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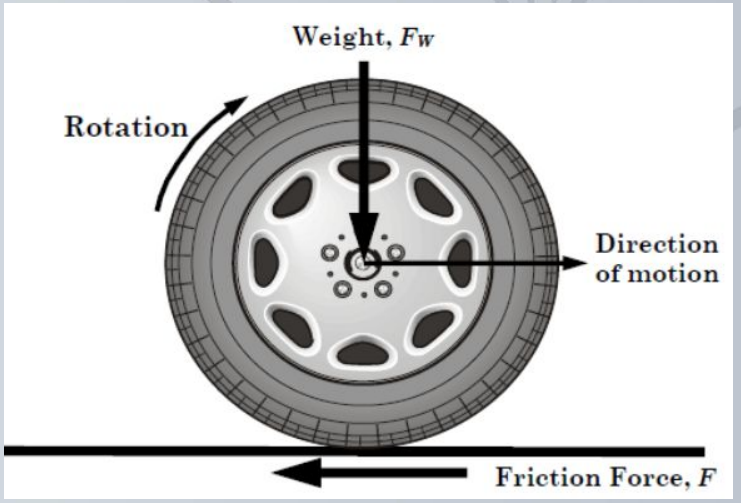
AIRPORT PAVEMENT FRICTION - CASE STUDIES FOR CANADA/US

INTRODUCTION

- What is Friction?
- Why is it important?
- How to create friction?
- How to measure friction?
- Examples of Runway friction data

WHAT IS FRICTION?

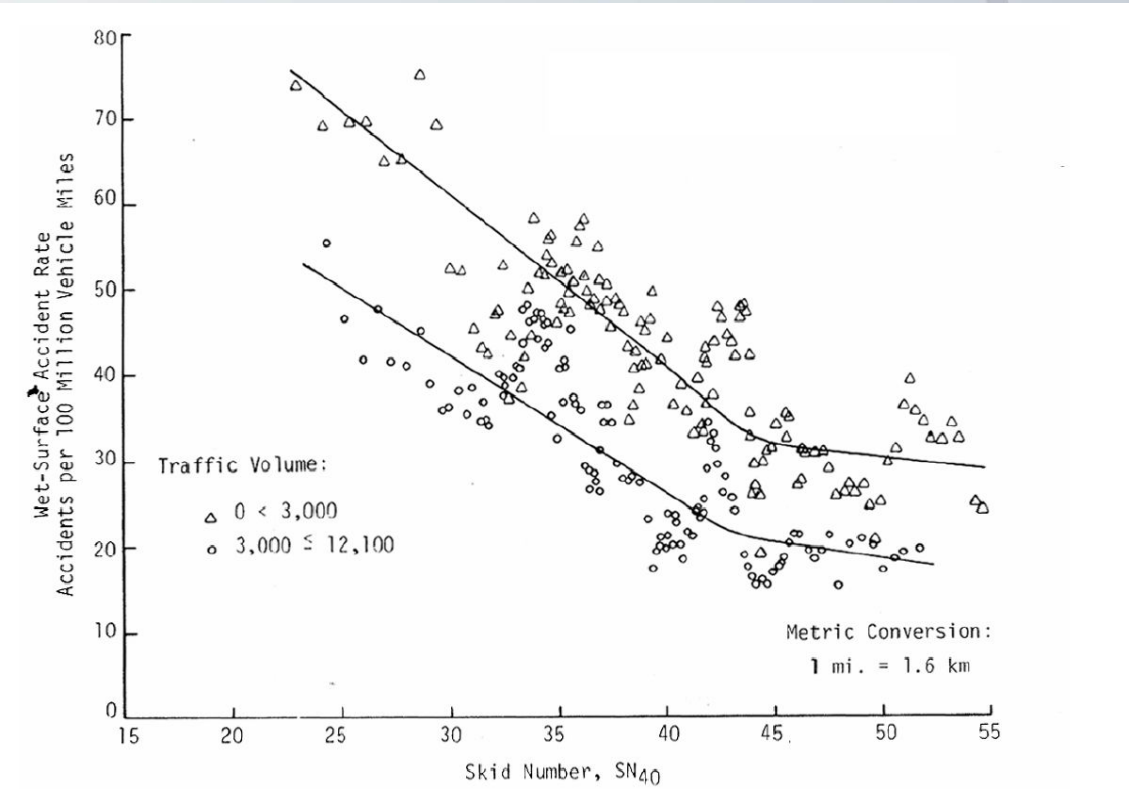
- Friction is the physical property derived when two materials make contact against each other.
  - Dependant on material properties and force between them.



WHY IS FRICTION IMPORTANT?

The ability of a *moving vehicle* to stop and maneuver *safely* is dependant on the friction available at the tire interface, the tires are the only point of contact between a vehicle and the pavement.

