



Establishing a Validation Procedure for Continuous Friction Measurement Equipment (CFME)

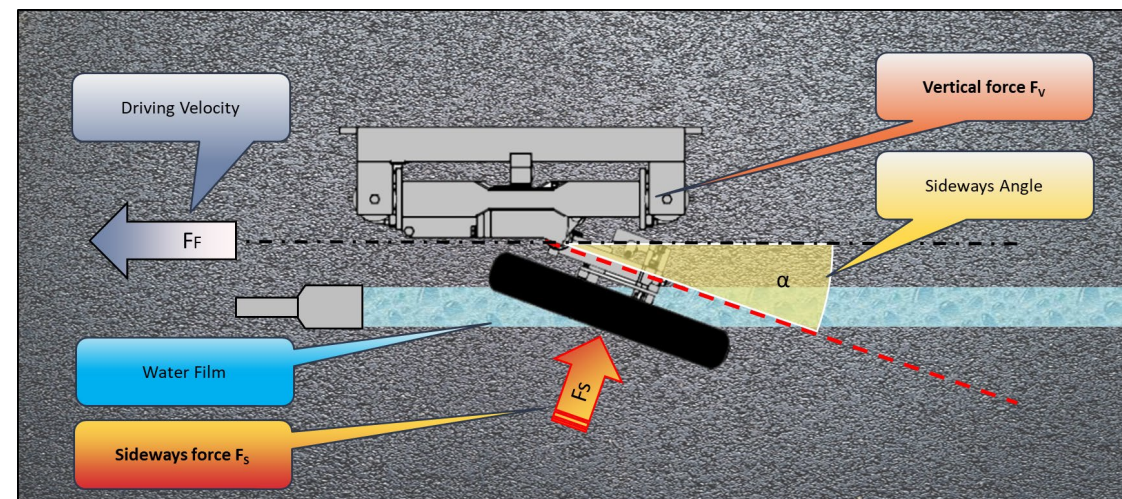
Chris Young, RPUG 2024

Overview

- CFME – How it works and why we care
- Motivation for Study
- Site Description
- Initial Collection Results
- Pre-Network Collection Results
- Results Analysis
- Thoughts at ~2700 Miles Collected

CFME – How it works

- Continuous measurement
- Tire skewed at 20°
- Dynamic Vertical Load
- Dynamic speed-controlled watering system
- Air & tire temperature monitoring
- Continuous tire pressure monitoring

