Rut Initiation Mechanisms in Asphalt Mixtures as Generated Under Accelerated Pavement Testing

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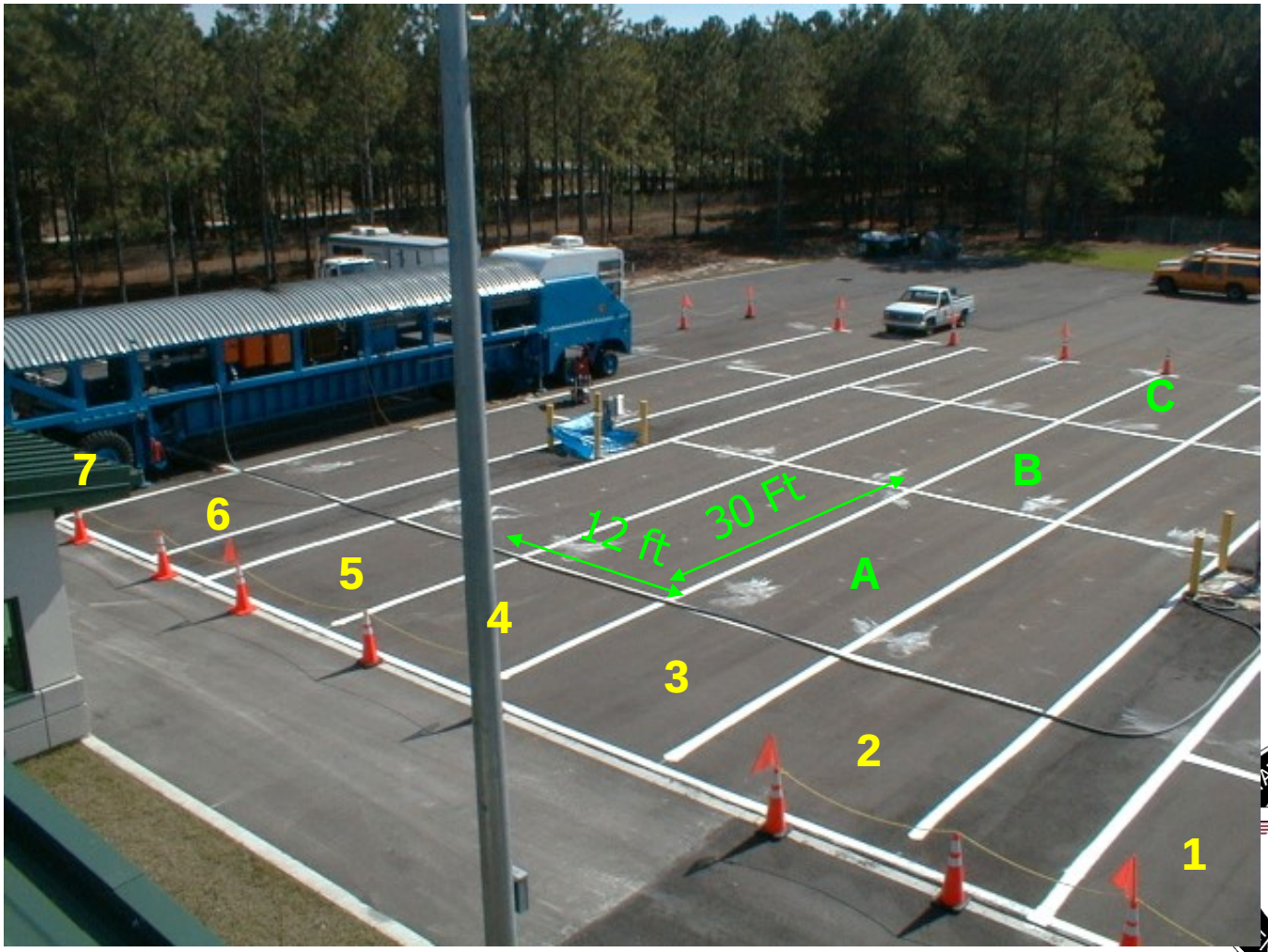
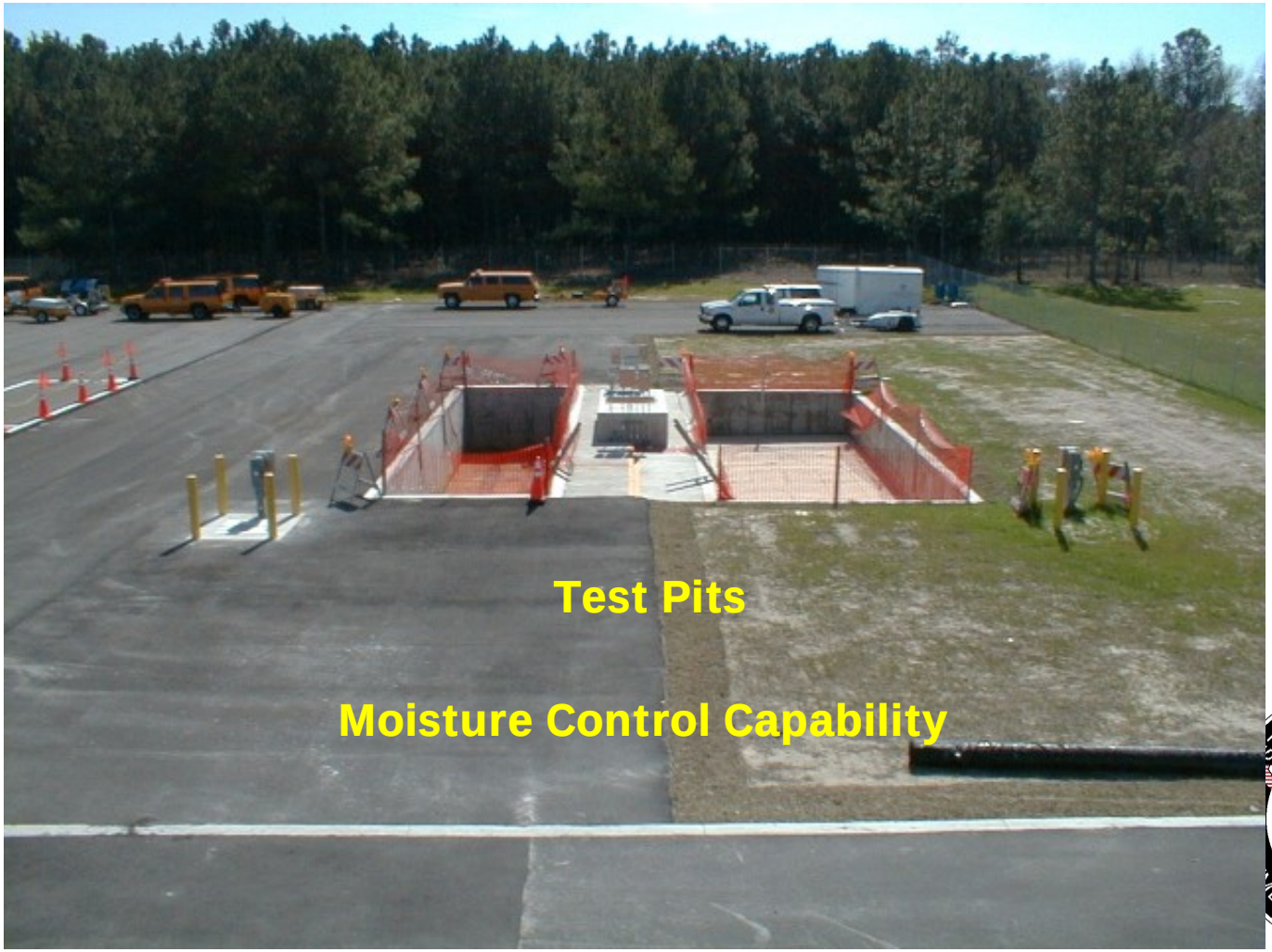
Overview