ADEQUATE PAVEMENT FRICTION HELP PREVENT ACCIDENTS



Friction
NCHRP 1-43
Final Guide

A lack of friction can lead to skidding, hydroplaning, or accidents, making it essential for safety.

THE SCIENCE OF FRICTION

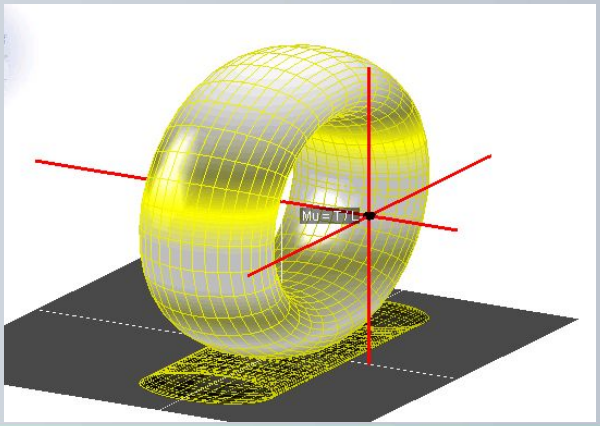
- Friction Coefficient (μ)
  - The friction coefficient measures how well tires grip the runway, directly influencing braking efficiency and aircraft control.
- Surface Friction – Force required to slide a tire on the pavement

$$\mu = F/W \quad and \quad F = \mu W$$

F = force required to pull skidding tire

μ = coefficient of friction

W = vertical load on tire



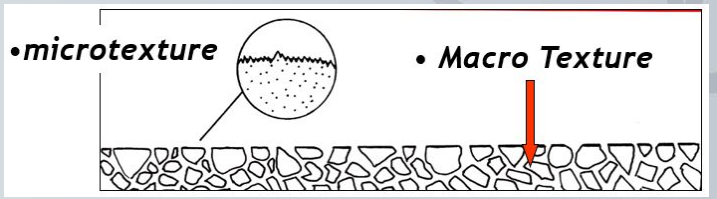
REGULATIONS

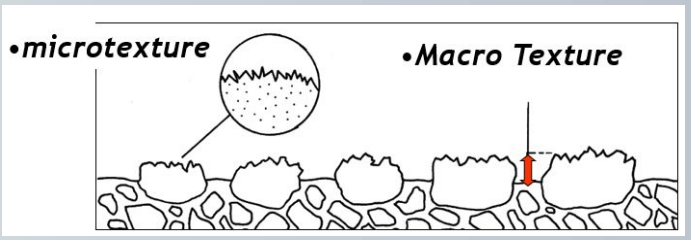
- ICAO Standards
  - ICAO defines the **Friction Level Requirements** for runways, setting specific limits for acceptable friction, especially in wet or contaminated conditions.
- Transport Canada
  - Follows ICAO's friction standards, with national regulations defined in the **TP 312** document, ensuring consistency with international practices.

FACTORS INFLUENCING SKID RESISTANCE

Remember, friction is dependant on the properties of the tire and the pavement…but lets assume our tire is taken care off!

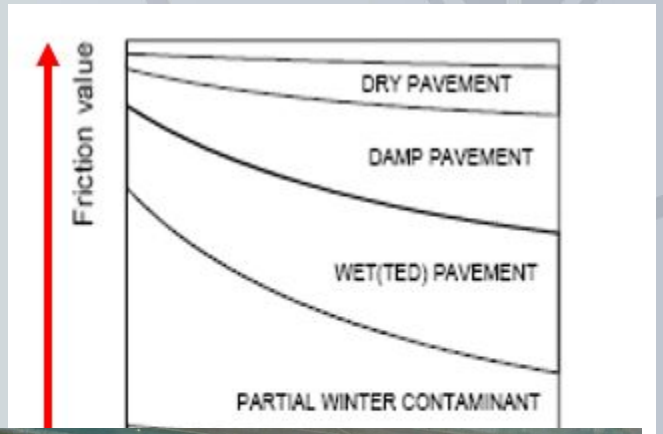
- Bleeding Asphalt
- Polished Aggregate
- Micro and Macrotexture
- Rutting
- Inadequate Cross Slope





FACTORS AFFECTING RUNWAY FRICTION

- Contaminants
  - Rubber Deposits
  - Jet Fuel
  - Oil Spillage
  - Water
  - Snow/Ice/Slush



FRICTION TESTING DEVICES

- Continuous Friction Measuring Equipment (CFME)
  - Surface Friction Tester (SFT)
  - Benchmark for standard runway coefficient of friction
- Spot Measuring Devices (Decelerometers)
  - Deceleration rate of vehicle braked to four wheel lock up
  - Friction values available to Pilots as CRFI (Canadian Runway Friction Index)

TYPES OF FRICTION MEASUREMENTS

- **Continuous Friction Measuring Equipment (CFME)**
  - Used globally, these devices comply with both **ICAO** and **Transport Canada** standards for measuring runway friction.
- 65 km/h (40 mph): Determines the overall micro texture / contaminant / drainage condition of the pavement surface
- 95 km/h (60 mph): Provides an indication of the condition of the surface's macro texture

CFME: OFFSET FROM CENTERLINE

- Runways Serving *Only Narrow* Body Aircrafts:
  - Friction surveys should be conducted 3 m (10 ft) to the left and right of the runway centerline

- Runways Serving *Narrow* Body and *Wide* Body Aircrafts:
  - Friction surveys should be conducted 3 and 6 m (10 and 20 feet) to the left and right of the runway centerline to determine the worst case condition.

