HMA Materials

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Introduction

- Purpose: Choose the right mix for the right application
  - Function
  - Economy
  - Performance
- Functions of Asphalt Mixtures
  - Durable, economical base layers
  - Strong, rut resistant base and surface layers
  - Smooth, safe, durable surfaces
  - Permeable, high-friction, low splash and spray surfaces

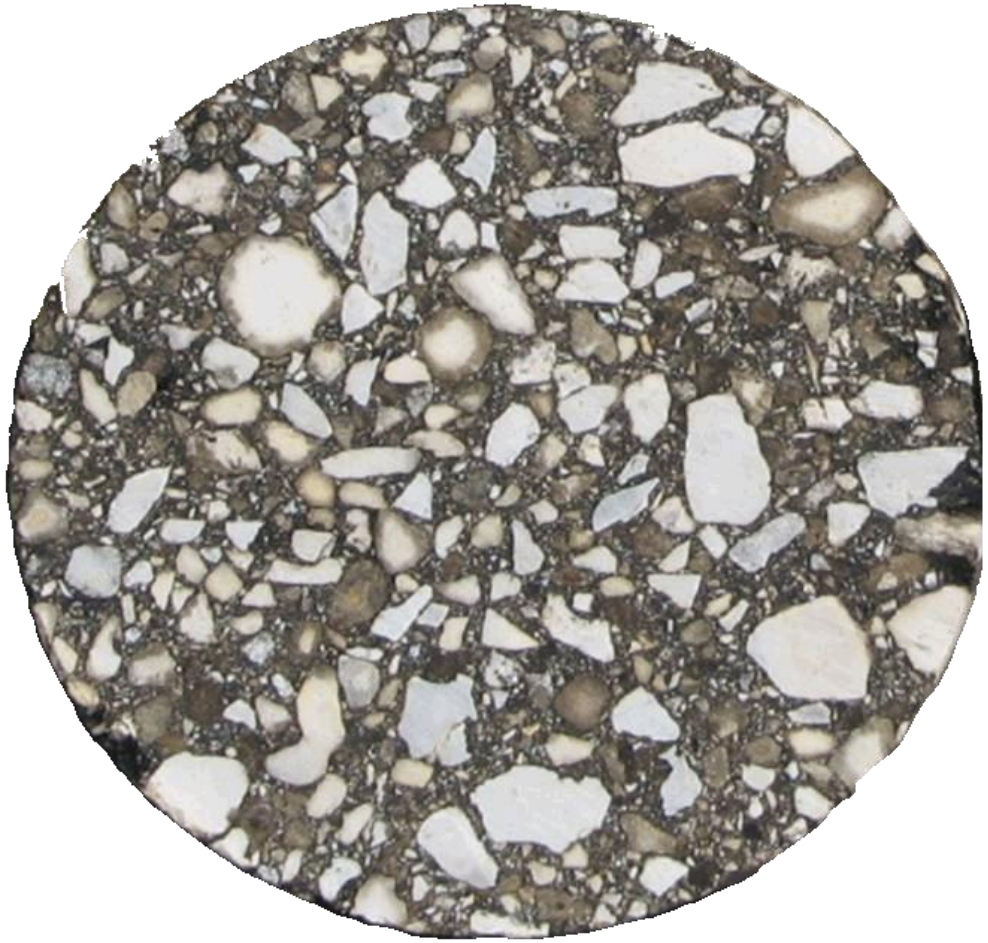
Mix Designs are recipes. Choose well.

Different recipes (based on top size rock)

- 341M B mix 1”
- 341M C mix 3/4"
- 341M D mix ½”
- 341M F mix 3/8”

Aggregates

- Ideal Aggregate:
  - Gradation with Sufficient Voids for AC
  - Angular, Uniform Shape
  - Low Porosity/Absorption
  - Clean
  - Rough Surface Texture
  - Hydrophobic (water-hating)
  - Available



Surface Aggregate Classification (SAC)

- Crushing Requirement: 85%, 2 or more faces

- SAC A – Friction – Surface Only
  - Insolubility to Acid
  - 25% loss on Mag Sulfate
  - SAC A Does NOT Mean Stronger…Only Friction
- SAC B – Surface – Intermediate – Base
  - 30% loss on Mag Sulfate

