

# FEATURE CORE INNOVATION AREA PRESENTATION:

## HIGH FRICTION SURFACE TREATMENT - LESSONS LEARNED

CIA TEAM

**INFRASTRUCTURE  
PRESERVATION**


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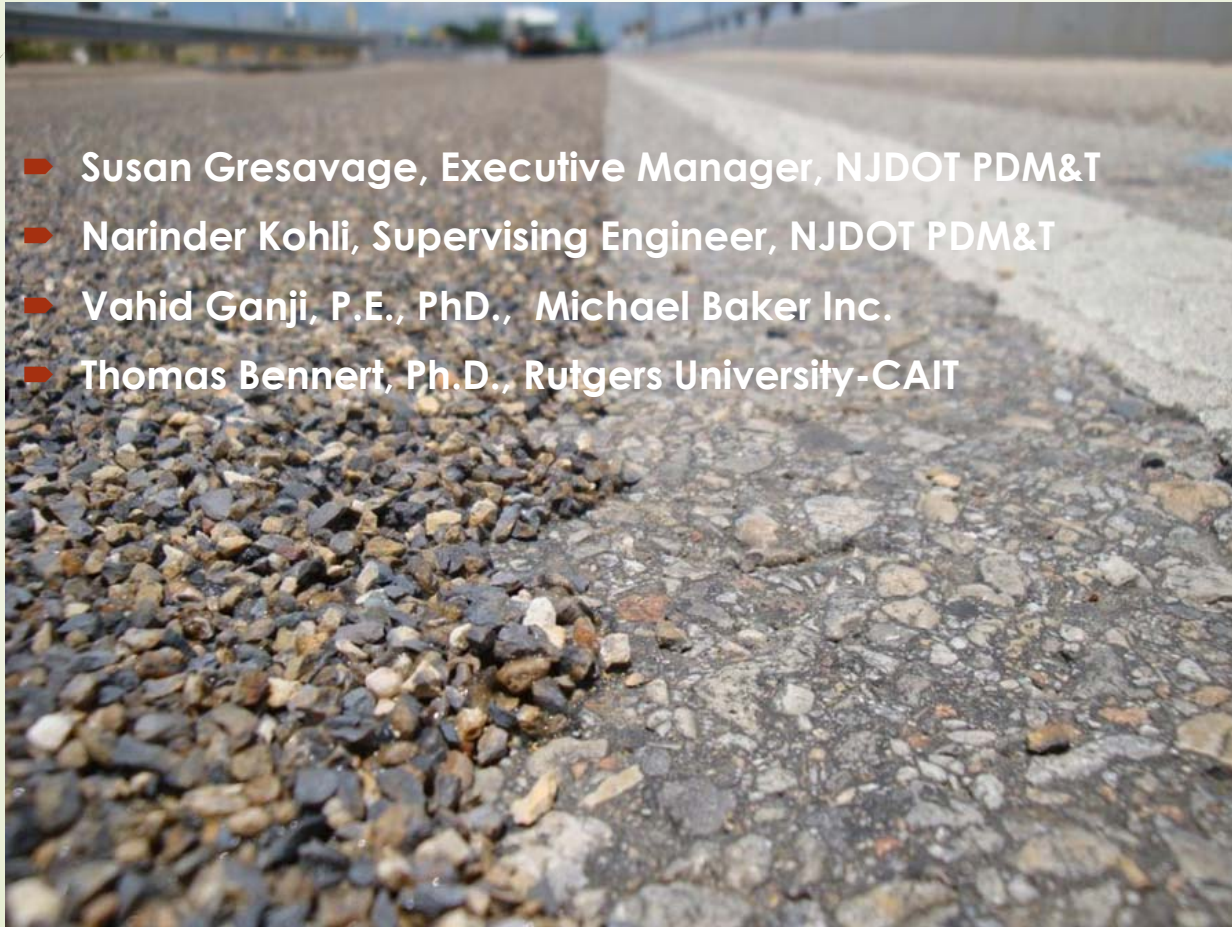
# NJDOT High Friction Surface Treatment Update



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# Acknowledgements

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# NJDOT HIGH FRICTION SURFACE TREATMENT (HFST)

- WHAT IS HFST?
- LESSON LEARNED & CHALLENGES





# What is High Friction Surface Treatment (HFST)?



- ▶ HFST is a safety countermeasure
  - ▶ polish-resistant calcined bauxite aggregate (**grit**)
  - ▶ bonded to the pavement surface using a polymer resin binder (**glue**)

# Why do we need HFST?

- Targeted Solution to Roadway Departure Crash Reduction—curve location only
- Friction  Crashes 
- Distracted Driving?- HFST does not need to communicate with the driver to work
- Speeding?- HFST does not enhance driver comfort or promote higher speeds
- It's a Proven, Effective Solution.