FRICTION CLASSIFICATION

FAA AC150/5320-12C

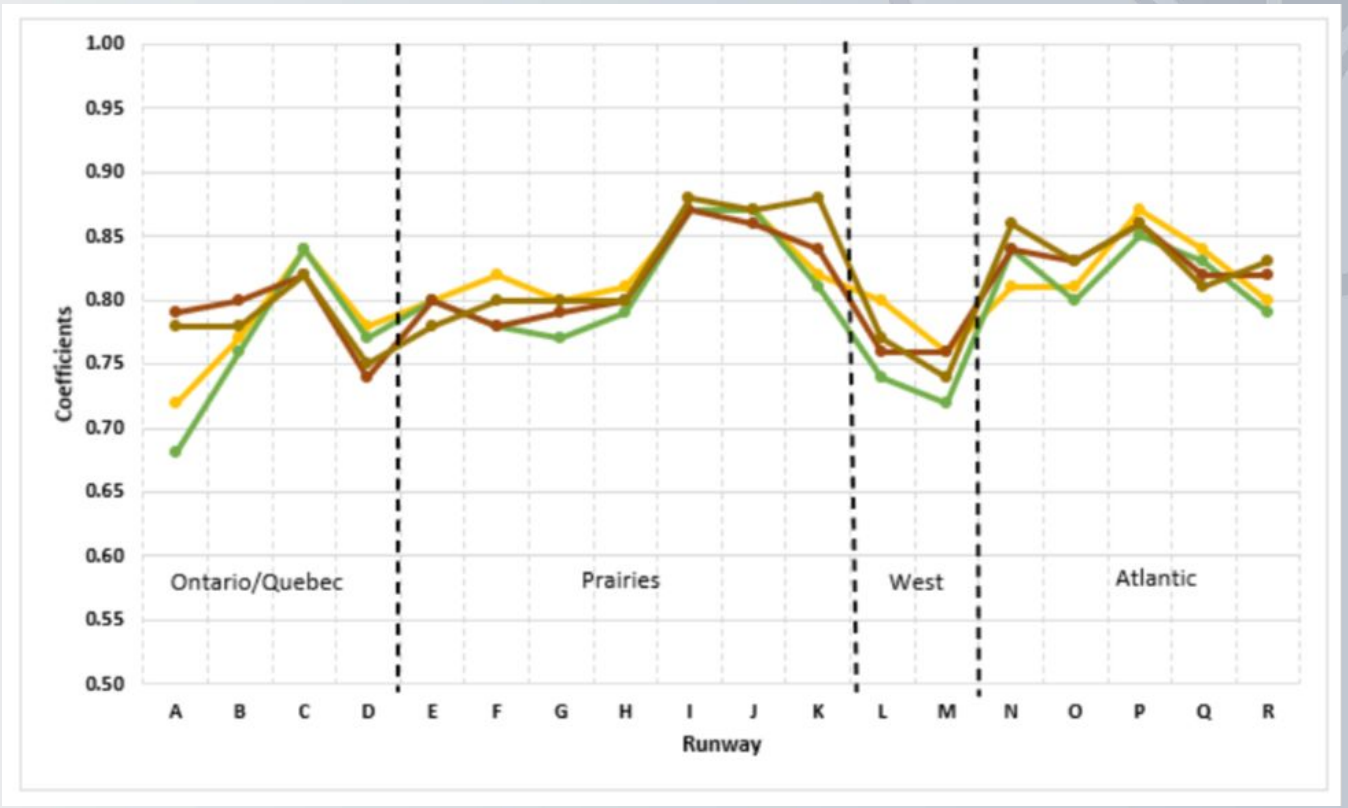
TABLE 3-2. FRICTION LEVEL CLASSIFICATION FOR RUNWAY PAVEMENT SURFACES

	40 mph			60 mph		
	Minimum	Maintenance Planning	New Design/ Construction	Minimum	Maintenance Planning	New Design/ Construction
Dynatest Consulting, Inc. Runway Friction Tester	0.50	0.60	0.82	0.41	0.54	0.72
Airport Equipment Co. Skiddometer	.50	.60	.82	.34	.47	.74
Airport Surface Friction Tester	.50	.60	.82	.34	.47	.74
Airport Technology USA Safegate Friction Tester	.50	.60	.82	.34	.47	.74
Findlay, Irvine, Ltd. Griptester Friction Meter	.43	.53	.74	.24	.36	.64
Tatra Friction Tester	.48	.57	.76	.42	.52	.67
Norsemeter RUNAR (operated at fixed 16% slip)	.45	.52	.69	.32	.42	.63