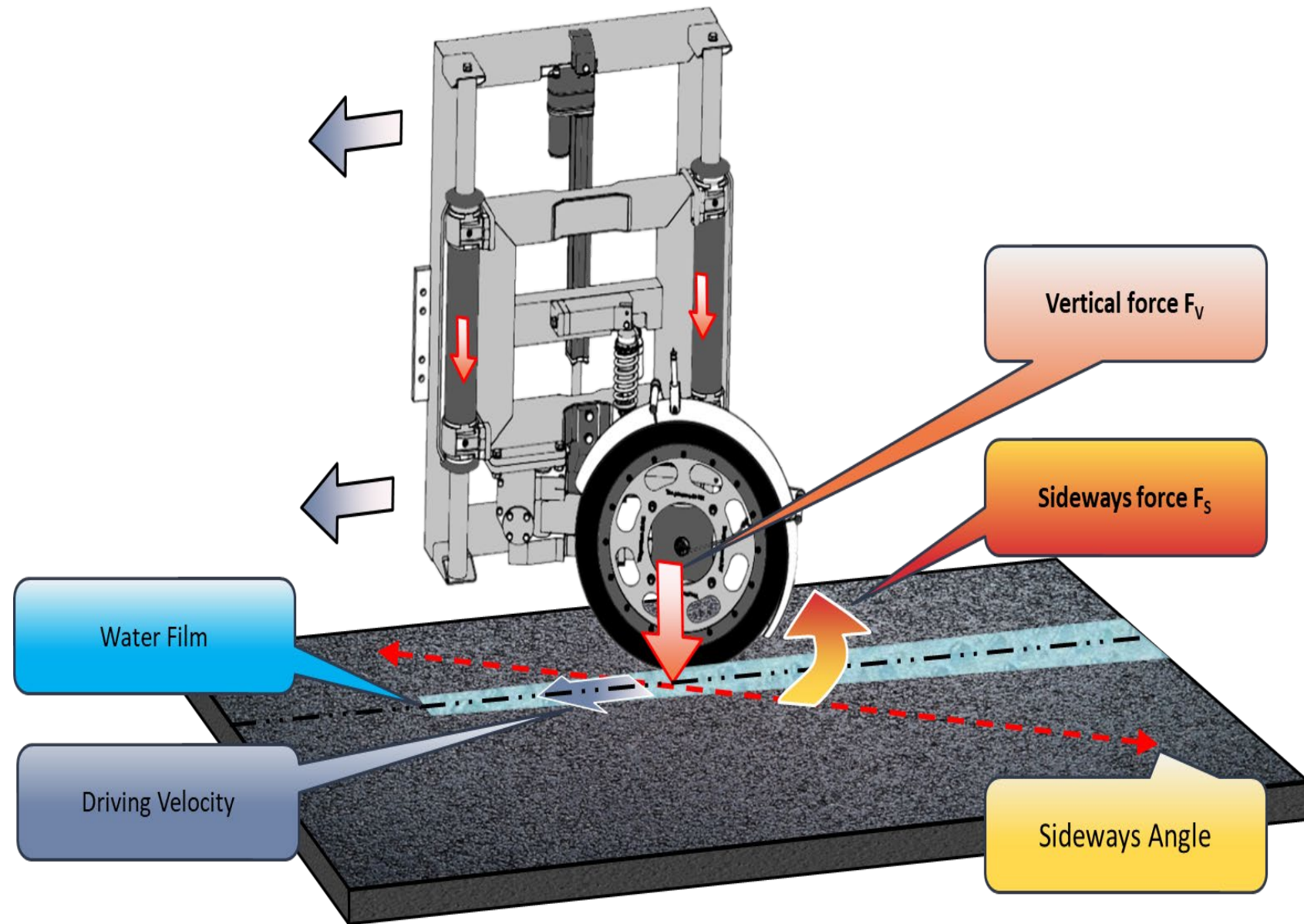


Sideways Force Coefficient

$$SFC = \frac{F_S}{F_V}$$

Sideways-force Ratio or Skid Ratio (SR) is:

$$SR = SFC * 100$$



Why do we care about Skid Ratio and CFME?

➤ Safety

- "Nearly 5,700 people are killed and more than 544,700 people are injured in crashes on wet pavement annually."
- "...about 70% of wet pavement crashes can be prevented or minimized by improved pavement friction"

-FHWA

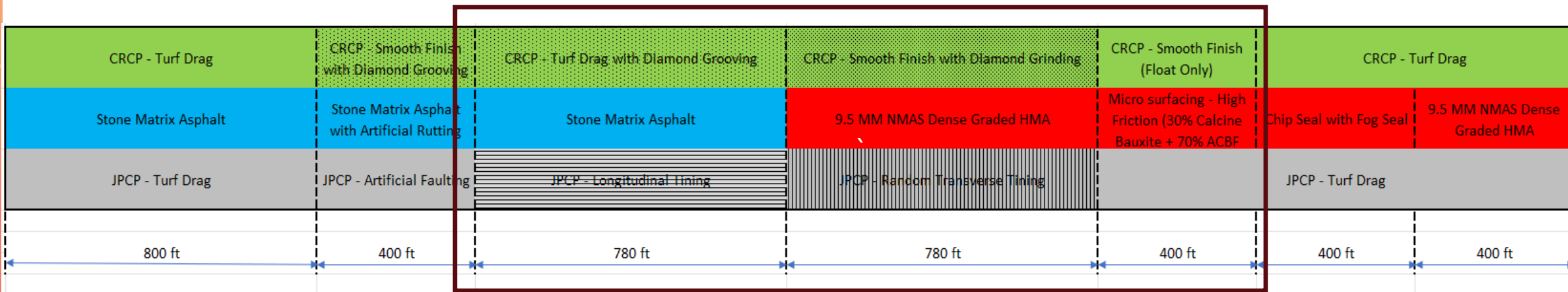
Motivation for Study

- Precision and bias values are not prescribed in existing standard (AASHTO TP143)
- Solution
 - Partner with IDOT to validate the CFME
- Goals
 - Quantify repeatability of our equipment
 - Produce repeatable, reliable results
 - Increase confidence in CFME