# Textures that affects friction

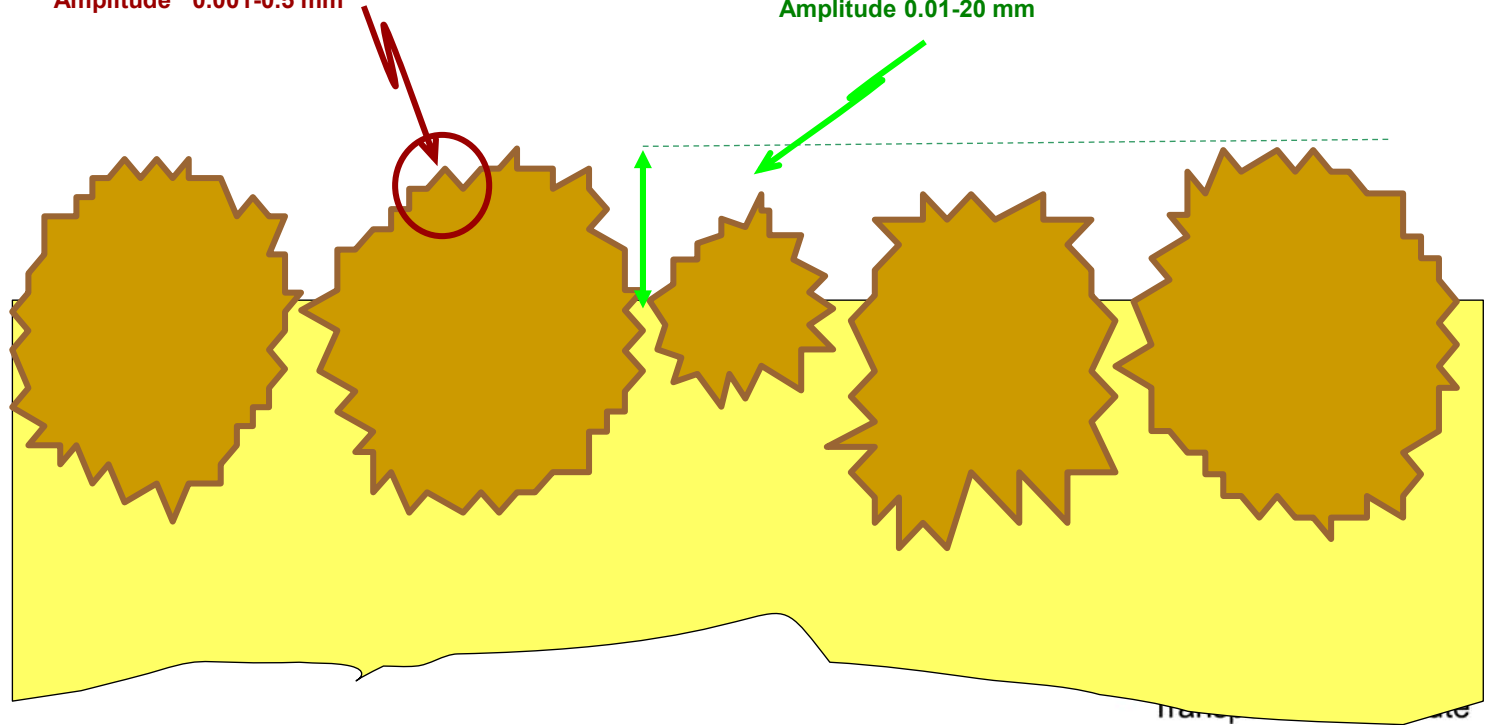
## Microtexture

Amplitude 0.001-0.5 mm

## Macrotexture

Wavelength 0.5-50 mm

Amplitude 0.01-20 mm

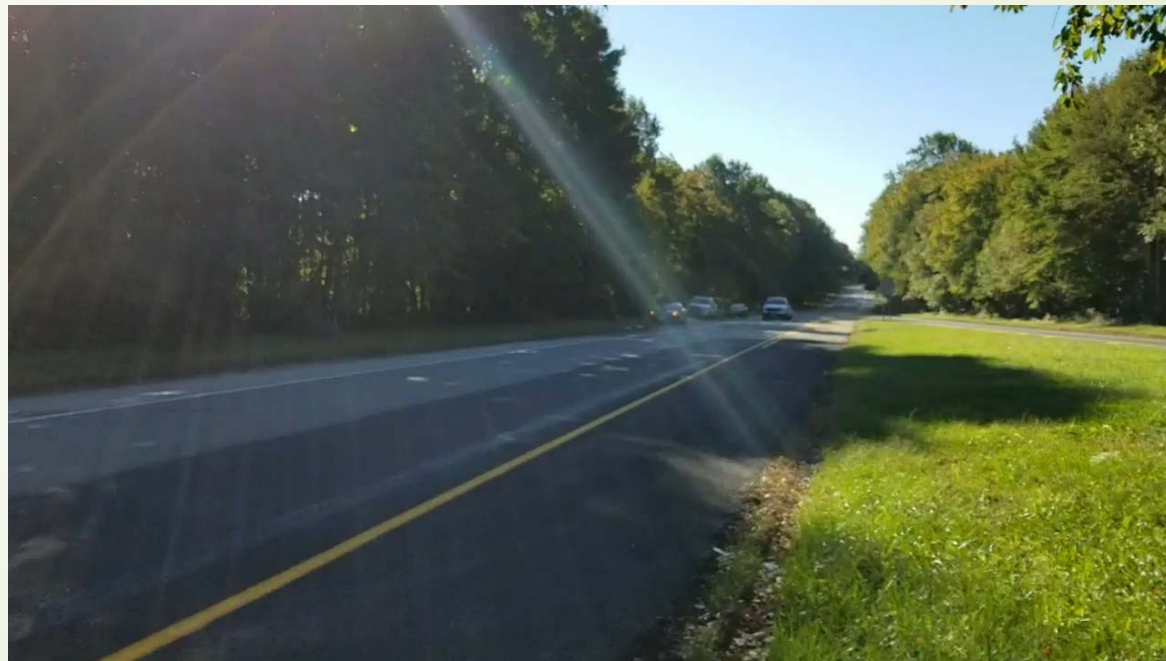


# NJDOT SPEC. Surface Quality Skid Resistance Acceptance

- RE performs visual inspection of HFST
- RE can reject HFST based on visual assessment and require corrective action
- If RE visually approves HFST, then NJDOT Pavement Management performs Skid Resistance Testing using ASTM Test Method E 274 for Initial Acceptance
  - Average Minimum SN  $\geq 65$**



# HFST Quality Acceptance Skid Test Video



# HFST Limitations



- Are NOT designed as:
  - **Pavement preservation methods**
  - Pavement repair methods
  - Bridge deck overlays
  - Educational or driver alert systems (not rumble strips)
  - Only wet weather systems
- HFSTs ARE: Designed to act mostly invisibly, under all times of the day or night, in all weather conditions to dramatically enhance the friction and reduce or eliminate roadway departure crashes.

# Where to Install HFST?

- Horizontal Curves
- Intersections
- On and Off Ramps– especially with elevation change (loop ramps)
- Steep Grades
- Line of Sight problem locations
- High Speed connectors/Merge locations
- **Where there are high crash clusters, roadway departures or poor roadway friction conditions**