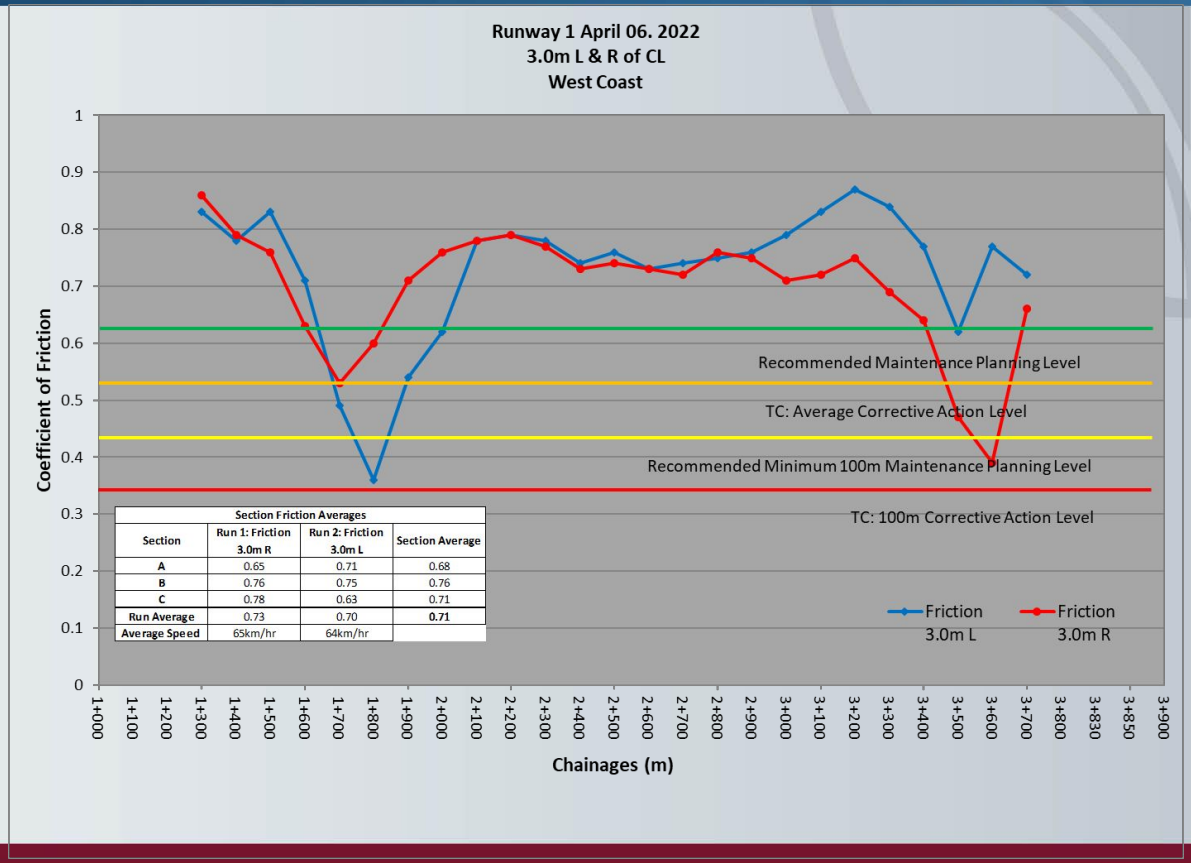
CASE STUDY – DND AIRPORTS CANADA

- Annual summer testing program.
- Testing complete with a SARSYS, Surface Trailer Friction Tester (STFT).
- Geographical location around Canada