- FDOT's APT Program
- Rut Measurements
- First Experiment – Performance of SBS Modified Asphalt Binder
- Rut Initiation Mechanisms – Densification and Shear
- Conclusions

APT Site



APT Site



HVS Loading Characteristics

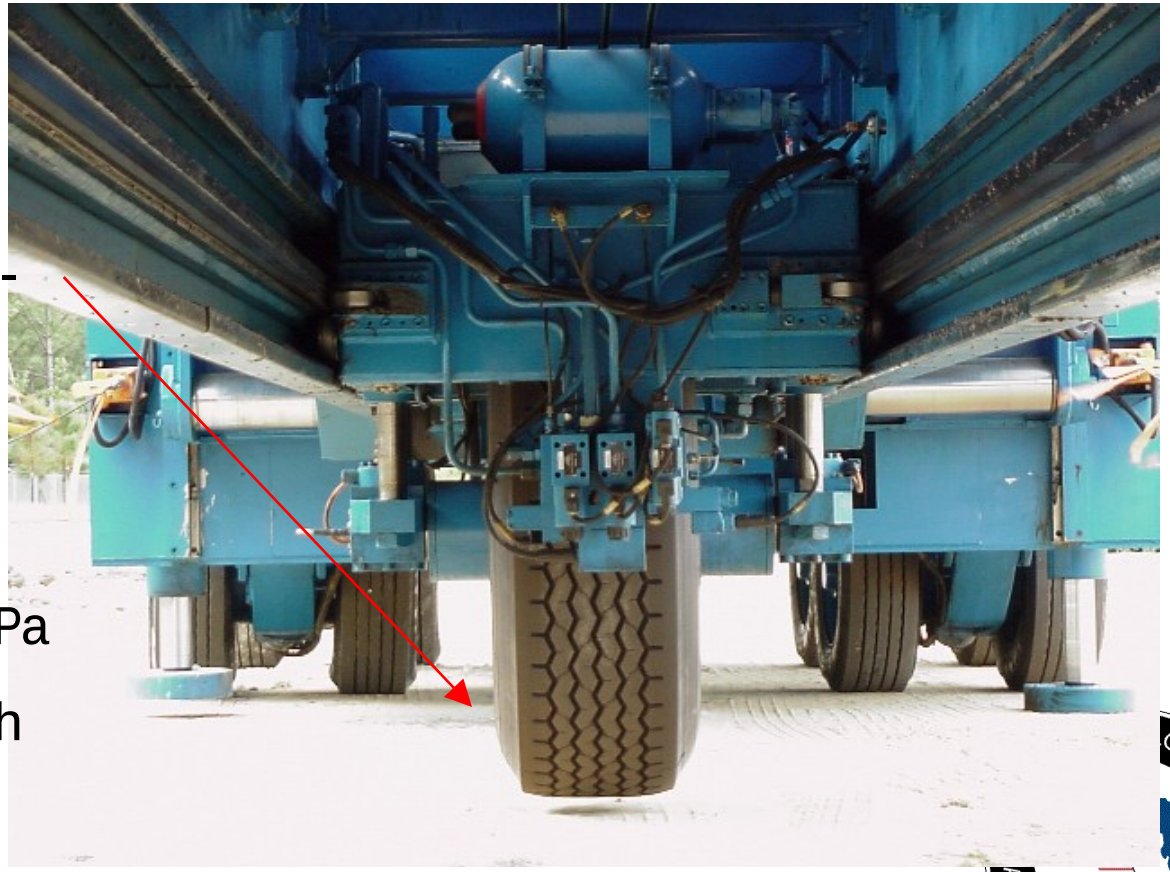
Goodyear G165 Super-single Tire

305mm (12 in) wide

Tire Load = 40 kN

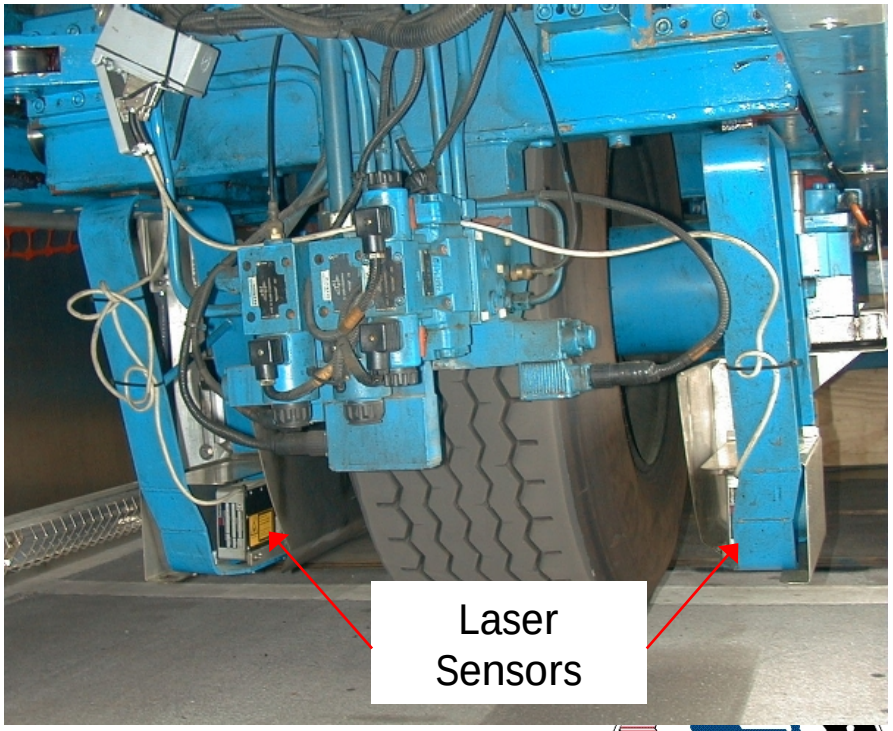