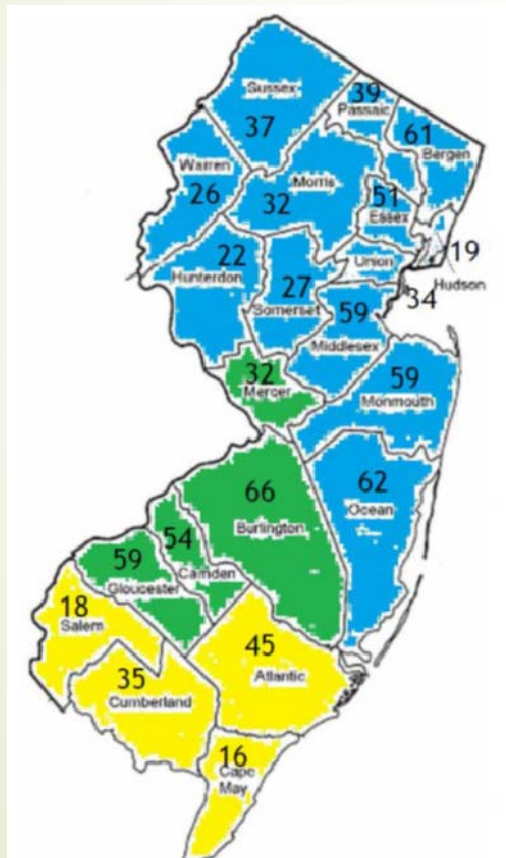


# Lessons Learned & Challenges



# HFST Pilot Program Start

## 2016 Lane Departure Serious Injuries and Fatalities in New Jersey



- Safety Programs and NJ FHWA requested Pavement Design assistance for HFST Specification
- Goal: Reduce Roadway Departures on Horizontal Curves
  - 336 Fatalities
  - 517 Serious Injuries
- Need NJDOT Spec. for HFST
- Other products being used as HFST by Locals
- Pavement Design provided Safety Programs HFST Specification in March 2016

# FOLLOW NJDOT HFST GUIDELINES



- Good Pavement
  - Newer pavement with adequate Remaining Service Life
  - Distress free or repair/resurface
  - Smooth
  - Structurally adequate
  - Quality material

Apply HFST ONLY on GOOD Pavement



# FOLLOW NJDOT SPECIFICATION

- MATERIALS
- **EQUIPMENT**
- EXPERIENCE
- WEATHER LIMITATIONS
- CONSTRUCTION REQUIREMENTS
- QUALITY ASSURANCE
- MAINTENANCE BOND (3 YEARS)



# **TRUCK MOUNTED HFST APPLICATION EQUIPMENT VS. MANUAL APPLICATION**



## Manual HFST Placement or Mechanically Assisted Installation = Premature Failure



# Automated Equipment Installation = Best Opportunity for Success

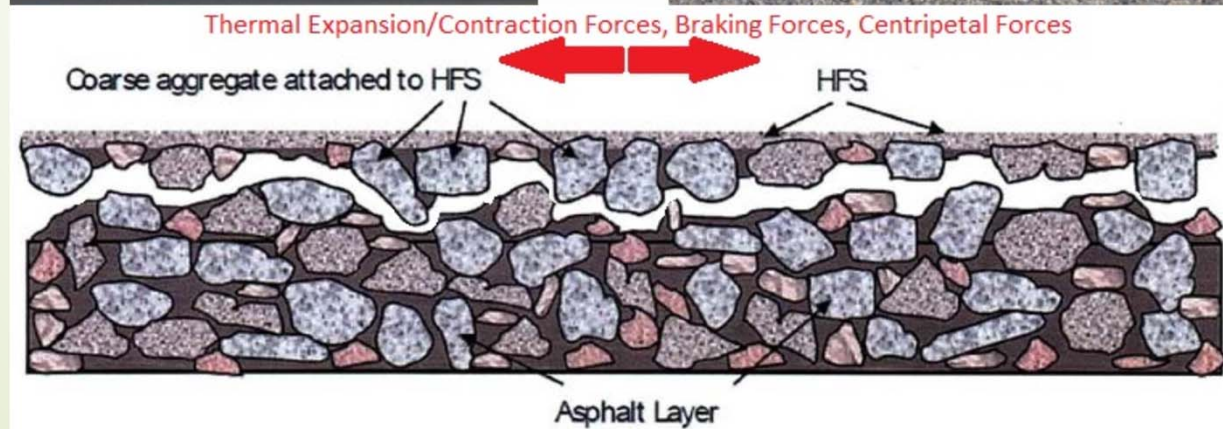


Automated Equipment = Binder + Aggregate placed by machine without manual spreading or leveling