NMAS vs. MAS

Nominal Maximum Aggregate Size (NMAS)

- One sieve size larger than the first sieve to retain more than 10 percent

Maximum Aggregate Size (MAS)

- one sieve size larger than the NMAS

Sieve Size	Percent Passing	
3/4”	100	- MAS
1/2”	94	- NMAS
3/8”	89	*1st sieve to retain more than 10%*
No. 4	60	
No. 8	35	
No. 16	23	
No. 30	13	
No. 50	9	
No. 100	6	
No. 200	4.8	

What is Asphalt?

- “Thermoplastic” - Properties vary with Temperature and Loading Duration
- Natural Glue/Adhesive - Available Where Oil is Refined
- Chemistry Varies – Test the Physical Properties at Temperature Ranges
- Polymers to Improve Performance
- Other Oils/Applications (Item 300):
  - TRAIL/Tack/Prime/Seal Coats
  - Emulsion/Foam/Fog
  - Crack Sealer
  - Recycling

Table 19
Typical Material Use

Material Application	Typically Used Materials
Hot-mixed, hot-laid asphalt mixtures	PG binders, A-R binder Types I and II
Surface treatment	PG 58-22, AC-15P, AC-20XP, AC-10-2TR, AC-20-5TR, HFRS-2, MS-2, CRS-2, CRS-2TR, CMS-2P, HFRS-2P, CRS-2P, CHFRS-2P, A-R binder Types II and III
Surface treatment (cool weather)	AC12-5TR, RC-250, MC-800, MC-3000, CMS-2P
Precoating	PG 58-22, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack coat	PG binders, SS-1H, CSS-1H, EAP&T, TRAIL, EBL
Fog seal	SS-1, SS-1H, CSS-1, CSS-1H, CSS-1H 50/50, CSS-1H 40/60, CSS-1H 30/70, CMS-1P
Hot-mixed, cold-laid asphalt mixtures	AC-0.6, AC-1.5, PG 58-22, CMS-2
Patching mix	MC-800, SCM I
Recycling	AC-0.6, AC-1.5, recycling agent, ARA-1, ARA-1P
Crack sealing	Polymer-modified AE crack sealant, asphalt-rubber crack sealers (Class A, Class B)
Microsurfacing	CSS-1P
Prime	MC-30, AE-P, AE-P 50/50, AE-P 40/60, AE-P 30/70, EAP&T, PCE
Curing membrane	SS-1, SS-1H, CSS-1, CSS-1H, PCE
Erosion control	SS-1, SS-1H, CSS-1, CSS-1H, PCE
FDR-foaming	PG 64-22, FDR EM-SY, FDR EM-HY

Asphalt Binder Testing

- Penetration Grading – 1900's
- Viscosity Grading – 1950's
- Superpave Performance Grading (PG) – 1990's (Performance Based)
  - Rotational Viscosity – Workability
  - Dynamic Shear Rheometer (DSR) – Rutting/Cracking
  - Rolling Thin-Film Oven (RTFO) – Short-Term Aging
  - Pressure Aging Vessel (PAV) – Long-Term Aging
  - Bending Beam Rheometer (BBR) – Thermal Cracking
  - Direct Tension Test (DTT) – Low Temperature Strain
  - Multiple Stress Creep Recovery (MSCR) – Rutting
  - Elastic Recovery – Verify Polymer Modification/Rutting/Cracking

Superpave PG Asphalt Binder Spec

Binder Selection Based on Local Climatic Conditions

PG 64 - 22

Performance Grade

Meets all requirements up to this pavement temperature (°C)