Tire Pressure = 767 kPa

Wheel Speed = 13 kph



Laser Profiler

- Two 16 kHz Lasers, mounted 762mm (30 in) apart
- SLS 5000™, LMI Silicon
- Accuracy of 0.025% of measurement range
- Wheel carriage travels at 4 kph during data collection
- Carriage is ‘unloaded’

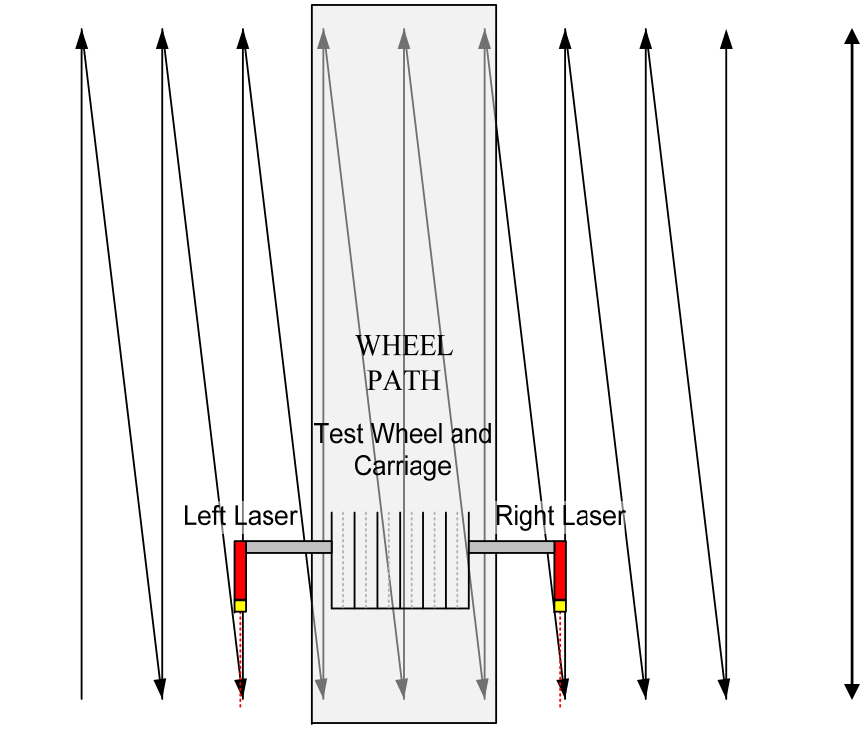


Pavement Profiles

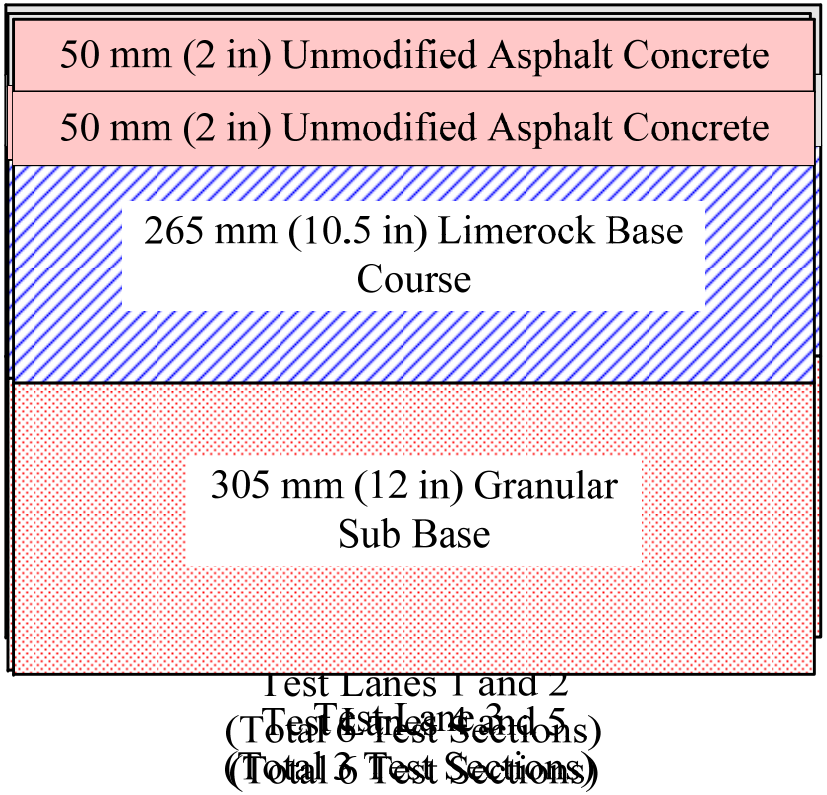
Data collection:

