



North Dakota

ASPHALT

conference

photo credit: Justin Hyndman, PE, KLS

Welcome

North Dakota
ASPHALT
conference

NDSU | UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
NORTH DAKOTA LOCAL TECHNICAL ASSISTANCE PROGRAM



U.S. Department
of Transportation
**Federal Highway
Administration**



**DAKOTA ASPHALT
PAVEMENT ASSOCIATION**

- Binder Basics:
Polymer Modified Asphalt and the
Multiple Stress Creep Recovery
(MSCR) Test

- Jeff Shoger
Flint Hills Resources, LP

North Dakota Asphalt Conference

Bismarck, ND - April 10-11-2018

MSCR Test Development

- AASHTO M320 (standard PG grading) was found to be inadequate for characterizing different types of modifications
- Lack of correlation between $G^*/\text{Sin}(\delta)$ and field performance for modified asphalt
- $G^*/\text{Sin}(\delta)$ stress level was too small

MSCR Test Components

- Uses the DSR
- Increases the stress level to determine what traffic level the asphalt resists flow
- Measures two parameters
 - Jnr (non-recoverable creep compliance) which correlates with field rutting performance
 - Percent Recovery, which indicates the presence of sufficient and effective polymer modification

Dynamic Shear Rheometer (DSR)



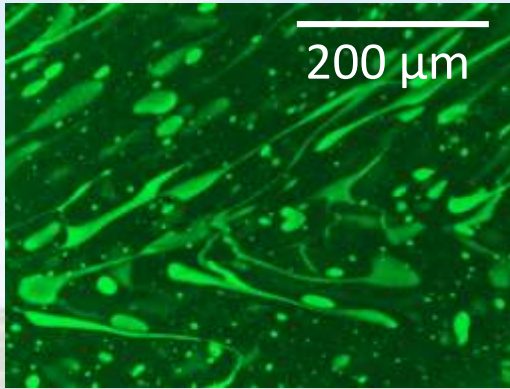
Benefits of Modification

- The asphalt industry needs economical pavements that perform for a long time
- Modification improves the glue that binds the aggregates together for better:
 - Resistance to permanent deformation
 - Reduction of large-scale aggregate movement
 - Adhesion
 - Fatigue life
 - Resistance to cracking

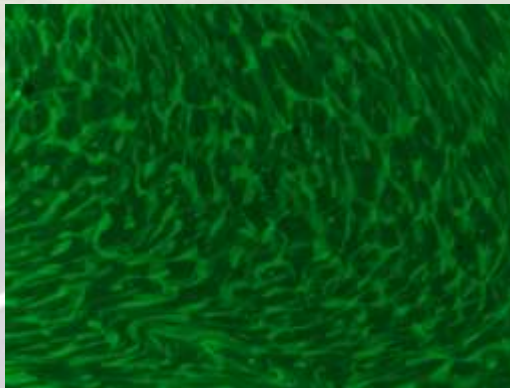
Polymer Properties

- Elastomeric polymers stretch and elastically recover their shape when released
- A valuable property in:
 - Running shoes
 - Rubber bands
 - Vehicle tires
 - And asphalt pavement!

Engineered PMAC viewed under a Fluorescence Microscope



Unreacted	
% R = 21.0	Jnr = 0.68 Pa ⁻¹



Partially Reacted	
%R = 46.4	Jnr = 0.39 Pa ⁻¹



Fully Reacted	
%R = 58.3	Jnr = 0.31 Pa ⁻¹

Past Asphalt Binder Grade

Grading System Based on Climate

PG 58 - 28

Performance
Grade

Average 7-day
max pavement
design temp

Minimum
pavement
design
temperature

MSCR Asphalt Binder Grade

Grading System Based on Climate and Traffic

PG 58H - 28

Performance
Grade

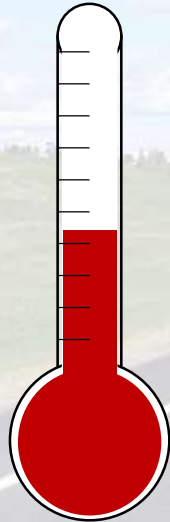
Average 7-day
max pavement
design temp

**Traffic
Level**

Minimum
pavement
design
temperature

Past Temperature Grade “Bumps”