Meets all requirements down to this pavement temperature

Note: Grades are specified in ***6°C increments***

Asphalt Binder Grades in Texas

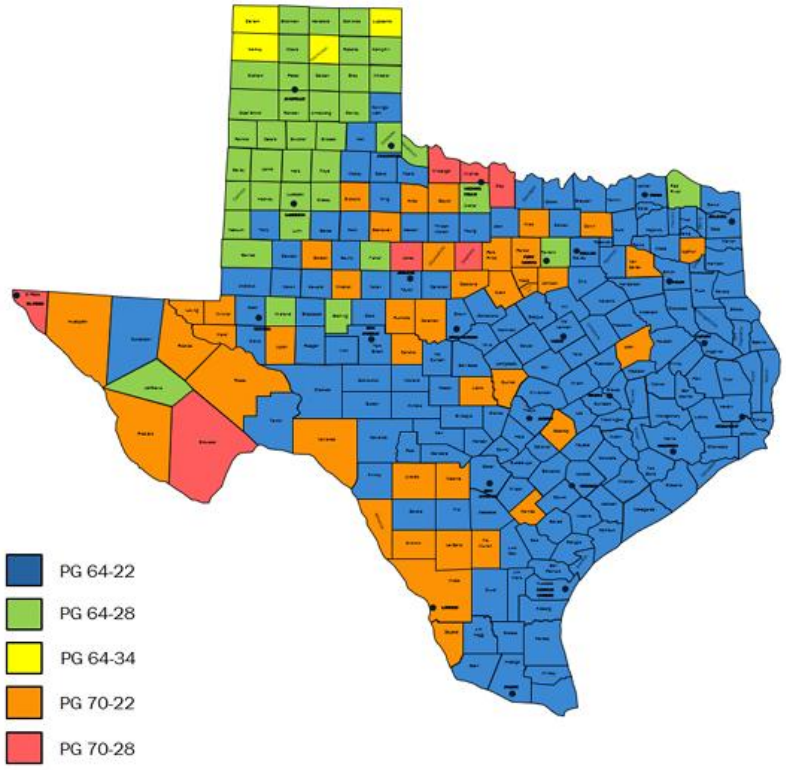


Figure 2.1
Recommended Climate-Based PG Binder Grade – 98% Confidence

- Map is Based on Climate *Only*.
- Lower “High Temperature” Grades Can Balance Stiffer Recycled Binders in RAP or RAS.
- Higher “High Temperature” Grades Can Stiffen Mixes Subject to High Traffic or Low Speeds.
- Lower “Low Temperature” Grades Can Balance Stiffer Recycled Binders in RAP or RAS.