Wheel unloaded

Profile time = 15 minutes



Pavement Sections



Asphalt Mixtures

- 2 asphalt mixtures
  - Virgin binder - PG 76-22
  - SBS modified binder – PG76-22
- Same aggregate gradation
- Same effective mix design
- Constant pavement temperature of 50° C at a depth of 50 mm

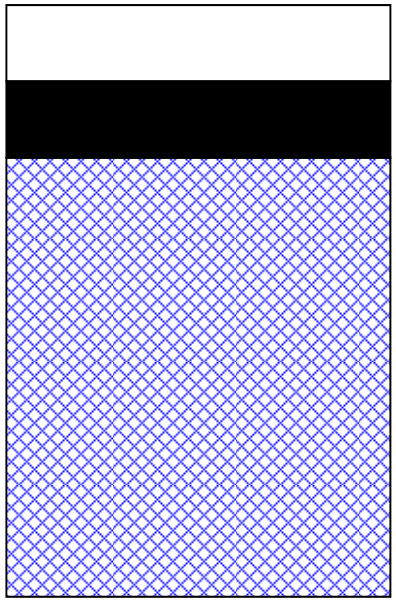
Rutting Mechanisms

- Densification
  - Caused by the reduction of air voids
- Shear flow
  - Affected by the shear strength of the material

Rutting Mechanisms

Densification in the vertical direction only

Densification equal in all three directions



Air voids

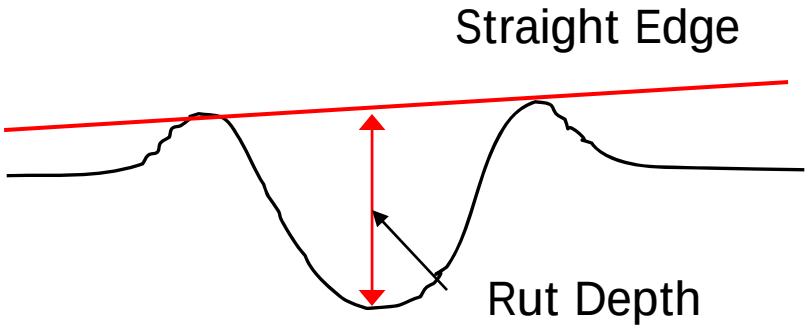
Liquid binder

Aggregate

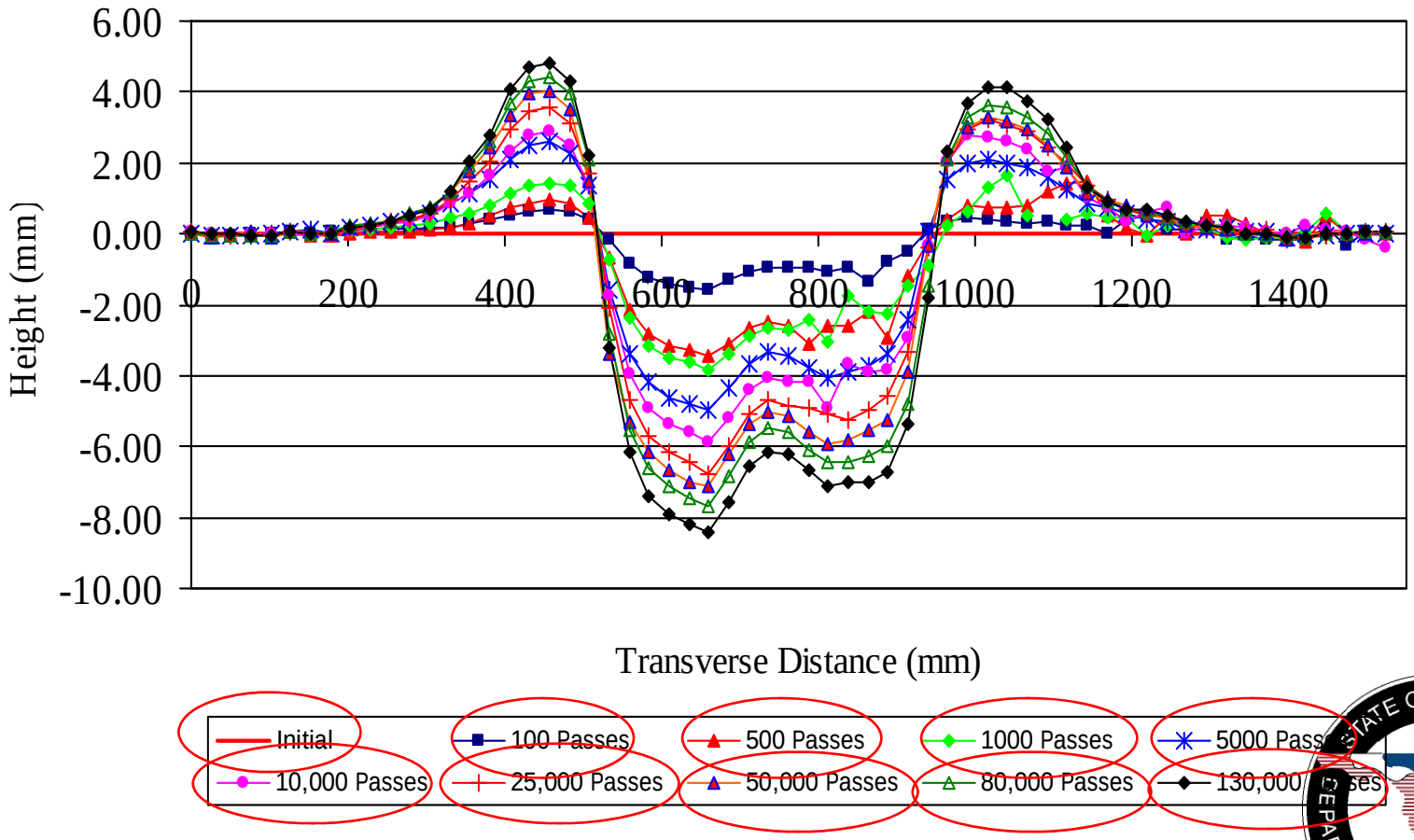
- 1% reduction in air voids = 1% reduction in thickness
- 1% reduction in air voids = 0.33% reduction in thickness