CASE STUDY – DND AIRPORTS CANADA

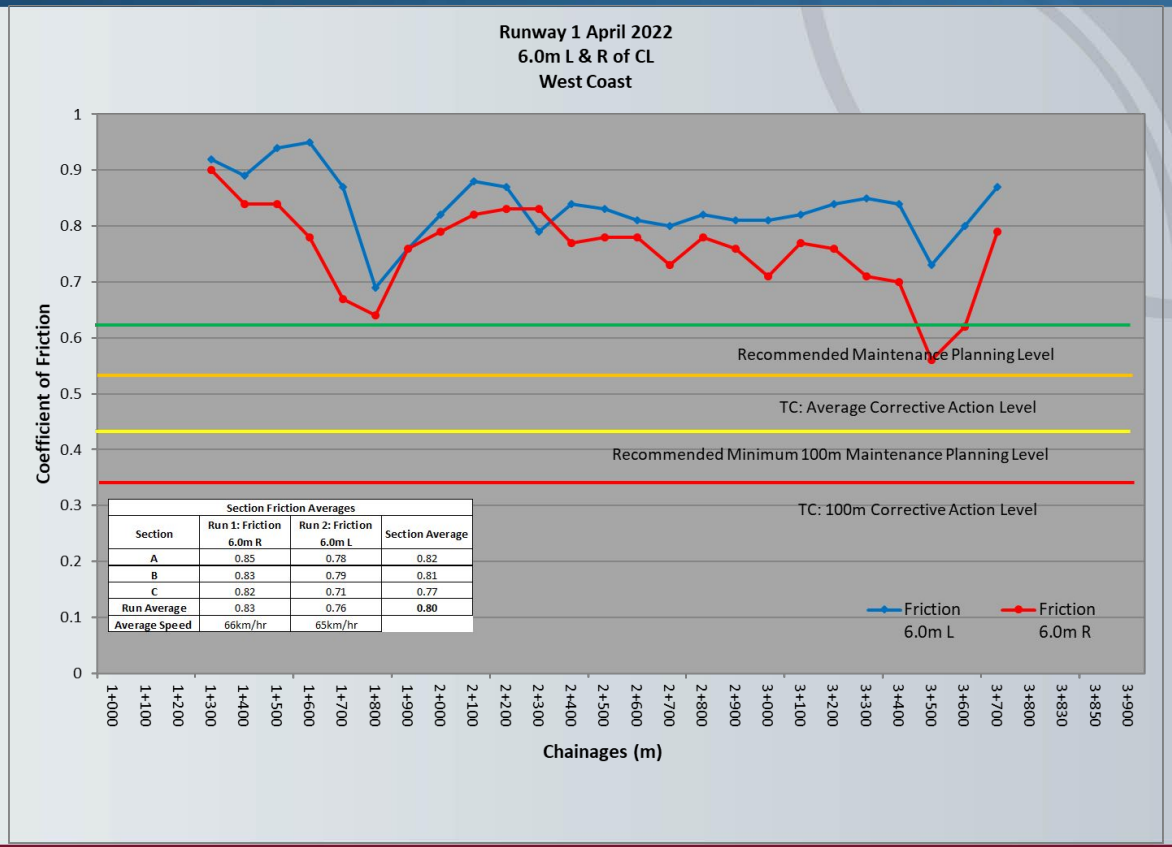


CASE STUDY – RUNWAY IN BRITISH COLUMBIA



Section Friction Averages			
Section	Run 1: Friction 3.0m R	Run 2: Friction 3.0m L	Section Average
A	0.65	0.71	0.68
B	0.76	0.75	0.76
C	0.78	0.63	0.71
Run Average	0.73	0.70	**0.71**
Average Speed	65km/hr	64km/hr	

RUNWAY IN BRITISH COLUMBIA



Section Friction Averages			
Section	Run 1: Friction 6.0m R	Run 2: Friction 6.0m L	Section Average
A	0.85	0.78	0.82
B	0.83	0.79	0.81
C	0.82	0.71	0.77
Run Average	0.83	0.76	**0.80**
Average Speed	66km/hr	65km/hr	

CASE STUDY –RUNWAY IN NORTH CAROLINA

- Pavement – dry, Weather – 50s degree F
- At 3 m and 6 m left and right of the runway centerline
- Testing completed with 1 mm water film application at 65 km/hr and 95 km/hr
- Tested with Dynatest 6875 Runway Friction Tester (RFT) – Meets

FRICTION VALUES AT 65 KM/HR (40 MPH)

Runway 10-28 40mph		Mu				
From 10 End Threshold (ft)	From 10 End Threshold End (ft)	10-28 20ft Left	10-28 10ft Left		10-28 10ft Right	10-28 20ft Right
0	500	-	-		-	-
500	1000	0.60	0.58		0.61	0.81
1000	1500	0.64	0.59		0.56	0.75
1500	2000	0.62	0.56		0.61	0.70
2000	2500	0.60	0.56		0.65	0.68
2500	3000	0.61	0.58		0.63	0.67
3000	3500	0.58	0.56		0.61	0.64
3500	4000	0.58	0.54		0.61	0.69
4000	4500	0.59	0.56		0.61	0.66
4500	5000	0.56	0.54		0.57	0.63
5000	5500	0.57	0.55		0.57	0.64
5500	6000	0.60	*0.47*		0.50	0.67
6000	6500	0.61	0.50		*0.499*	0.66
6500	7000	-	-		-	-

Mu Map Color Legend 40mph	
Mu < 0.50 (MFL)	RED (0.5 is the FAA Minimium Friction Level, MFL)
Mu > 0.5 and < 0.60 (MPL)	YELLOW (Maintenance Planning Friction Level, MPL)
Mu > 0.6 and < 0.82 (DOL)	GREEN (FAA Acceptable Range)
Mu > 0.82	BLUE (New Design/ Construction Level)

FRICTION VALUES AT 95 KM/HR (60 MPH)