Mix Types

Dense Graded

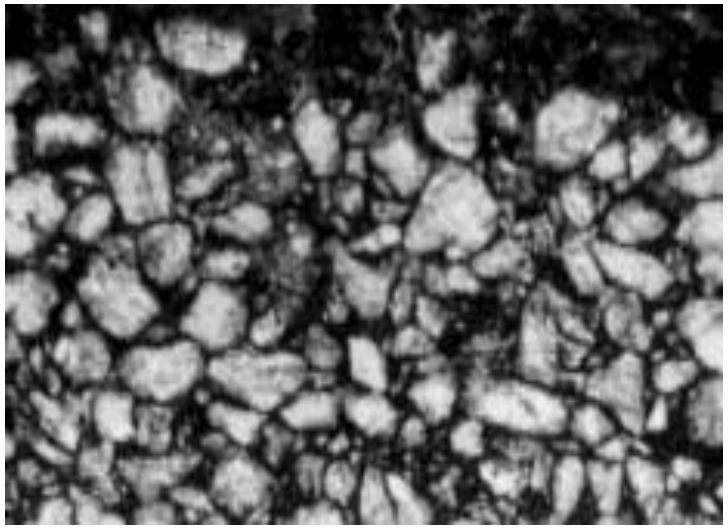
DG-B, C, D, F,
Superpave, Black Base

Gap Graded

SMA, TOM,
TBFC - A, B, C

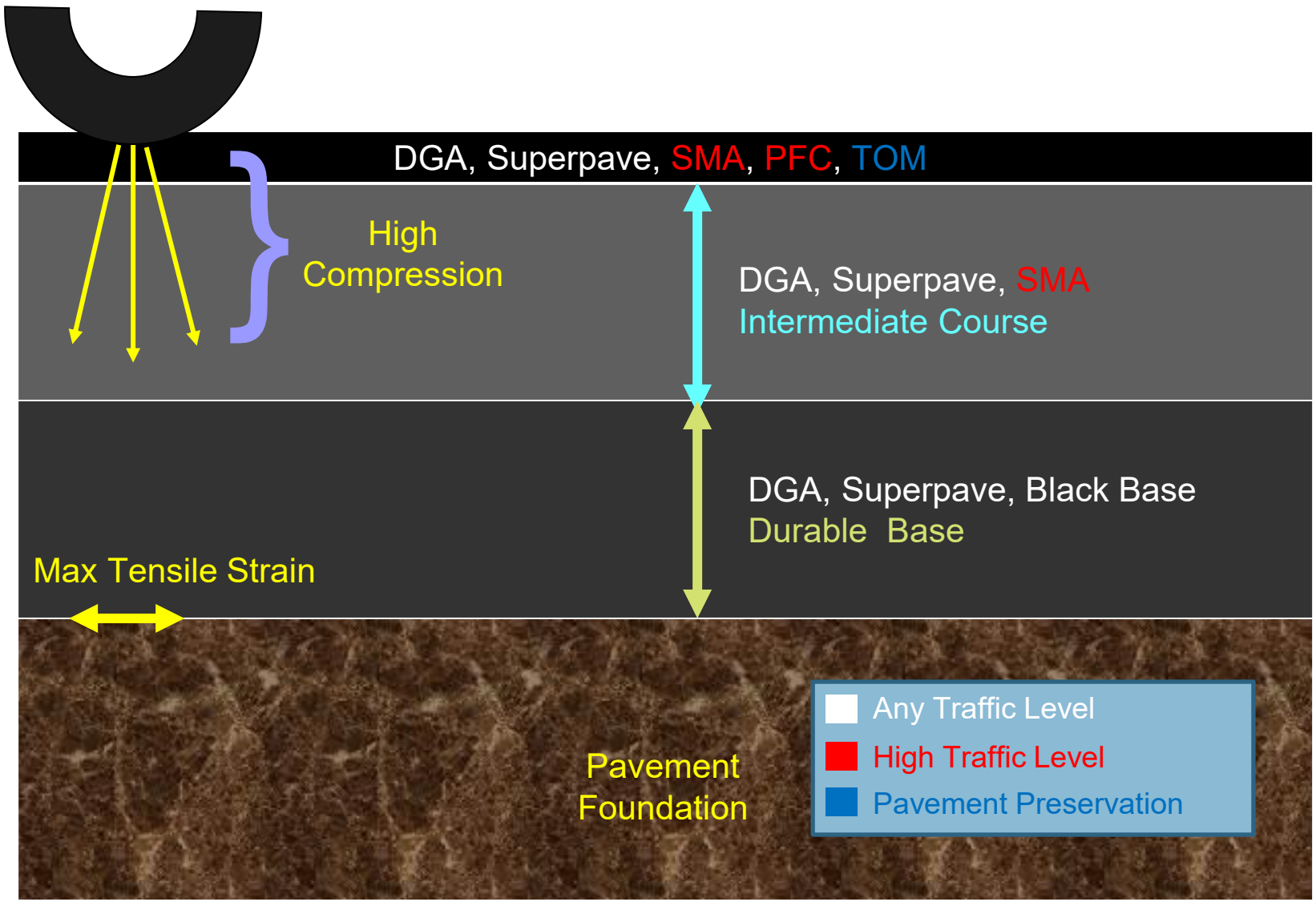
Open Graded

PFC
TBFC Types PFC-C, F



Where Mixes are Used

- Constructability (All layers)
- Durability (All layers)
- Fatigue Resistance (Lowest layer)
- Rut Resistance (Upper/Intermediate layers)
- Safety (Surface)
- Noise Mitigation (Surface)



NMAS vs Lift Thickness

Dense Graded

- Fine – 3X NMAS min
- Coarse – 4X NMAS min

Table 13
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness Guidelines		Min Untrimmed Core Height Eligible for Testing (in.)
	Min (in.)	Max (in.)	
DG-B	2.50	5.00	1.75
DG-C	2.00	4.00	1.50
DG-D	1.50	3.00	1.25
DG-F	1.25	2.50	1.25