Measurement of Rut Depth

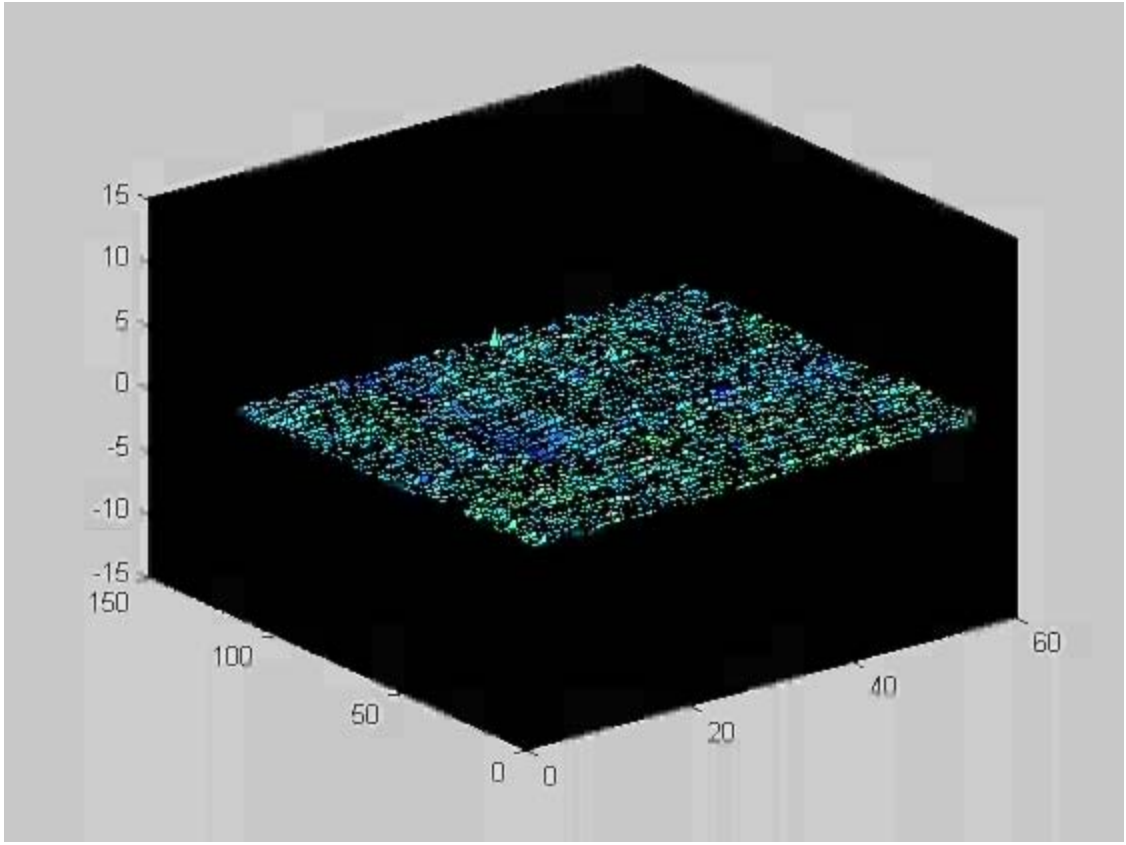
- Manual Methods
  - Straight edge
- Automated Methods
  - Non contact profilers
  - Various proprietary devices