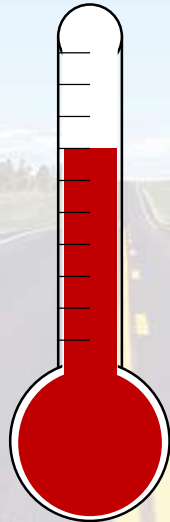
58°C
(136°F)



PG 58-28

■ Standard traffic

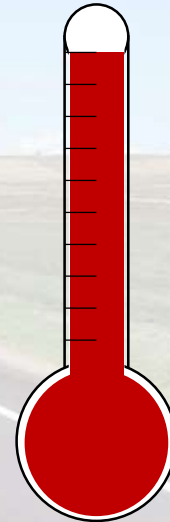
64°C
(147°F)



PG 64-28
1 “Bump”

■ Slow or heavy traffic

70°C
(158°F)

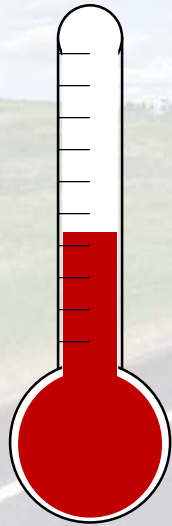


PG 70-28
2 “Bumps”

■ Stationary or high volume traffic

MSCR Traffic “Bumping”

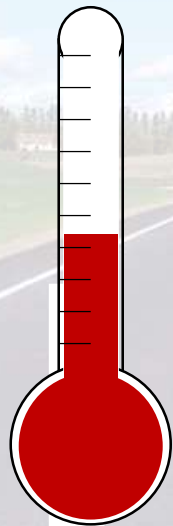
58°C



PG 58S-28

■ Standard traffic

58°C

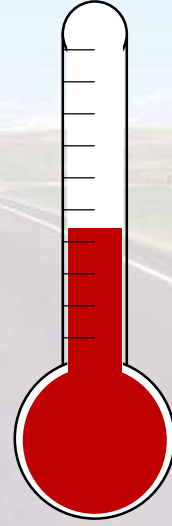


PG 58H-28

1 “Bump”

■ Heavy traffic

58°C

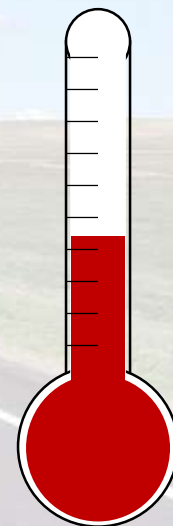


PG 58V-28

2 “Bumps”

■ Very heavy traffic

58°C



PG 58E-28

3 “Bumps”