Materials Summary

- Select the **Right Material** for the **Right Place** at the **Right Time**
- You want **Quality Pavements** that are:
  - *Durable*
  - *Strong*
  - *High Performing*
- Dense Graded and Superpave Mixtures are the Workhorses – 80/20 rule
- Select Binders and Aggregates to Meet Project Needs
- Consider the Budget Effects of NMAS, Binder Grade, and %RAP

Practical Pavement Design Tips

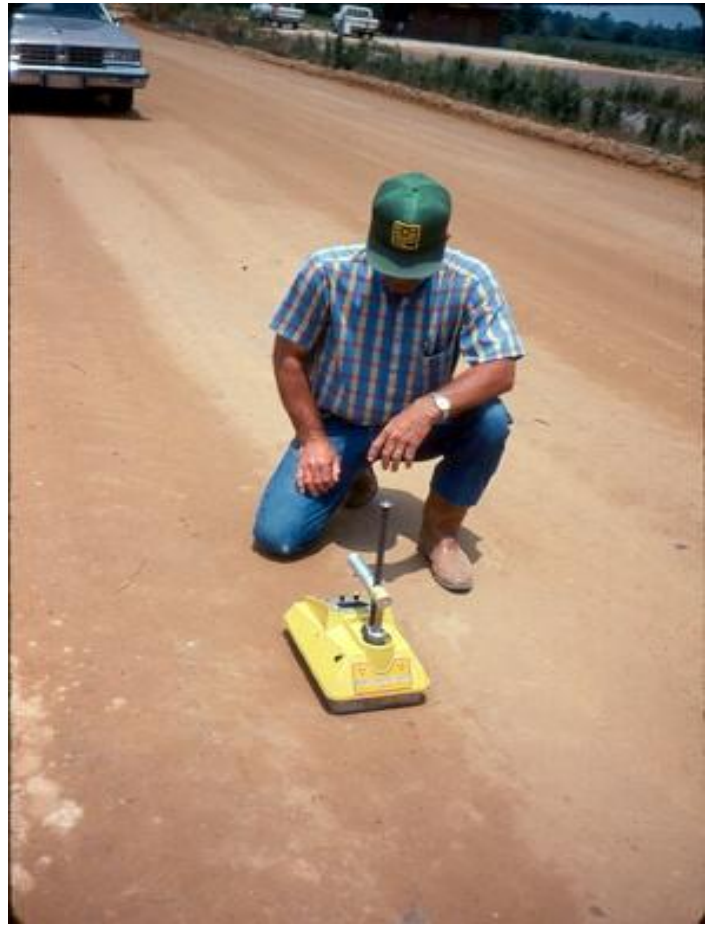
- Keep It Simple – Design, Constructability, and Consistency
- Transitions, Driveways, Manholes, Handwork
- Understand the Roadway, Existing Pavement/Subgrade
  - Site and Core Photo Logs, Phenolphthalein, DCP, Proofroll
  - Don’t Guess…Visit the Site and Run Tests
- Understand the Traffic…Especially the Trucks
- Know the Inputs, Iterate Options, Run a Sensitivity Analysis
- Consider the Impact of Time From Design and Construction
- Good Communication between Civil, Geotech, and Owner

What does an Asphalt Paving job look like?

1. Proper base repair and surface preparation
2. Tack coat uniformly applied.
3. Properly loaded trucks.
4. Care in delivery of mix to paver.
5. Correct Paver Setup & Operation.
6. Placing the right mix at the correct uniform thickness
7. Quality joint construction.
8. Achieving Uniform Density/Air Voids with rollers.
9. Verifying density/air voids in the finished asphalt mat.

Subgrade Preparation

- The subgrade is the pavement foundation.
- Must support the pavement and anticipated traffic
  - Soil type and Stabilization considered in design
- Must be properly graded to provide drainage.
  - Transverse and longitudinal grade
  - Smoothness and cross slope
- Must be uniformly compacted to required density.



MATERIALS & ASPHALT PAVEMENT SOLUTIONS

QUESTIONS?