3. Gyratory Compaction Level

Superpave mixes are designed in the laboratory using a Gyratory compactor. The gyration levels are 50, 75, and 100. 100 gyration mixes are generally restricted to high volume interstates or heavy truck arterial intersections. The predominate gyration level for most mixes is 75 gyration.

SUPERPAVE GYRATION LEVEL	SUGGESTED USE
50	Very low volume pavements – trails, parking lots, minor residential streets
75	Predominate gyration level, minor and major residential, minor and major collectors, minor and major arterials, highways
100	Very high volume, heavy truck intersections, heavy truck major arterials, high volume interstate highways

4. Aggregate Gradation & Lift Thickness

There are three generally accepted mix types used in Colorado – SG (1”), S (3/4”), and SX (1/2”). SG is reserved for bottom or lower lift paving in multi lift applications. Both S and SX mixes can be used for top mat paving and both can be used in high traffic conditions. The generally accepted standard for lift thickness is three times (3X) the nominal maximum particle size (NMPS). Thus the minimal thickness for an SG gradation should be 3”, 2-1/4” for S, and 1-1/2” for SX. Adjustments in mix design gradation should be considered when the lift thickness is less than the minimums shown. For thin lift overlays (less than 1-1/2”), the maximum aggregate size should be 100% passing the 3/8” sieve. CDOT has recently developed an ST (3/8” NMPS) mixture for thin lift paving applications.

SUPERPAVE AGGREGATE GRADATION*	MINIMUM LIFT THICKNESS	SUGGESTED USE
ST (3/8”)	1”	Preventive Maintenance thin lift overlays, surface mixes
SX (1/2”)	1½”	Surface mixes, some intermediate mixes
S (3/4”)	2¼”	Bottom, intermediate and some surface mixes
SG (1”)	3”	Bottom mats for multi lift paving

*- denotes gradation based on nominal maximum particle size (NMPS).

Warm mix asphalt (WMA) is allowed as an alternate to hot mix asphalt provided that all material requirements and specification standards are met and as approved by the Engineer.

This edition of “The Asphalt RAP” was authored by Thomas Peterson, PE, Executive Director of CAPA. For additional copies of this or any of “The Asphalt RAP” publications, Contact the CAPA office, 303-741-6150 or office@co-asphalt.com

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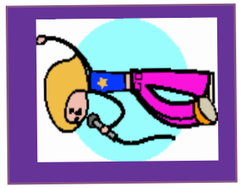

The Asphalt RAP

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Best Practices for Asphalt Mixture Selection

Specifying the right asphalt mixture for the right application is a very important consideration as it relates to long term pavement performance. Designing a mixture to be durable and able to withstand surface oxidation and weathering needs to be balanced with having stability to withstand rutting (ie. permanent deformation). There are a number of key variables that should be considered as part of asphalt mixture selection. These include performance grade (PG) asphalt binder selection, gyration level, gradation (top size of aggregate), and lift thickness, among others.

In Colorado, the predominate distresses on lower volume roads are durability related and include surface raveling, oxidation, and low temperature thermal cracking. Having adequate asphalt binder in the mixture is imperative to reduce durability related distresses and improve performance. A 75 gyration level (versus 100 gyration) mix results in a higher percentage of asphalt binder. The smaller sized SX mix (versus the S gradation) reduce the tendency of segregation, allow for better cohesion, and improved density of longitudinal joints. These mixes tend to reduce durability related distresses and improve performance of surface mixes. In 2012, over 90% of all mixes specified by CDOT were SX (1/2”) mixes. Another strategy used to improve durability of asphalt mixes on lower volume roads is to reduce the design air voids from 4% to 3.5%. This change results in an asphalt binder increase of approximately 0.1% to 0.3%.

CDOT has also expanded the use of **75 gyration mixes.** 100 gyration mixes are now generally restricted to very high traffic roadways such as the interstate and very heavily trafficked state highways. Since the initial implementation of Superpave in Colorado in the late 1990’s, rutting has been virtually eliminated. This is due in large part to the Superpave

“...Another strategy used to improve durability of asphalt mixes on lower volume roads is to reduce the design air voids from 4% to 3.5%...”

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aggregate consensus properties. With the Superpave mixes, (SG, S, SX, and now ST), all aggregates, coarse and fine are required to have a high percent of fractured faces and angularity. Thus, both fine aggregate and coarse aggregate contribute to mix stability and smaller sized mixes can be used effectively to withstand rutting. Thus, the attitude of only larger sized mixes can withstand rutting has changed with the implementation of Superpave and the improved aggregate requirements.

In the past, the most common rule of thumb for **lift thickness** was 2 to 1. The lift thickness was recommended to be twice as thick as the maximum aggregate size. At that time, the maximum aggregate size was generally referred to as the first sieve size that had 100 percent of the material passing. Now with Superpave, the nominal maximum aggregate size is specified and usually 100 percent of the material does not pass this sieve size. So a mixture that used to be ¾ inch (19 mm) maximum size is likely now to be referred to as a ½" (12.5 mm) nominal size.

