design, the estimate factors given in [Figure 6-07.1](#) may be used to compute quantities for bases, flexible type pavements, seal coats, etc. For final design, the designer should request estimate factors for anticipated rock formations from the district operations engineer to obtain more reliable results. When payment is by the ton [Mg], estimate factors should be shown on the plans with a note “For Information Purposes Only.” When payment is by the square yard [m²], estimate factors should not be shown on the plans.

6-07.2 ASPHALT BINDER. Performance grade (PG) asphalt binders are identified by their desired "high temperature" (e.g. "64", "70", "76", etc.) and "low temperature" (e.g. "-22", "-28", "-34", etc.) characteristics. The temperature numbers represent Celsius degrees and are used in 6 degree increments. The high temperature value is associated with controlling rutting, while the low temperature value is associated with resisting cold weather cracking. [Table 6-07.1](#) should be used as a guide to select asphalt binder grades for bituminous mixtures.

**TABLE 6-07.1
ASPHALT BINDER SELECTION CRITERIA**

TYPE OF CORRIDOR	LOCATION	TYPE OF CONSTRUCTION	TYPE OF MIX	ASPHALT BINDER
Heavy Duty	Districts 1-10	Full Depth Asphalt	Surface mixture (SP125 or SMA) and first underlying lift	PG 76-22
	All Districts	Full Depth Asphalt	Remaining Underlying Lifts	PG 64-22
	All Districts	Asphalt Overlays	Surface mixture (SP125 or SMA) and first underlying lift	PG 76-22
			Remaining Underlying Lifts	PG 64-22
Medium Duty	Districts 1-6	Full Depth Asphalt	Surface mixture (SP125) and first underlying lift	PG 70-22
	All Districts	Full Depth Asphalt	Remaining Underlying Lifts	PG 64-22
	All Districts	Asphalt Overlays	Surface mixture (SP125) and first underlying lift	PG 70-22
			Remaining Underlying Lifts	PG 64-22

Light Duty	Districts 1-10	Full Depth Asphalt	All Mixtures	PG 64-22
	All Districts	Asphalt Overlays	All Mixtures	PG 64-22

Mixtures for shoulders should use the same grade of asphalt binder as recommended for the adjacent traffic lanes at that depth, regardless if it is the same mixture or not.

The low temperature number is to remain as indicated in the above table. The high temperature numbers have been set for the traffic loads and operation speeds normally associated with these corridors. The high temperature numbers are recommended minimums and are not to be reduced; however, it is recommended the designer consider raising the high temperature number for medium and light duty pavements, when deemed necessary, to accommodate actual historical or anticipated traffic conditions. Typically, the high temperature number should be raised one increment (6 degrees) when traffic speeds are expected to be in the range of 12 to 45 mph [20 to 70 km/h] and raised two increments (12 degrees) for extremely slow traffic of < 12 mph [20 km/h]. Typical candidates for these high temperature number raises are roadways with ADT greater than 3500 that are in a highly congested, urbanized area, have frequent stop and go traffic, or have steep grades with significantly slow traffic speeds. The raises are added to the high temperature numbers in the above table.

If a higher type PG asphalt binder is warranted, it should be used in the surface mixture and the first lift of the underlying mixture.

Note that using the above process, the only recommended asphalt binder grades are PG 64-22, PG 70-22 and PG 76-22. Use of any other PG asphalt binder must be approved by the State Construction and Materials Engineer prior to use.

6-07.3 ITEM 401 - PLANT MIX BITUMINOUS BASE (PMBB) COURSE. Use of PMBB courses should be limited to bituminous bases beneath PMBP surface mixtures on full depth light duty pavements, as base widening on routes designated as light duty corridors, or on any bypasses or temporary roadways, regardless of the corridor designation. A SP250 mixture may be used in lieu of a PMBB mixture when ADT less than or equal to 3500. Such a substitution should be limited and requires approval by the District Operations Engineer. A PMBB mixture cannot be placed in lifts of less than 3 in. [75 mm] or greater than 6 in. [150 mm] in thickness (six times the maximum aggregate diameter). Mineral aggregate-gradation requirements are set forth in the standard specifications. An approved commercial mixture may be used in lieu of PMBB mixtures for work that is considered temporary construction, primarily defined as work that is to be removed prior to completion of the contract, pavement that will become non-mainline pavement, or pavement that will not remain in MoDOT inventory. GHQ Construction and Materials should be contacted to determine whether commercial mixture would be an appropriate substitution. After concurrence from GHQ Construction and Materials, the designer should note on the 2B sheets in the “Remarks” section where a commercial mixture may be substituted for a PMBB mixture and on the typical section.