Runway 10-28 60mph		Mu				
From 10 End Threshold (ft)	From 10 End Threshold End (ft)	10-28 20ft Left	10-28 10ft Left		10-28 10ft Right	10-28 20ft Right
0	500	-	-		-	-
500	1000	-	-		-	-
1000	1500	0.58	0.54		0.48	0.55
1500	2000	0.55	0.49		0.50	0.51
2000	2500	0.52	0.50		0.50	0.54
2500	3000	0.55	0.52		0.53	0.54
3000	3500	0.53	0.49		0.51	0.51
3500	4000	0.51	0.48		0.49	0.51
4000	4500	0.52	0.47		0.51	0.52
4500	5000	0.50	0.46		0.45	0.49
5000	5500	0.49	0.45		0.42	0.47
5500	6000	0.51	0.47		0.47	0.51
6000	6500	-	-		-	-
6500	7000	-	-		-	-

Mu Map Color Legend 60mph	
Mu < 0.41 (MFL)	RED (0.41 is the FAA Minimium Friction Level, MFL)
Mu ≥ 0.41 and < 0.54 (MPL)	YELLOW (Maintenance Planning Friction Level, MPL)
Mu ≥ 0.54 and < 0.72 (DOL)	GREEN (FAA Acceptable Range)
Mu ≥ 0.72	BLUE (New Design/ Construction Level)

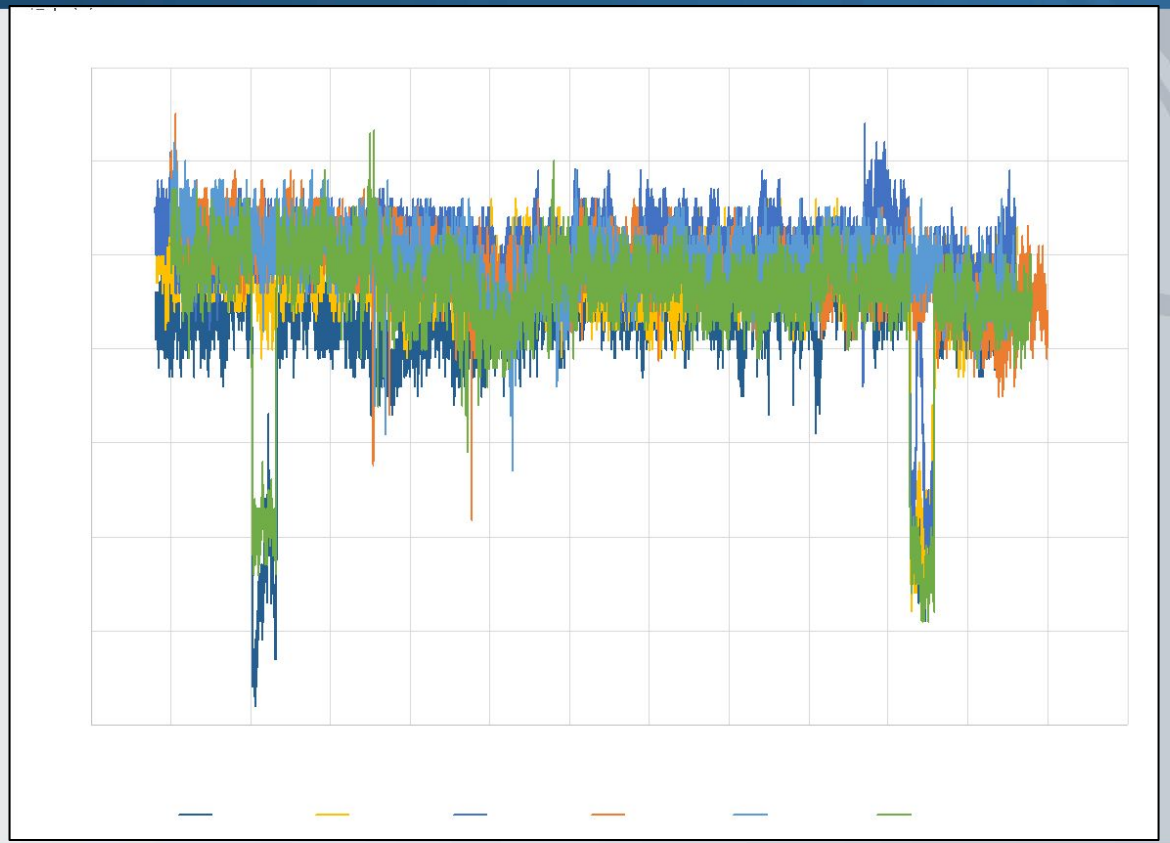
CONCLUSION

- 48% of the runway is below the maintenance planning friction level at 40mph and 88% is below the maintenance planning friction level at 60mph.