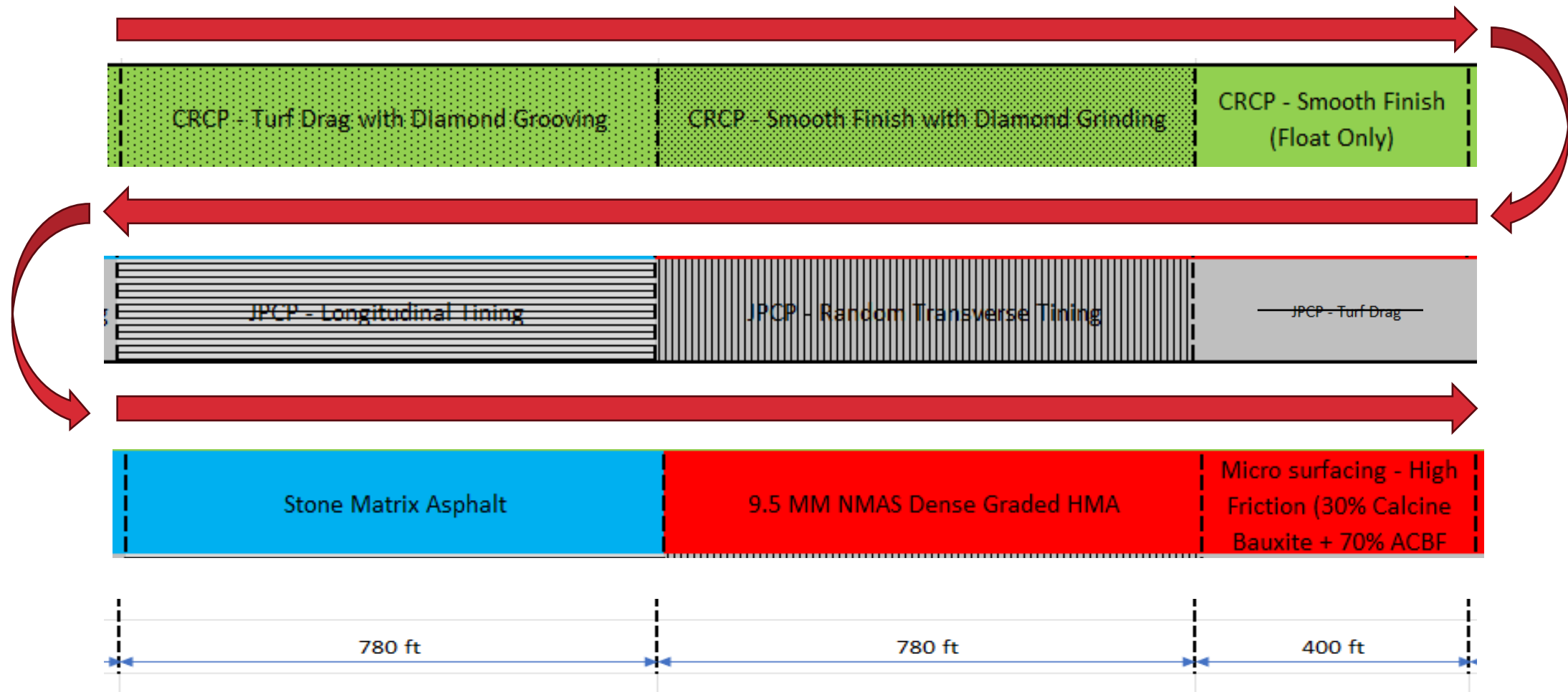
Description of Testing

- ICART testing track
 - Part 1 in October 2023
 - 2 different types of tires (A&B)
 - 3 lanes – CRCP, JPCP, Asphalt
 - 5 passes on each lane per tire (A&B)
 - Part 2 in March 2024
 - 1 type of tire
 - 5 passes on each lane
 - Check repeatability on network level with selected tire

