Alberta

DESIGN BULLETIN #13
(Revised September 2018. Supersedes March 2017)

Revisions to Pavement Design Manual for Selection of ACP Mix Types and Asphalt Binder Grades

Updates to Design Bulletin #13 (September 2018)

- Terminology included for Base, Intermediate and Surface lifts.
- Further reference provided towards using Superpave designed mixes in terms of selecting the Nominal Maximum Aggregate Size.

Summary

This revised design bulletin is being issued as an addendum to Alberta Transportation's Pavement Design Manual (June 1997). Design ESAL criteria, mix types and mix type selection process replace those listed in the Pavement Design Manual.

Implementation

This Design Bulletin is effective immediately.

1. Mix Types

Asphalt Concrete Pavement (ACP) mix types are listed in Table 3.50.3.2 Asphalt Concrete Mix Types and Characteristics of Specification 3.50 ACP – EPS contained in the Standard Specifications for Highway Construction.

The H, M and L designations refers to High, Medium and Low service applications. The selection of these mixes is governed by expected traffic loads, geographic location and type of application (new construction versus overlay rehabilitation). Asphalt binder grades are selected based on the expected traffic loads, geographic location and type of application. The "S" series of mixes are for specialty applications as discussed in Section 4 of this bulletin.

Superpave mix types, selected for pavements with design loadings greater than or equal to 20.0 million ESAL, are described in Specification 3.53 ACP - Superpave.

All references to design ESAL are for a 20-year period regardless of that used in the pavement thickness design.

Lift placement for ACP is described in this document as follows:

- Base Lift – First lift placement. May be on top of base course or existing ACP. In all cases the base lift is to be overlaid with subsequent ACP lifts within the same paving contract.

- Surface Lift – The top lift placed within an individual paving contract. Also referred to as wearing course.

- Intermediate Lift(s) – Any lifts, if required, placed between the base and surface lifts. Also referred to as binder course.

2. Mix Type Selection

Temperature zone is determined from the map shown in Figure 1 (attached). Zone 1 is the area of the province south and east of the boundaries created by the Red Deer River, Highway 36 (excluding Highway 36), and Highway 4 south of Warner (excluding Highway 4). Zone 2 is the area of the province south of the North Saskatchewan River, not including that area defined as Zone 1. Zone 3 is the area of the province north of Zone 2.

Mix type selection is based upon geographic location and traffic loading as outlined in Table 1.

Table 1 ESAL Criteria for Selection of Mix Types

Temperature Zone	Design ESAL (millions)				
	<1.0	1.0 to <3.0	3.0 to <6.0	6.0 to <20.0	≥20.0
1	L1[1]	H2	H2	H1	100-S-NMAS
2	L1	M1	H2	H1	100-S- NMAS
3	L1[1]	M1	M1	H2	100-S- NMAS

Note:
[1] An adjustment in the mix type selection for projects involving overlays of pavements with a low incidence of existing transverse cracks and new construction is described in Section 3.1 and 3.2, respectively.

2.1 Superpave Mix Types

Superpave mix types are designated as follows.

Traffic – S – Nominal Maximum Aggregate Size (NMAS)

where: **Traffic -** Design traffic where “100” is for ≥20 million ESAL

S - Specification 3.53 provides definitions for “F” and “C” designations.

NMAS - **N**ominal **M**aximum **A**ggregate **S**ize is selected according to Table 2.

Table 2 Selection of Nominal Maximum Aggregate Size (mm)

Allowable Designated Lift Thickness (mm)[1]	Lift Placement	NMAS (mm)
20	Base	S1[2]
30	Single	S1, S2[2,3]
30	Base	10
40	All	12.5
>40 to ≤70	All	12.5
>70 to ≤100	Intermediate	12.5
>70 to ≤100[4]	Base	20
>70 to ≤100[5]	Base	12.5

Note:
1 Expressed in increments of 10 mm.
2 Marshall mix type – see Section 1 and Table 5
3 Superpave NMAS of 10 mm can be used if Superpave mixes are used elsewhere on the project.
4 Minimum thickness of subsequent ACP ≥60 mm.
5 Subsequent ACP thickness of <60 mm.

3. Asphalt Binder Grade Selection

Asphalt binder grade selection is based upon geographic location, traffic loading, location in the pavement structure and whether consideration is required for enhanced resistance to low temperature cracking and/or wheel path rutting.

Material specifications for Performance Grade asphalts are contained in Specification 5.7 Supply of Asphalt.

Construction type is broadly sorted into two categories:

i. Overlay construction
ii. New construction involving, first stage, final stage or non-staged paving.

3.1 Overlay Construction

Asphalt binder grade selection for overlay construction is outlined in Table 3. For these projects less emphasis is placed on controlling low temperature transverse cracking.

Table 3 Selection of Asphalt Binder Grades for Overlay Construction

Temperature Zone	Design ESAL (millions)					
	<1.0	1.0 to <3.0	3.0 to <6.0	6.0 to <10.0	10 to <20	≥20.0
1	PG 58-28[1]	PG 58-28	PG 58-28	PG 58-28	PG 64-28	PG 64-28
2	PG 52-34	PG 52-34	PG 58-28	PG 58-28	PG 58-28	PG 64-28
3	PG 52-34[2]	PG 52-34	PG 58-28	PG 58-28	PG 58-28	PG 64-28

Note:
1 Overlays of pavements with a very low incidence of existing transverse cracks use PG 52-34 and M1 mix type.
2 Overlays of pavements with a very low incidence of existing transverse cracks use PG 46-34 and M1 mix type.