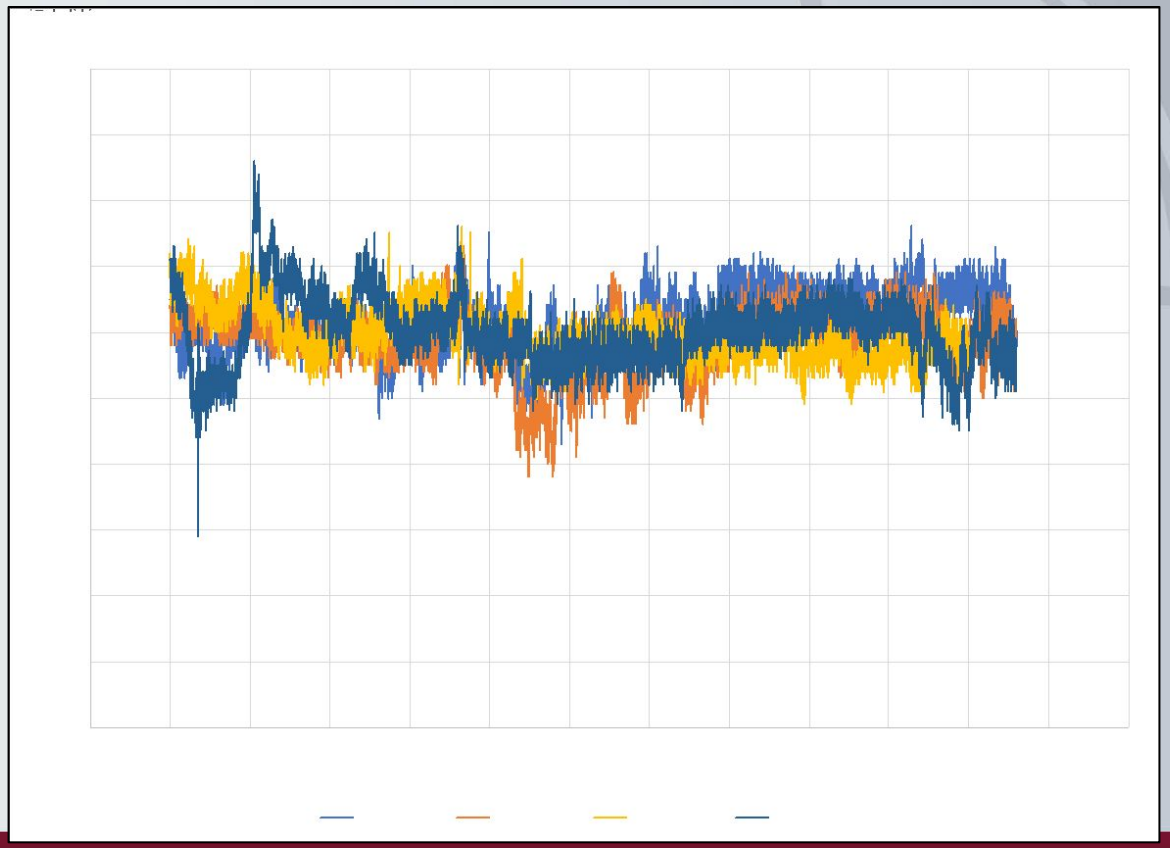
CASE STUDY - RUNWAY IN ARIZONA

- Municipal Airport
- Length- 6,500 ft
- Pavement Surface Type – AC
- Before and after application of a surface treatment