Typical Transverse Profiles



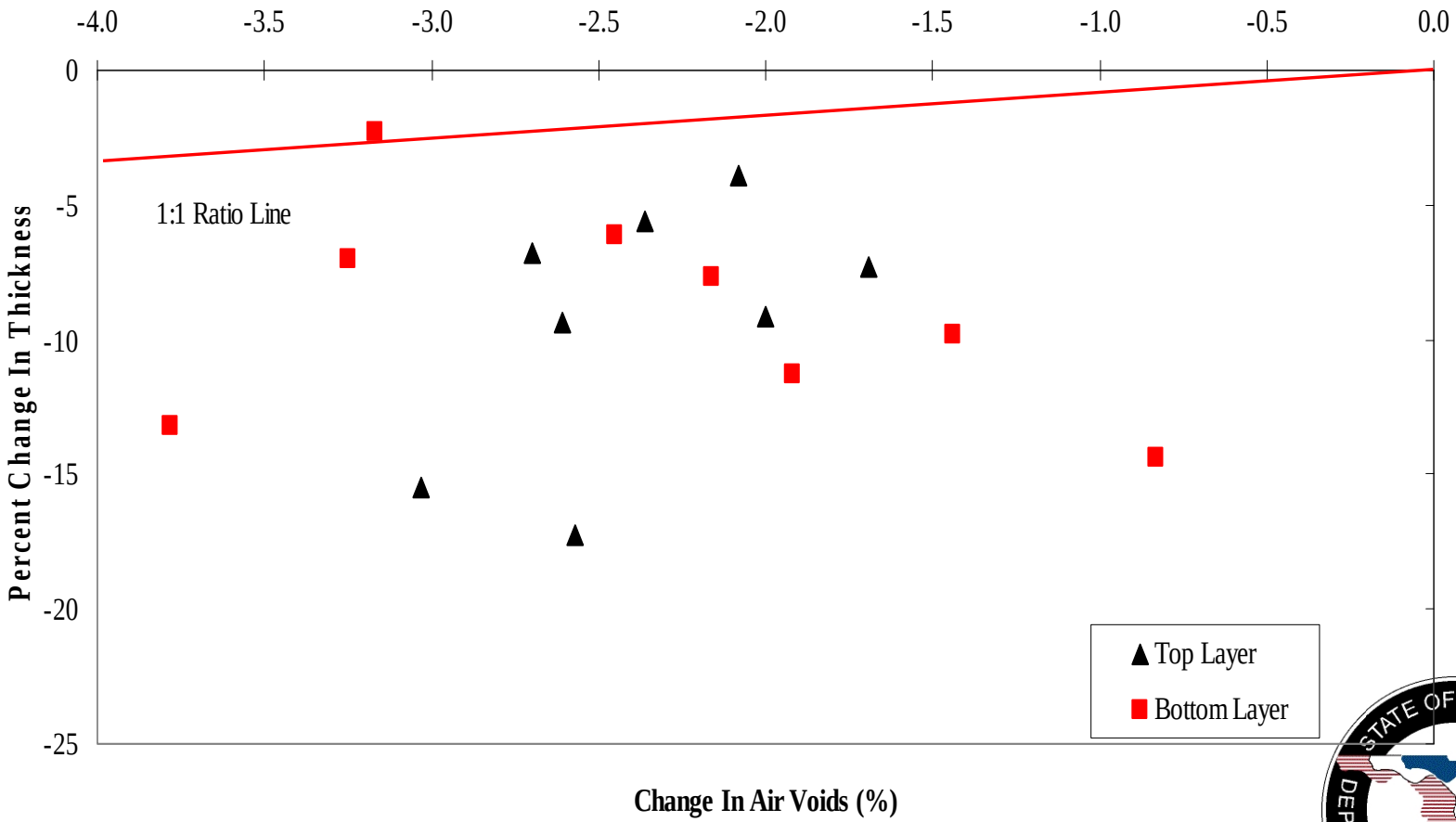
Rut Development



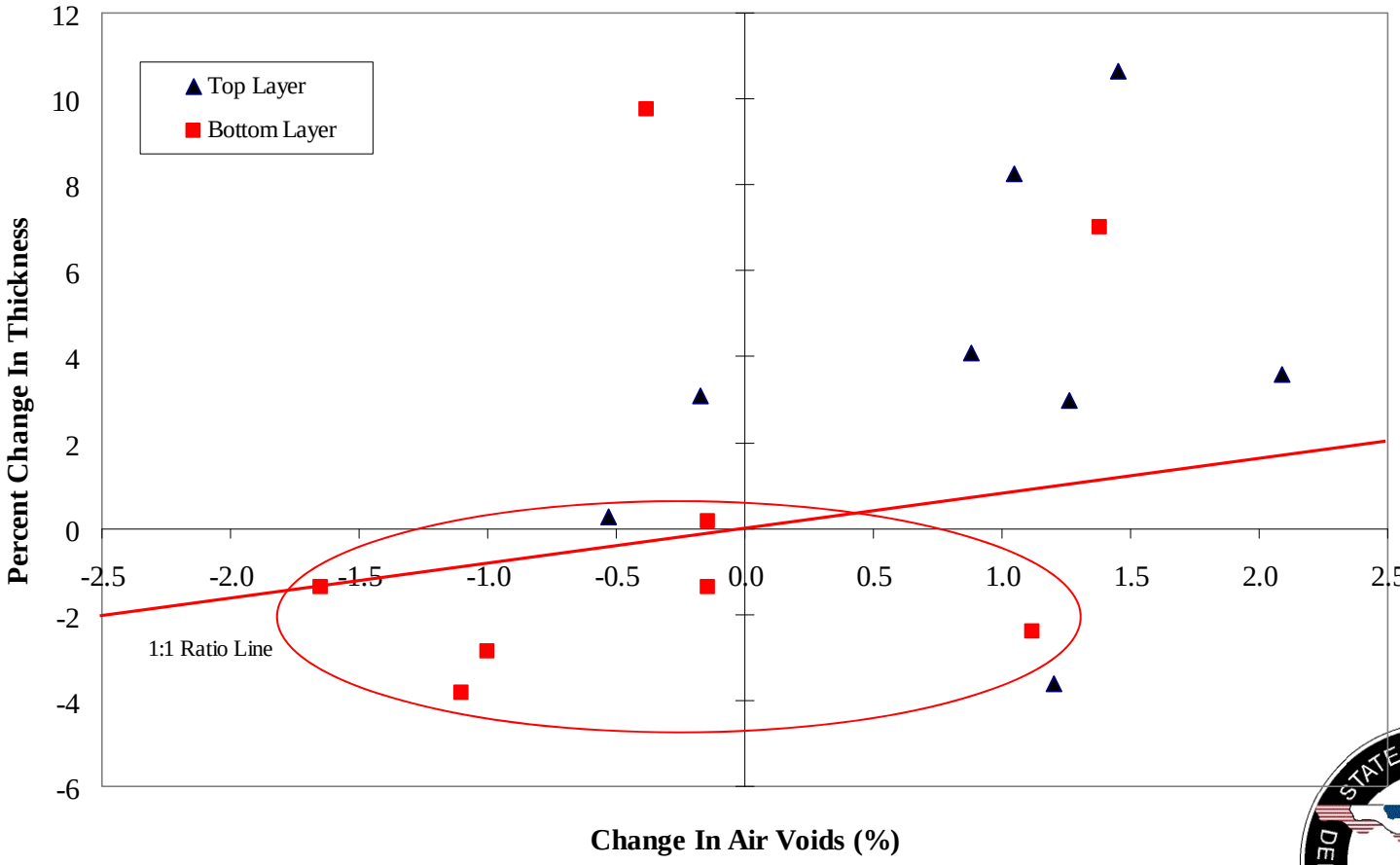
Rutting Analysis

- Volume Change Analysis
  - Cores
    - Change in thickness and air void content
  - Surface Profiles