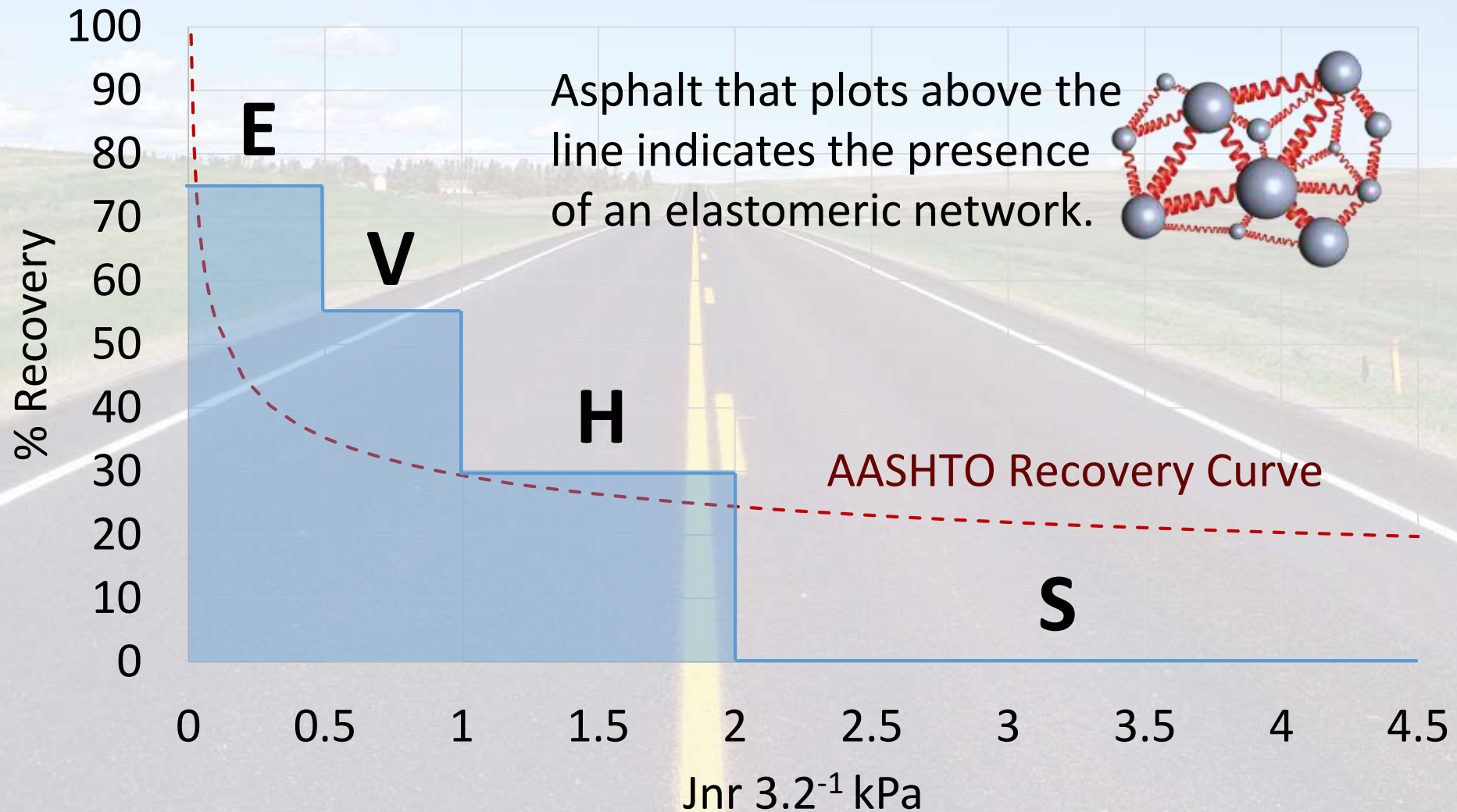
■ Extreme traffic

MN-DOT Binder Guidelines

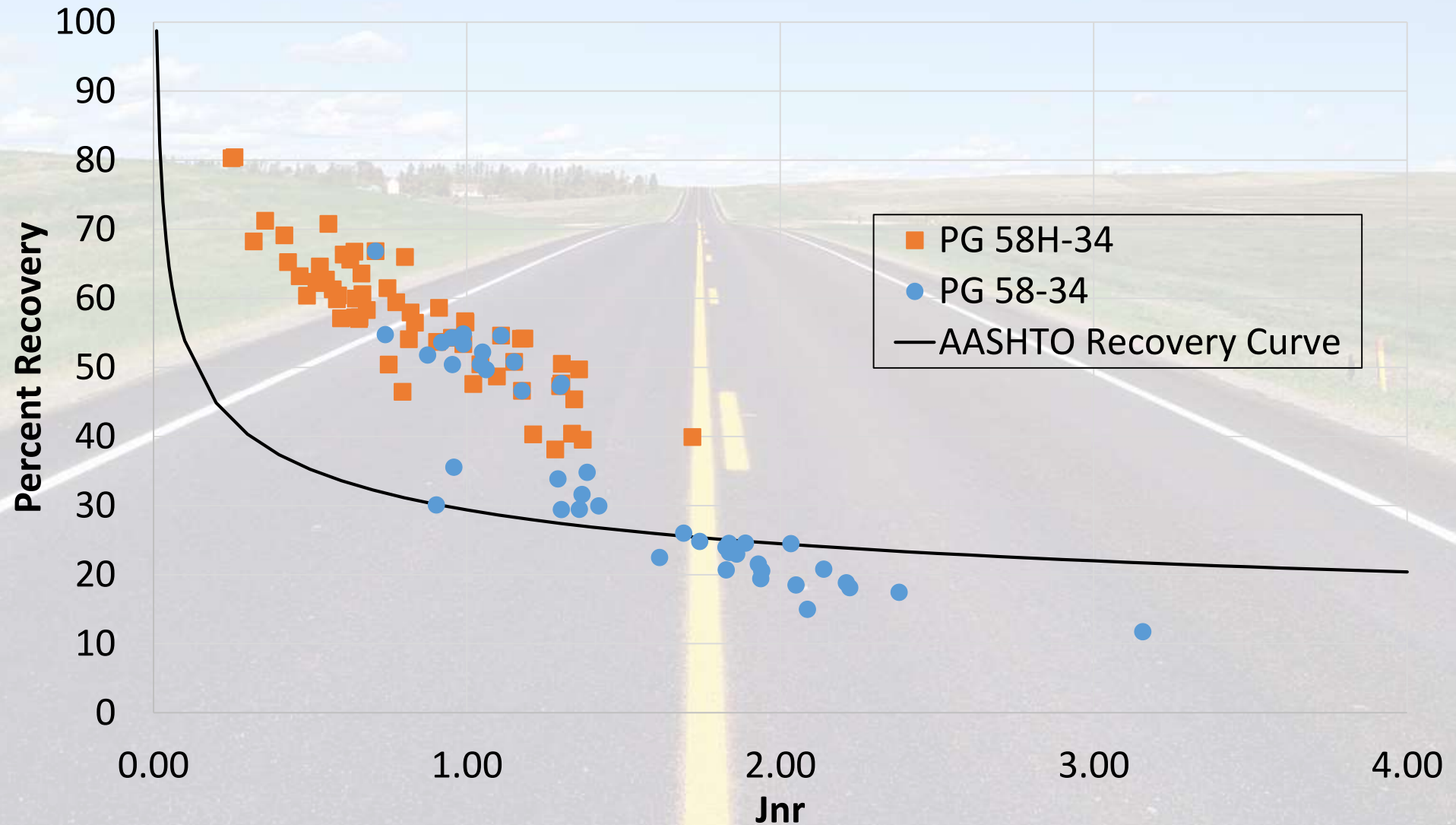
Type of Construction	Recommended Asphalt Binder for < 3 Million ESALs (20 yr)	Recommended Asphalt Binder for 3 - 10 Million ESALs (20 yr)	Recommended Asphalt Binder for > 10 Million ESALs (20 yr)
Overlay Wearing Mixture (Top 4'') ³	PG 58S-28	PG 58S-28 ¹	PG 58H-28 ¹
New Construction ² Wearing Mixture (Top 4'') ³	PG 58H-34	PG 58H-34 ¹	PG 58V-34 ¹
All Non-Wear Mixture (Below 4" from Surface)	PG 58S-28		

1. Selecting a higher PG grade and/or mixture type (traffic level), for higher ESALs within the category, will provide better resistance to rutting.
2. New construction includes: reconstruction, rubblization, CIR, reclaiming (FDR)
3. For Non-Trunk Highways with traffic levels <3 million ESAL, consider modifying the "top 4" criteria to "top 3".

AASHTO M332 (modified by CSBG)



PG 58-34 vs PG 58H-34



FHR Production Samples 2013 -2017

Grade	High Performance Grade		% Recovery
	Average	Lowest	Lowest
PG 58-34	61.8	58.9	11.8
PG 58H-34	63.3	59.9	38.1
PG 64-34	66.6	64.4	43.4
PG 58V-34	67.3	64.0	60.2
PG 64-28	67.2	65.2	19.8
PG 58H-28	67.6	65.3	35.8

Red values plot below AASHTO Recovery Curve



Questions?

Jeff Shoger
Flint Hills Resources, LP



Dakota Asphalt Pavement Association, Inc.

"Dedicated to Quality Asphalt Paving Through Engineering, Research, and Education"



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