This Lecture

- PG Grading System
- Specifications

Sources of Information

- American Association of State Highway Transportation Officials (AASHTO)
- Federal Highway Administration (FHWA)
- Departments of Transportations (DOT) for individual States
- National Asphalt Pavement Association (NAPA)
- National Center for Asphalt Technology (NCAT)
- The Asphalt Institute (TAI)
Superpave Asphalt Binder Specification

The grading system is based on Climate

PG 64 - 22

Performance Grade

Min pavement temperature

Average 7-day max pavement temperature

Performance Grades

How the PG Spec Works
Permanent Deformation

- Addressed by high temp stiffness
  - G*/sin δ on unaged asphalt binder ≥ 1.00 kPa
  - G*/sin δ on RTFO aged asphalt binder ≥ 2.20 kPa

> Early part of pavement service life

Fatigue Cracking
Fatigue Cracking

- Addressed by intermediate temperature stiffness
- $G^*\sin\delta$ on RTFO & PAV aged asphalt binder $< 5000$ kPa

> Later part of pavement service life

Low Temperature Cracking

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ROLLING THIN FILM OVEN (RTFO)
- Mass Loss $< 1.00\%$
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PRESSURE AGING VESSEL (PAV)
- Original
- Aged
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PAV Aged

Dynamic Shear Rheometer (DSR)
- $G^*\sin\delta$

Bending Beam Rheometer (BBR)
- "S" Stiffness & "m"-value

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### Miscellaneous Spec Requirements

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### PG Binder Selection

- Many agencies have established zones

- PG 52-28
- PG 58-22
- PG 58-16
- PG 64-10

### Developed from Air Temperatures

- Superpave Weather Database
- 6500 stations in U.S. and Canada
- Annual air temperatures
  - hottest seven-day temp (avg and std dev)
  - coldest temp (avg and std dev)
- Calculated HMA pavement temps used in PG selection

- > 20 years
Reliability

- Percent Probability of Not Exceeding Design Temp > using Normal Distribution

- Reliability is area under curve to the left of $T_{des}$

Observed Air Temperatures

- 50% reliability
- average summer
- very hot summer

- 98% reliability

7-Day Maximum Air Temperatures

Observed Air Temperatures

- very cold winter
- average winter

- standard deviation of 4°C
Convert to Pavement Temperature

- Calculated by Superpave software
- High Temperature
  - 20 mm below surface of mixture
- Low Temperature
  - at surface of mixture

$Pavt = f(\text{Air Temp, Depth, Latitude})$

Calculated Pavement Temperatures

$Pavt > \text{Air}$

PG Asphalt Binder Grades

PG asphalt binder grades - six degree increments
Effect of Rounding to Standard Grades

PG 58 provides 85% reliability
PG -28 provides 90% reliability

Effect of Rounding to Standard Grades

Minimum Pavement Temperatures

Effect of Loading Rate on Selection

- Dilemma
  - specified DSR loading rate is 10 rad/sec
  - what about longer loading times?
- Use asphalt binder with more stiffness at higher temperatures
  - slow - increase one high temperature grade
  - stationary - increase two high temperature grades
  - no effect on low temperature grade

90 kph
Effect of Loading Rate on Selection

- Example
  - for toll road: PG 64-22
  - for toll booth: PG 70-22
  - for weigh stations: PG 76-22

90 kph

90 kph

Example

Effect of Traffic Amount on Selection

- 10 - 30 x 10^6 ESAL
  - Consider increasing - - one high temp grade
- 30 x 10^6+ ESAL
  - Recommend increasing - - one high temp grade

ESAL Comparison

- 80 kN
  - 18,000 lb.
- 100 kN
  - 22,000 lb.
- 44 kN
  - 10,000 lb.

1 ESAL
2.2 ESAL
0.9 ESAL

> Equivalent Single Axle Loads
How the PG Spec Works

Spec Requirement Remains Constant

Test Temperature Changes

Summary of How to Use PG Asphalt Binder Specification

- Determine
  - 7-day max pavement temperatures
  - 1-day minimum pavement temperature
- Use specification tables to select test temperatures
- Determine asphalt cement properties and compare to specification limits