Although not commonly encountered, overlays of existing pavements with little or no transverse cracking would fit into the selection of modified asphalt binder grades for new construction, Table 4.

Likewise, binder selection for asphalt pavement used within a grade widening situation would depend upon the condition of the existing pavement - i.e. treat as new construction if existing has little or no transverse cracks, otherwise treat as overlay construction.

3.2 New Construction

Asphalt binder grade selection for highways involving new construction (either: first stage, final stage or non-staged construction) is outlined in Table 4. For these highways the asphalt binder grade selection is meant to provide increased resistance to the formation of low temperature transverse cracks.

Table 4 Selection of Asphalt Binder Grades for New Construction

Temperature Zone	Design ESAL (millions)						
	<1.0	**1.0 to <3.0**	**3.0 to <6.0**	**6.0 to <20**		**≥20.0[3]**	
				1st Stage	Final	1st Stage	Final
1	PG 52-34[1]	PG 58-34	PG 58-34	PG 58-34		PG 64-34	
2	PG 52-34	PG 52-34	PG 58-34	PG 58-34		PG 64-34	
3	PG 46-34[1]	PG 52-34	PG 58-34	PG 58-34	PG 58-37[2]	PG 64-34	PG 64-37[2]

Note:
1 Use M1 mix type.
2 For non-staged new construction or thick pavement structures use a PG xx-37 in the upper 100 mm and a PG xx-34 for material greater than 100 mm in depth from pavement surface.
3 In certain special applications where resistance to wheel path rutting is paramount use a PG 70-28 in all lifts as per Section 3.3 Special Applications.

3.3 Special Applications

For locations with very high ESAL and slow moving traffic, consideration should be given to a grade bump to PG 70-28. This would include such applications as urban roadways with intersections or Vehicle Inspection Stations.

3.4 Airports

For community airports a L1 mix type is to be used with a PG 46-34 asphalt binder for overlays and new construction. Community airports with higher aircraft loadings (water bombers) should use a H2 mix with a PG 58-28 asphalt binder for overlays and a H2 mix with a PG 58-34 asphalt binder for new construction.

4. Specialty Mixes

The selection of mix types S1, S2 and S3 is based upon specific pavement design and construction requirements as outlined in Table 5.

Table 5 Selection of Specialty Mixes

Specialty Mix	Application	Asphalt Binder Grade
S1	i.) Paver laid first lift of 20 mm or less. Used to improve pavement cross-section and mitigate roughness problems. ii.) Single lift of 30 mm where traffic loading and geographic location call for a L1 type.	i.) Same as upper pavement lift ii.) Select according to Section 3.
S2	Single lift of 30 mm where traffic loading and geographic location call for an “H” or “M” mix type.	Select according to Section 3.
S3	Base lift mix used where the design pavement thickness is 140 mm or greater. Minimum lift thickness is 80 mm and maximum lift thickness is 100 mm. To be used as a base lift only; not intended for use as an intermediate or surface lift. The minimum thickness of the subsequent surface lift is to be 60 mm[1].	Same as upper pavement lift.

Note:
[1] In cases where the S3 mix is used elsewhere on the project (i.e. ACP ≥140 mm), short sections of pavement that are designed for a total thickness of 130 mm may use a S3 mix with a 50 mm surface lift.

5. Preparation of Tender Documents

References to mix types in tender documents are to include both the mix type and PG asphalt grade in both the unit price schedule (UPS) and on the typical section drawings (e.g. Mix Type M1, PG 52-34).

For updating purposes only: any existing surfacing strategies where penetration grade asphalts are indicated the PG asphalt grades shown in Table 6 are to be used.

Table 6 Conversion of AT Penetration Grades to Performance Grades

AT Penetration Grade	Corresponding AT Performance Grade
80-100A	PG 64-28
120-150A & 150-200A	PG 58-28
200-300A	PG 52-34
300-400A	PG 46-34

For updating purposes only: any existing surfacing strategies where design ESALs are greater than or equal to 20 million and a mix type H1 are indicated, Superpave mix types should be used following the nomenclature as indicated in 2.1 Superpave Mix Types.

Tenders may include more than one project and surfacing strategy resulting in multiple mix types and asphalt grades. In such cases the designer should review to determine if mix type rationalization is warranted. Items to consider:

- Is the project located near a temperature zone boundary?
- Are the traffic levels near a change in ESAL zones?
- Is there an advantage to rationalize mix types? For an example: a H2 mix used on Hwy xx and a M1 mix used on Hwy xxx do not necessarily need to be rationalized. A H2 mix type also meets M1 design criteria and thus a contractor may use the exact same aggregate sources and proportions to supply each project.
- Are small quantities of mix type used to deal with a specific application? For example, small quantities of mix using a PG 70-28 may be included for placement at rut prone locations such as a signalized intersection.
- For small quantities of S1 (<2,000 tonnes) consider increasing the lift thickness from 20 mm to 30 mm to avoid using this mix type.

Questions on the use of this design bulletin may be directed to the Pavement Engineering section of Technical Services Branch.

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Figure 1 Temperature Zones for Mix Type Selection