ICART Track



Test Description



Results Analysis

- Processed data at 0.001-mile interval in initial testing
- Calculated r^2 for all combinations of runs
- Reported median r^2 for each pavement type
- Produced graphs for SR values at each segment
- Calculated average SR for each segment

Trial Run Results – Tire A

AM Runs

Site	Pavement Type	0.001-mile Correlation	0.001-mile Correlation CORRECTED	Average SR CORRECTED
1	CRCP	86.7%	91.8%	74
2	JPCP	61.5%	75.9%	75
3	Asphalt	79.1%	87.6%	73

PM Runs

Site	Pavement Type	0.001-mile Correlation	0.001-mile Correlation CORRECTED	Average SR CORRECTED
1	CRCP	68.7%	90.3%	74
2	JPCP	52.9%	84.2%	72
3	Asphalt	74.2%	81.2%	73

Trial Run Results – Tire B

AM Runs

Site	Pavement Type	0.001-mile Correlation	0.001-mile Correlation CORRECTED	Average SR CORRECTED
1	CRCP	63.3%	91.4%	74
2	JPCP	80.1%	81.9%	73
3	Asphalt	62.8%	91.7%	75

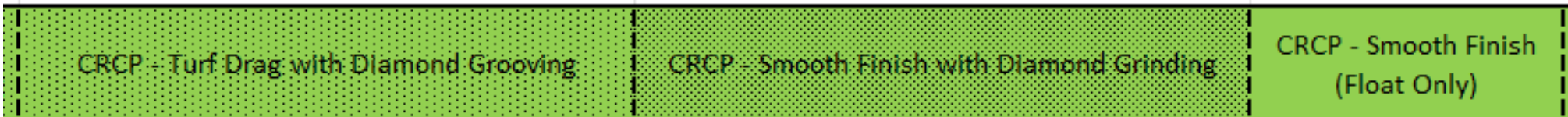
PM Runs

Site	Pavement Type	0.001-mile Correlation	0.001-mile Correlation CORRECTED	Average SR CORRECTED
1	CRCP	71.0%	94.0%	72
2	JPCP	91.6%	92.0%	73
3	Asphalt	86.4%	94.9%	73

Pre-Network Collection Results

Site	Pavement Type	0.001-mile Correlation	0.01-mile Correlation	Average SR
1	CRCP	96.1%	97.5%	73
2	JPCP	83.2%	86.1%	70
3	Asphalt	87.4%	91.1%	74