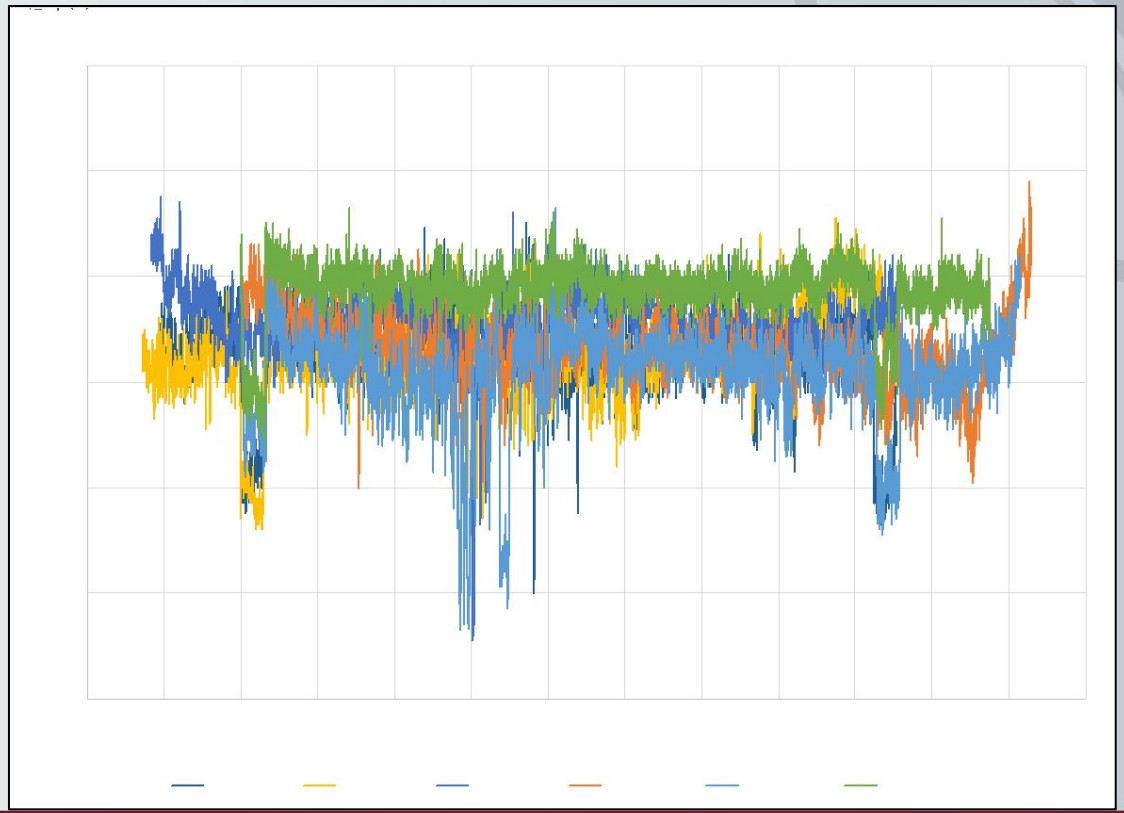
PRE-APPLICATION DATA 40MPH



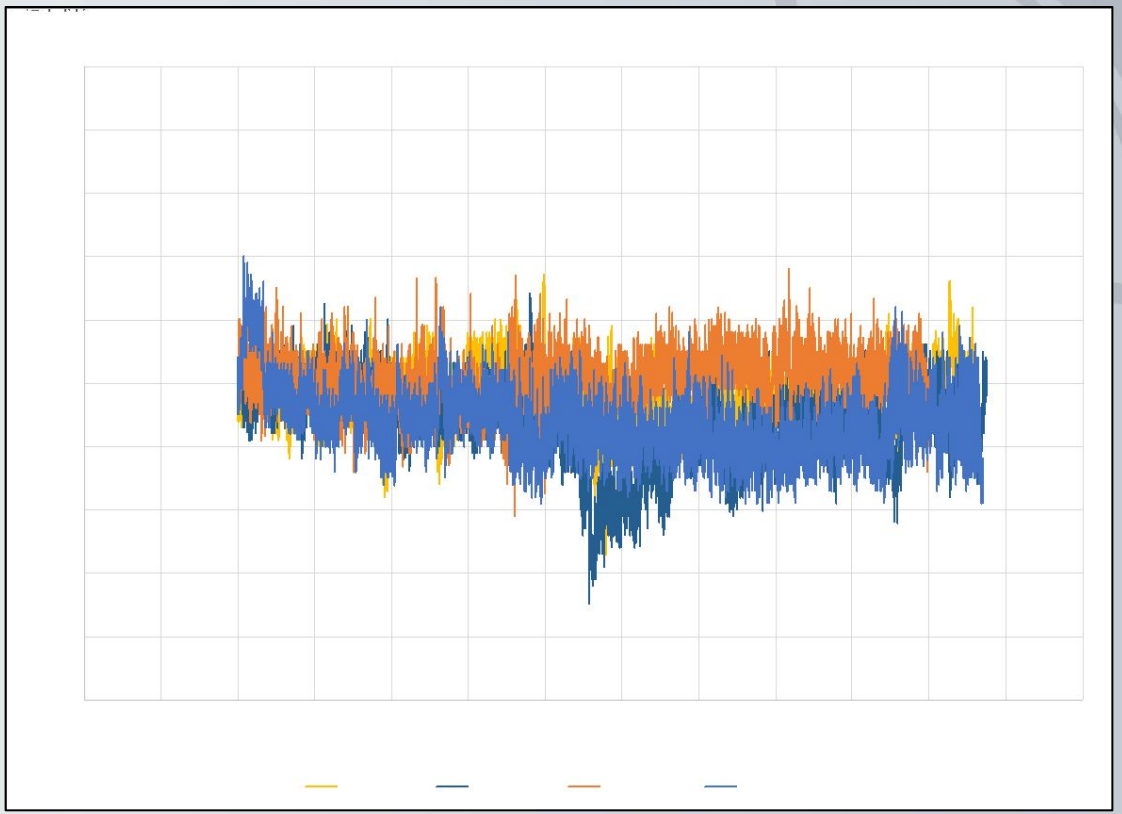
POST APPLICATION DATA 40 MPH



PRE-APPLICATION DATA 60 MPH



POST-APPLICATION DATA 60 MPH



QUESTIONS?