6-07.4 ITEM 401 - PLANT MIX BITUMINOUS PAVEMENT (PMBP). Use of mineral aggregate-gradation, BP-1, should be limited to a surface mixture for full-depth construction of light duty pavements, resurfacing or contract leveling projects. Guidance for using this mix is given in Table 6-07.2. The thickness of the PMBP mixture should be 1 ¾ in. [45 mm] to 3 in. [75 mm]. It may also be used as an underlying lift when the PMBB cannot be used because of thickness limitations, i.e., total overlay thickness is 3 ¾ in. [95 mm] or less. Where it is desirable to eliminate edge drop off treatment, BP-1 may be used in lieu of the 4" [100 mm] PMBB. However, it is recommended for normal applications, use the 4" [100 mm] PMBB. An SP125 mixture should not be used in lieu of a PMBP mixture, unless approved by the District Operations Engineer. An approved commercial mixture may be used in lieu of PMBP mixtures for work that is considered temporary construction, primarily defined as work that is to be removed prior to completion of the contract, pavement that will become non-mainline pavement, or pavement that will not remain in MoDOT inventory. GHQ Construction and Materials should be contacted to determine whether commercial mixture would be an appropriate substitution. After concurrence from GHQ Construction and Materials, the designer should note on the 2B sheets in the “Remarks” section where a commercial mixture may be substituted for a PMBP mixture and on the typical section.

The designer may use any reasonable combination of lifts, but the normal lift thicknesses should be:

- 1 ¾" BP-1
- 3 ¾" = 1 ¾" BP-1 over 2" BP-1
- 5 ¾" = 1 ¾" BP-1 over 4 " PMBB
- 7 ¾" = 1 ¾" BP-1 over 6" PMBB

**TABLE 6-07.2
ASPHALT MIX SELECTION CRITERIA**

Corridor Designation	Traffic	Recommended Mix
Light Duty	ADT < 3500 and Total Average 24 Hour Commercial Truck Traffic < 400	BP-1 or BP-2 *
Light Duty	ADT > 3500 and Total Average 24 Hour Commercial Truck Traffic < 400	BP-1 (Sec 401)
Light Duty	Total Average 24 Hour Commercial Truck Traffic > 400	Superpave
Medium Duty	All traffic	Superpave
Heavy Duty	All traffic	Superpave
*The selection of which mix to use is left to the district's discretion based upon past field performance.		

6-07.5 ITEM 402 - PLANT MIX BITUMINOUS SURFACE LEVELING. This item is for work designated as contract leveling course projects with ADT less than or equal to 1750. A PG 64-22 asphalt binder should be specified for use in this mixture. When a higher type mixture, such as PMBP or a Superpave mixture, is being considered for this type of work, the thickness of the leveling course must be increased as specified for those mixtures.

6-07.6 ITEM 403 - SUPERPAVE PAVEMENT. Mineral aggregate-gradation requirements for these mixtures are set forth in the standard specifications or the Superpave special provisions.

6-07.6 (1) SUPERPAVE MIXTURES. Table 6-07.2 provides guidance when to use a Superpave mixture. For full depth flexible pavements, the Superpave cross sections should consist of a 1-3/4 in. [45 mm] SP125 surface course over a SP250 course as needed for the total thickness. For overlays, the Superpave cross section should consist of 1-3/4 in. [45 mm] SP125 surface course over a SP190 course as needed for the total thickness.

Table 6-07.3 provides the Superpave mixtures to be specified for the different applications discussed above.

The Superpave mixture names have a technical background and specific meaning. The "SP" designates a Superpave mixture; the "125", "190" and "250" represent the nominal aggregate size contained in the mixture. The maximum aggregate size is 12.5 mm [1/2 in.] for "125", 19.0 mm [3/4 in.] for "190" and 25.0 mm [1 in.] for "250". The "B", "C" or "E" indicates a Superpave mixture design specified in the Superpave specifications; the "LP" indicates if the mixture contains limestone/porphyry or limestone/steel slag, and the "SM" indicates a stone matrix asphalt mix (See Subsection 6-07.6(2)).