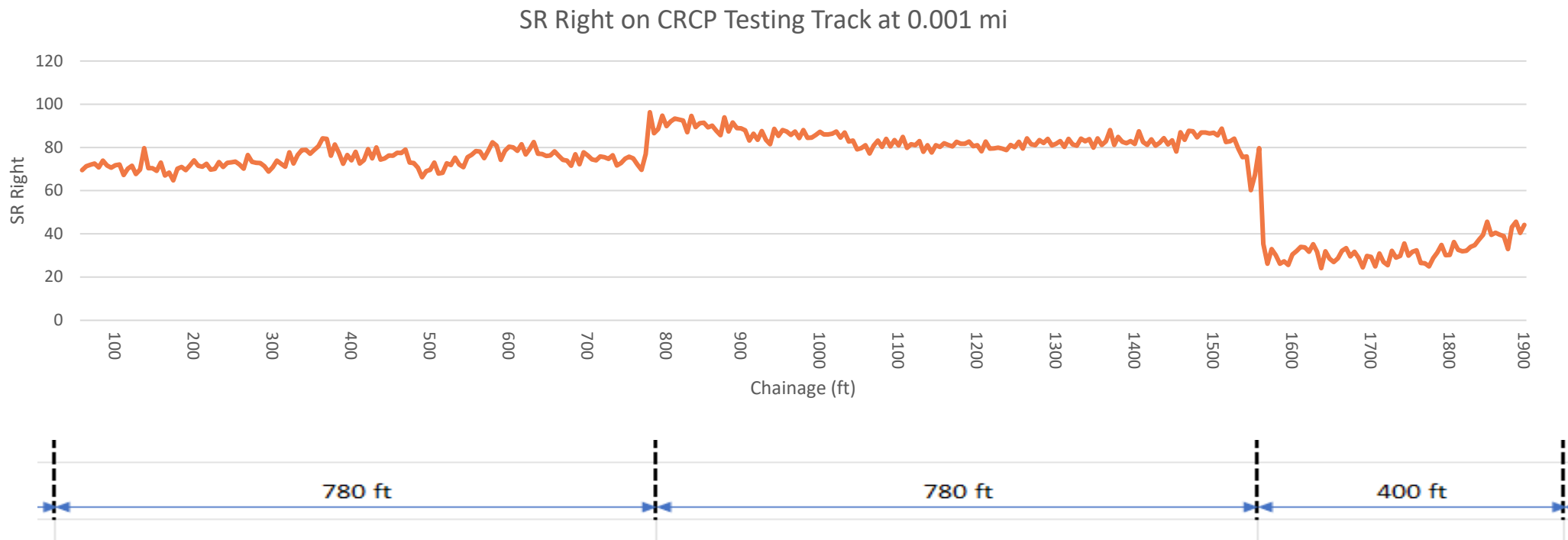
SR Values - CRCP



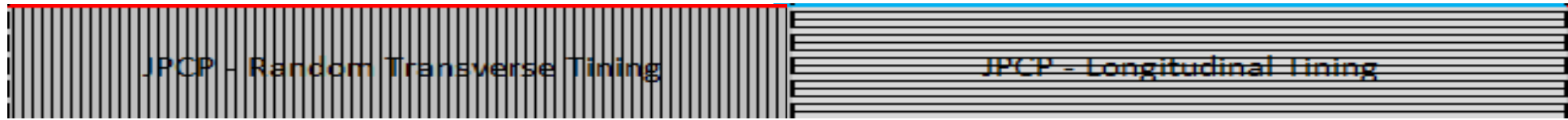
➤ Average SR - 74

➤ Average SR - 84

➤ Average SR - 32

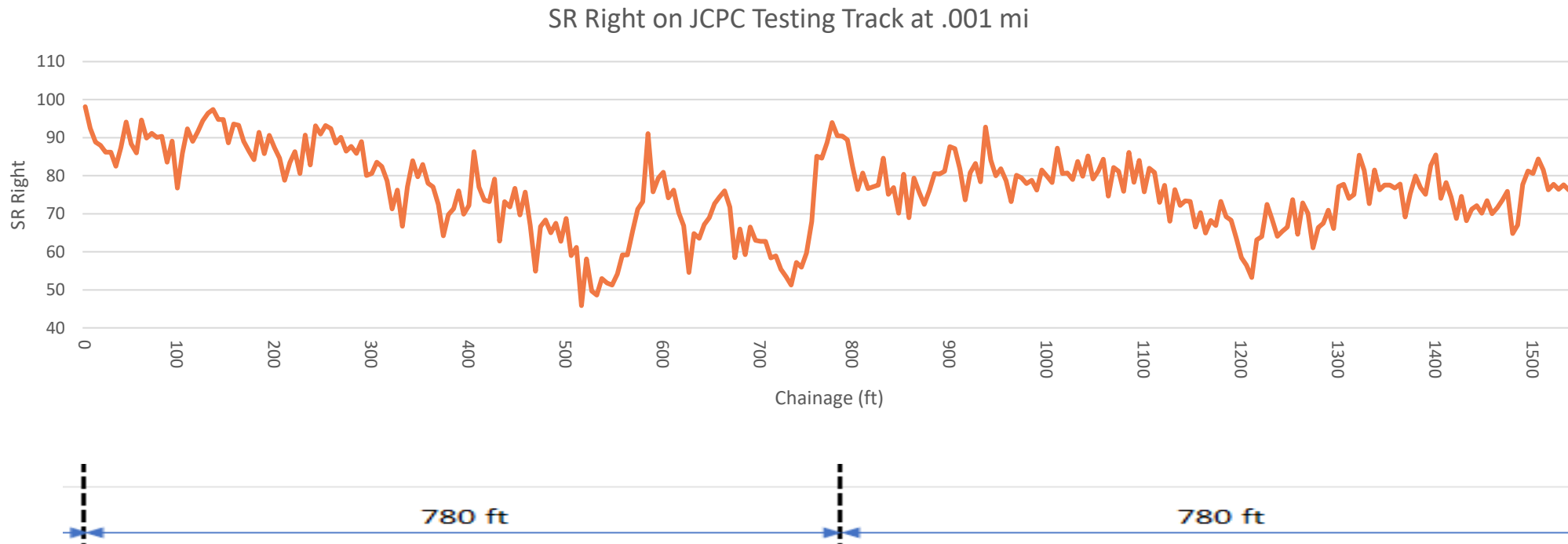


SR Values - JPCP

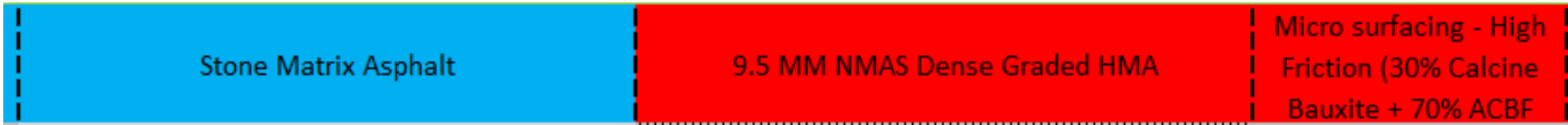


➤ Average SR - 76

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SR Values - Asphalt

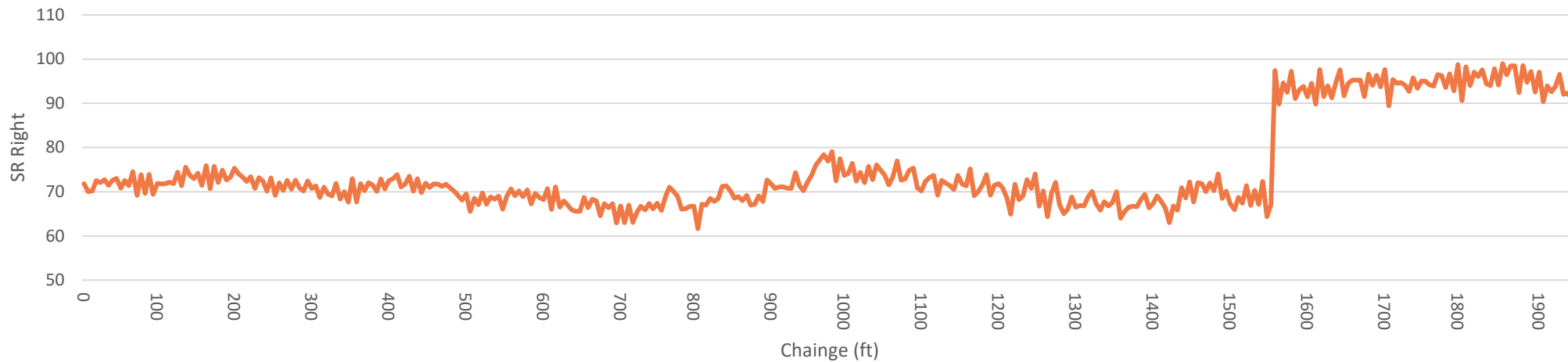


➤ Average SR - 70

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➤ Average SR - 94

SR Right on Asphalt Testing Track at .001 mi



Comments on Results

- High repeatability on CRCP and Asphalt
- Lower repeatability on JPCP
- SR on different surface treatments
 - Clear difference between surface treatments on CRCP and Asphalt
 - No clear difference between surface treatments on JPCP

Thoughts after 2,700 miles collected

- Formal validations in Mississippi
 - 0.1-mi section
 - 0.74 r^2 between most recent 5 runs
 - Values are lower than ICART results
- One-off longer validation test
 - 0.74 r^2 between two long tests over 8 miles
- Based on these tests, we think we are getting reliable friction measurements

Questions



Chris.Young@arrbsystems.com