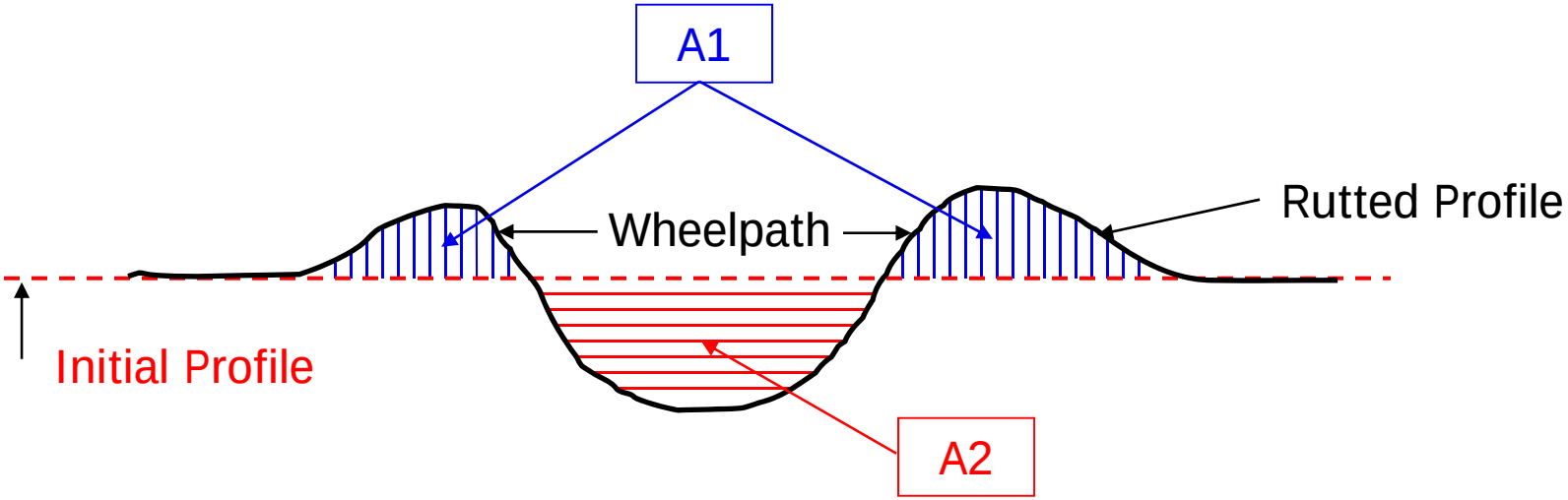
Wheelpath Cores



Edge of Wheelpath (hump) cores



Densification-Shear Analysis



A1 = Area of material at the edge of the wheelpath (Humps)

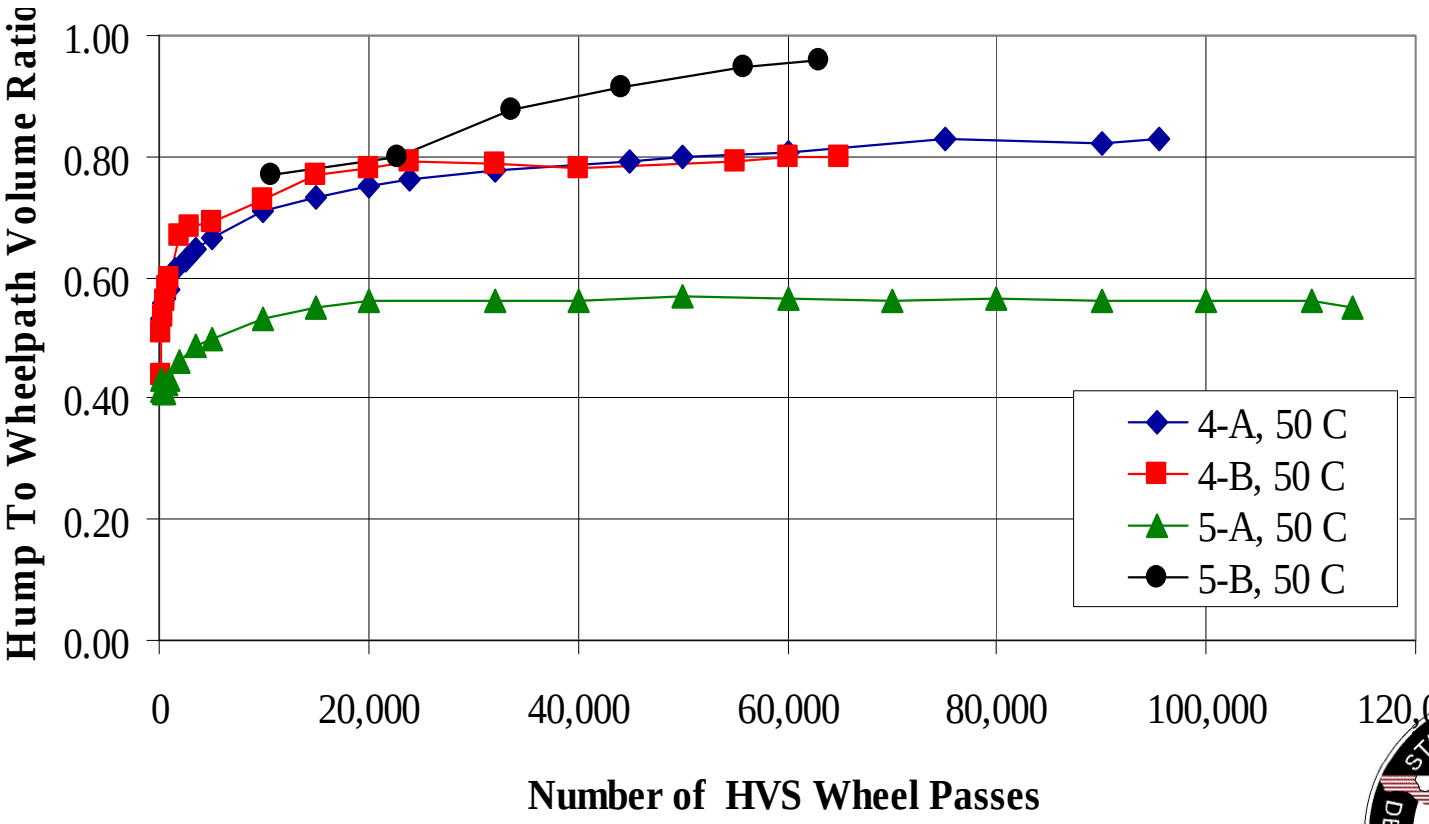
A2 = Area of empty space inside the wheelpath