**TABLE 6-07.3
SUPERPAVE SELECTION CRITERIA**

Location of Mixture	Type of Corridor		
	Heavy Duty	Medium Duty	Light Duty
Surface	SP125B, SP125BLP or SP125BSM	SP125C, SP125CLP or SP125BSM	SP125C or SP125CLP
Underlying Course for Overlays	SP190B or SP250B*	SP190C or SP250C*	SP190C or SP250C*
First Underlying Lift for Full Depth Pavements	SP250B	SP250C	SP250C
Remaining Underlying Lifts for Full Depth Pavements	SP250C	SP250C	SP250E
* An SP250 mixture may be substituted for a SP190 mixture to prevent drop-off and a trough section caused by coldmilling operations			

6-07.6 (2) SPECIAL SUPERPAVE MIXTURES. Special 403 surfacing mixtures, e.g. Superpave limestone-porphyr (SP125xLP), should be substituted for the SP125 mixture when a mixture with higher friction properties is needed, such as in high speed urban congested areas or where the project accident rate exceeds the statewide accident rate for the last 5-year period and the wet to dry accident ratio is 1:3 or greater.

Superpave Stone Matrix Asphalt (SP125xSM) should be used as the surface mixture on all interstates, including ramps, and all medium and heavy duty routes shown within the “COMMERCIAL ZONE LIMITS FOR ALL ROUTES OTHER THAN INTERSTATE” on the MISSOURI VEHICLE ROUTE MAP. The designer should show SP125xSM on the plans.

6-07.6 (3) LEVELING COURSE. Milling is the preferred method of leveling, however PMBP or SP125 asphaltic concrete may be used for spot wedging and for leveling course as per the standard specifications, providing the minimum thickness is 1 in. [25 mm]. The grade of asphalt binder to be specified in the contract should be the same as that for the surface mixture.

6-07.7 AUTOMATIC SCREED CONTROL OR ESTABLISHED GRADE REFERENCE. The standard specifications require the use of automatic screed controls with the sensor following a traveling reference plane. In some instances, such as a badly warped pavement or very poor riding condition, the use of an established grade reference may be desirable. If the established grade reference is desired, a special provision must be included in the contract requiring its use for the initial pass of the paver when placing the first continuous layer. The special provision may be modified to require the established grade reference for a portion of a project if necessary.

6-07.8 ITEM 405 - PROCESSING RECLAIMED ASPHALT. To reuse coldmilled material as described in [Subsection 6-05.13](#), it is necessary to use Job Special Provision MSP-04-02 and the appropriate pay item for liquid asphalt.

6-07.9 ITEM 407 - TACK COAT. This item is used for impervious surfaces such as portland cement concrete, asphaltic concrete or bituminous surfaces prior to resurfacing. The grade of emulsified asphalt is selected by the contractor.

6-07.10 ITEM 408 - PRIME COAT. This item is used for pervious surfaces such as earth, aggregate base or cement treated base over which a seal coat or bituminous mixture less than 4" thick is to be placed. Generally use RC-70 or MC-30 liquid asphalt.

6-07.11 ITEM 409 – CHIP SEAL. This item is used primarily to seal the surface of an asphalt pavement with non-load associated cracks and to improve surface friction. The surface is sprayed with asphalt and then immediately covered with aggregate and rolled. The type of bituminous material and grade of liquid asphalt is selected by the contractor. Differing aggregate qualities are available and specified according to the roadway traffic. Grade C is used only on roads with $ADT \leq 750$. Grade B is used on two-lane, two-way roads with $ADT \leq 1700$, and divided roads with $ADT \leq 3500$. Grade A is used on two-lane, two-way roads with $ADT \leq 3500$, and divided roads with $ADT \leq 14,000$.

A seal coat placed on a porous surface such as an aggregate base should receive a prime coat as described above.

6-07.12 COMMERCIAL MIXTURES. The standard specifications permit the use of approved commercial mixture for plant mix bituminous pavement and plant mix bituminous base course when so specified in the contract. Commercial mixtures are not permitted where Section 403 or Superpave mixtures are specified. Care should be exercised when setting up small quantities of asphaltic concrete in that it may be more desirable, all factors considered, to use plant mix bituminous pavement so that a commercial mixture can be permitted. The same mixtures specified for the traveled way should be placed on the shoulders. For projects with Type A2 shoulders to be built in conjunction with PCCP for the traveled way, specify PMBP over PMBB.

6-07.13 SHOULDER SURFACES. For projects having shoulder stabilization only and no resurfacing on the traveled way, specify PMBP over PMBB. Where it is anticipated trucks will be regularly driving on the shoulder, specify Superpave mixtures based on the expected ESAL's. Examples of locations requiring Superpave mixtures are on ramps where drivers pull over to rest, intersections or roadway sections where trucks regularly encroach on the shoulders during turning movements.

An SP125x mixture should be used on shoulders where SP125xLP, SP125xSM or other special 403 mixtures are required on the traveled way. However, when other Superpave mixtures are specified for the traveled way surface, that Superpave mixture should also be used on the shoulder surface. Underlying shoulder lifts should be of the same mixture as the traveled way mixture for that respective lift.