So without any other changes, one should now use approximately a 3 to 1 ratio instead of the old 2 to 1 ratio. As a general rule of thumb, it is recommended for Superpave designed mixtures that the layer thickness should be equal to or greater than three time the nominal maximum aggregate size. Thus, if an agency is using a thin lift overlay, say less than 1-1/2" in thickness, it is recommended that a 3/8" nominal maximum aggregate size material be used. CDOT has recently implemented the ST (3/8" nominal maximum aggregate size) mix for thin lift surface mix paving.

The most common mix in a number of locations in Colorado is a **PG 64-22, SX, 75 gyration mix with 20% RAP**. In the high country it is more common to use a PG 58-28 asphalt binder in lieu of the PG 64-22 for low temperature conditions. Also, the PG 58-28 is a softer asphalt binder and is used in colder climates, in high RAP mixes, and/or where low temperature thermal cracking is a concern. 50 gyration mixes are rarely used and 100 gyration mixes are becoming less and less common on the local road network.

Although some agencies are allowing more than 20% recycled asphalt pavement (RAP) and CDOT allows 25% RAP in lower lift, it is more common for agencies to use a standard 20% RAP on all mixes on all lifts. It is becoming less common for agencies to have an allowable RAP percentage less than 20%. For example, Douglas County revised their requirements in 2012 to standardize mix requirements at 20% RAP. In 2011, CDOT reported that approximately 135,000 tons of RAP were used on CDOT projects using the 20% RAP specification.

"...It is more common for agencies to use a standard 20% RAP on all mixes on all lifts. It is becoming less common for agencies to have an allowable RAP percentage less than 20%..."

A common specialty mix that is used routinely by CDOT for high traffic urban interstate rehabilitation and by some local agencies for high traffic urban arterial roadways is **stone matrix asphalt (SMA)**. Since 1994, approximately 1.7 million tons of SMA has been placed on Colorado highways. In addition, since 2003, the City of Aurora has been using SMA as part of its annual street overlay program. SMA combines the use of a high asphalt binder content (6.0% plus) with a gap graded skeleton filled with mastic. The high binder content with a polymer modified binder provides the durability and is combined with rock on rock for stability to be a premium performing mix.

It is important that agencies in a geographic area recognize the benefit of using similar standards for materials. Often minor variations in requirements from one agency to another agency result in higher costs associated with mix designs, aggregate crushing, plant changes, etc. There are a number of areas that have worked together to reduce the variation of requirements from one agency to another and to encourage standardized mix requirements. This includes in the Denver Metro area (Metropolitan Government Pavement Engineers Council – MGPEC), Colorado Springs/El Paso County (Pikes Peak Region Asphalt Specifications), and in northern Colorado (Larimer County Urban Street Standards).

Best Practices for Asphalt Mixture Selection

Asphalt Mixture Selection Guideline

*-the following is adapted from information developed by the Colorado Association of Geotechnical Engineers, 2010

Asphalt Mix Selection

1. Superpave Mix Design & Mix Selection

Superpave mix designs have generally replaced Marshall and Hveem mix designs for nearly all applications in Colorado. The Superpave mix design methodology consists of three primary components. These components are:

PG Asphalt Binder Selection
Gyratory Compaction Level
Aggregate Gradation and Physical Properties

A Superpave mix design can be established for all paving applications (highways to driveways). A Superpave mix design may or may not include a modified asphalt binder.

2. PG Asphalt Binder Selection

There are generally six different grades of Performance Graded (PG) asphalt binders used in Colorado. PG 58-28, PG 64-22, PG 58-34, PG 64-28, PG 70-28 and PG 76-28. PG 64-28, PG 58-34, PG 70-28, and PG 76-28 are modified asphalt binders and are restricted to top mat of paving and where warranted based on traffic and climate conditions. PG 76-28 is generally restricted in use to very high traffic, heavy truck volume arterials or highways. PG 58-34 is generally restricted in use to very low temperature conditions to address the potential of low temperature transverse thermal cracking. Pavement distress associated with surface oxidation is mitigated primarily through mix design (gradation, asphalt binder content) and not through asphalt binder selection. Smaller sized mixes (SX) generally have higher asphalt binder content mixes and are used to mitigate surface oxidation, raveling, and weathering related distress.

PG ASPHALT BINDER	SUGGESTED USE
PG 58-34*	Modified asphalt, very low temp. climates, low volume roadways
PG 58-28	Unmodified, low volume roadways
PG 64-22	Unmodified, most commonly used PG grade, for low, moderate and high volume roadways
PG 64-28*	Modified asphalt Moderate to high volume roadways, colder climates
PG 70-28*, PG 76-28*	Modified asphalts ery high volume roadway

* - asterisk denotes modified asphalt binder, generally restricted to top mat paving

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