# Pavement Condition Matters

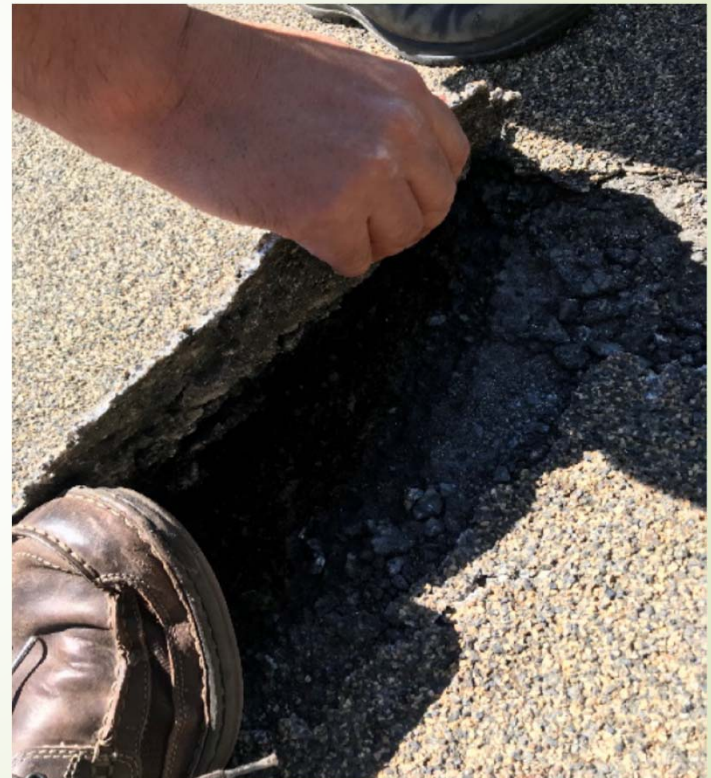


# Pavement Condition Matters



# HFST Failure Forensic Investigation - Conclusions

- Asphalt pavement was significantly aged or contained high amounts of RAP when placed in 2014
- Areas within the project showed excessive amounts of epoxy binder thickness and high variability of thickness
- Combination of poor asphalt and excessive epoxy binder caused accelerated delamination failures in the asphalt substrate



# Products Advertised as HFST, but Not HFST = Inadequate Skid Resistance



Route 29 Southbound to Lalor St. Ramp						
Pass 1		Pass 2		Pass 3		Average
MP	SN40	MP	SN40	MP	SN40	SN40
0.000	40.5	0.000	37.4	0.000	36.7	38.2
0.036	37.2	0.024	32.9	0.035	36.4	35.5
0.071	34.1	0.054	31.4	0.073	32.7	32.7
0.109	52.2	0.085	50.0	0.111	46.5	49.6
0.144	51.4	0.119	50.1	0.141	50.4	50.6
0.174	48.2	0.142	49.7	0.163	48.4	48.8
0.203	49.5	0.168	45.4	0.186	51.8	48.9
0.229	54.4	0.200	54.2	0.206	50.7	53.1

Route 29 Southbound to Lalor St. Ramp						
Pass 1		Pass 2		Pass 3		Average
MP	SN40	MP	SN40	MP	SN40	SN40
0.000	66.4	0.000	66.3	0.000	66.7	66.5
0.013	64.2	0.011	56.5	0.011	61.5	60.7
0.026	63.0	0.022	56.8	0.022	55.9	58.6
0.039	52.2	0.034	63.1	0.036	49.9	55.1
0.053	58.8	0.048	65.9	0.058	59.9	61.5
0.067	64.0	0.064	59.9	0.086	55.9	59.9
0.082	55.6	0.081	55.8	0.100	60.0	57.1
0.099	58.3	0.098	56.1	0.113	61.5	58.6
0.115	60.8	0.115	57.5	0.125	59.4	59.2
0.13	52.7	0.131	52.9	0.138	65.1	56.9

## Products Advertised as HFST



**NOT HFST (as per NJDOT specification)**

# Route 68 High Friction Chip Seal (HFCS) Case Study



# Route 68 High Friction Chip Seal (HFCS) Case Study



- What if we tried high friction aggregate with a highly modified asphalt binder?
  - Stellarflex PG82-22 FR
    - True Grade PG88-22
    - 7.5% Polymer
- Try some other aggregates?  
Locally sourced
  - TRI Diabase (NJ)
  - Calcined Bauxite (Great Lakes Minerals)
  - Flint Rock (Oklahoma)

# Route 68 High Friction Chip Seal (HFCS) Case Study

PG82-22 FR Binder Appl.



Aggregate Spreading



# High Friction Chip Seal Installation Video





## LESSONS LEARNED

- **Automated equipment matters** - properly functioning and calibrated
  - Consistent binder thickness
- Make sure **pavement condition is GOOD!**
  - Visual condition assessment NOT ADEQUATE!
- Not all products advertised as HFST meet NJDOT specification or FHWA/AASHTO requirements
- Experience and workmanship matters
- NJDOT still in the pilot phase with HFST
- Researching HFCS. Stay Tuned!

# Challenges – Aggressive Snow Operations



## Challenges – Aggressive Snow Operations + Improper HFST Equipment



## Challenges – Maintenance Bond Enforcement



Stay Tuned!



Questions?

# High Friction Surface Treatment Can Save Lives!

- When done properly
- In appropriate locations



Thank you!  
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