Densification-Shear Analysis

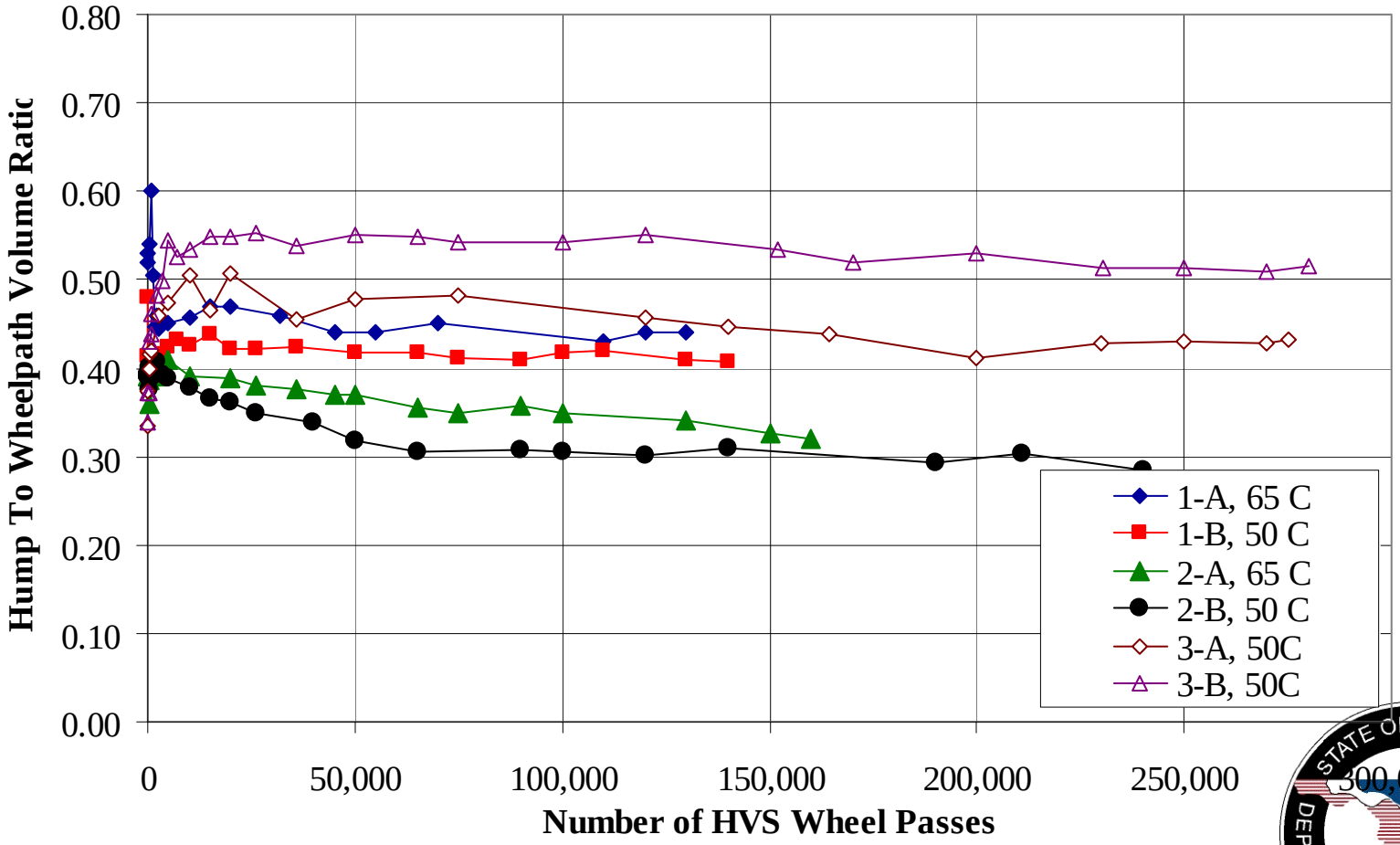
- Areas calculated for every single transverse profile, at given number of passes
- Assuming a unit length of 1 m, equivalent volumes calculated
- Ratio = A1 / A2
- Note: No rutting observed in base course

Analysis Results

Unmodified Mixtures



Modified Mixtures

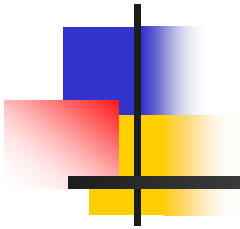


Conclusions

- Under FDOT-APT conditions
  - No observable rutting in the base course
  - SBS modified mixtures clearly out performed unmodified mixtures

Conclusions

- Under FDOT Conditions
  - A significant portion of rutting can be attributable to shear flow (at higher pavement temperatures)
  - Higher shear strength of asphalt mixtures can reduce rutting



Questions?