Runway Grooving in Canada, Ottawa (YOW) Runway 07-25

SWIFT 2014

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Presenters; Maurice Best
Paul R. Walkington
Philip Zuzelo

Agenda

1. Runway 07-25 – Before The Build
2. Runway 07-25 – The Changes
3. Runway 07-25 - The construction:
   how it is done, where it can be done, northern climates, trapezoidal vs vertical grooves
4. Runway 07-25 – After the build

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1 Runway 07-25: Before The Build

Characteristics

Runway 07-25

- CYOW is leased and operated by the Ottawa International Airport Authority, under a 60-year lease from Transport Canada.
- There are 3 runways: 07/25, 14/32, and 04/22.
- Runway 07/25 is the primary/preferred runway.
- 8000 feet long by 200 feet wide, with an asphalt surface. The longitudinal slope is <1% on average for the full length of the runway.

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Characteristics

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Characteristics

Runway transverse slope

- Last 6000 feet of Runway 07, the crown shifts to the left of the centreline, such that 75% or more of the crossfall was on the right side of the runway.
- During times of rainfall from April to September, the wind is primarily from the **SW**.
- This is in the opposite direction to the crossfall, and would result in water building up or draining more slowly from Runway 07.

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Characteristics

Runway transverse slope

TP312E recognizes the value of having adequate transverse slope on a runway to facilitate the rapid drainage of water.

Wet runways are considered a contributing factor in many runway-overrun accidents. The transverse profile of Runway 07 for the first 1700 to 1800 feet complied with the recommended practices outlined in TP312E. However, the remainder of Runway 07, as constructed, did not meet the minimum recommended practices in the following ways:

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Characteristics

Runway transverse slope

- The minimum transverse slope of the left side of the runway was less than 1%;
- The transverse slope on each side of the centreline was not symmetrical;
- The slope was not substantially the same throughout the length of the runway; and
- The apex of the runway crown moved left of centreline, reaching the left edge by the end of the runway.

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Incidents and accidents

WestJet

- On February 17, 2008, a WestJet Boeing 737 from Calgary International Airport left the end of runway 07 shortly after landing.

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Incidents and accidents

UNITED EXPRESS/TRANS STATES AIRLINE

- On June 16, 2010, United Express Flight 8050, an Embraer ERJ-145 (N847HK) operated by Trans States Airlines, overran the runway and was substantially damaged when the nose gear collapsed.

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Incidents and accidents

The Transportation Safety Board (TSB)

- Released a final report regarding the United Express/Trans States Airline runway overrun on June 16, 2010.
- Accumulation of rainwater on Runway 07/25 due to the crosswind and conatruction of its slope, resulting in a decline in the friction for the occurrence flight.

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2 Runway 07-25 – The Changes

This runway was last rehabilitated in 1994 and consisted of resurfacing to guidelines set forth by Transport Canada, at the time.

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What was done

- In 2012, the complete reconstruction of Runway 07/25 was completed including;
- addition of FAA and ICAO standard runway end safety areas (RESAs),
- change to the runway profile from a crossfall to a centre crown, and
- the chamfering of all sub-terrain obstacles within the runway strip.

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What was done

What was done

After allowing the pavement to cure for a year;

Runway 07/25 was grooved in 2013 per FAA and Transport Canada advisory circulars.

Photo Credit: INTERATIONAL GROOVING & GRINDING ASSOCIATION

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What was done

HWD testing results following construction confirmed a PLR 12 rating.

Runway	Side of Centerline	Number of Tests Completed	Normalized Deflection D_1 (µm)	Subgrade Resilient Modulus M_R (MPa)	Effective Pavement Modulus E_p (MPa)	Effective Structural Number SN_{eff}	PLR
Runway 07-25	L	55	188	111	1,188	104	12
	R	54	191	112	1,234	104	12

- The hot mix asphalt (HMA) was a modified TC mix designed using a **50 blow** Marshall method and PGAC grade of **58 -34**.
- Including specific requirements to provide an aggregate polished stone value **(PSV)of >65**.
- This mix has been used successfully on runway 04-22, Taxi A, Taxi B, Taxi K & recently the rehabilitation of the de-icing pad.

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Why Grooving

There is currently no regulation requiring grooved runways at Canadian airports.

In Canada, runway grooving has been used to address site-specific issues such as to promote drainage on runways with low or problematic transverse slopes that could not be cost-effectively corrected by other means.

TSB Aviation Investigation Report A11H0003

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Why Grooving

Cutting or forming grooves in existing or new runways is a proven and effective technique for improving drainage, minimizing skids and drift, improving braking, and reducing the risk of hydroplaning.

The effects of hydroplaning, which can occur in as little as 2.54mm of standing water can result in unwanted excursions.
Note the “steam cleaning” of the ungrooved pavement surface that occurs under the tires.

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TSB Aviation Investigation Report A11H0003

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.....and here is where you end up

TSB Aviation Investigation Report A11H0003

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Why Grooving

On November 20, 2012, TC issued AC 300-008: Runway Grooving. (effective April 8, 2013)

The purpose is to provide information and guidance to airport operators regarding the grooving of runways.

Factors to be considered in determining the need for runway grooving:

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Advisory Circular (AC) No. 300-008

- History of incidents due to hydroplaning;
- Wetness frequency (annual rainfall rates & intensity);
- Transverse & longitudinal slopes, flat areas, depressions, mounds, or any other surface abnormalities that may impede water runoff;
- Surface texture quality, which contribute to slipperiness in dry or wet conditions, such as,
  - ✓ polishing of aggregate,
  - ✓ improper seal coating,
  - ✓ inadequate micro-texture or macro-texture,
  - ✓ contaminant build-up, (rubber, soil, snow, ice)
  - ✓ crosswind effects, particularly during freezing.

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Advisory Circular (AC) No. 300-008

In evaluating the suitability of the pavement for grooving consider;

- Conducting a condition survey of the runway to determine if an overlay or pavement rehabilitation is required prior to grooving.
- Areas with extensive structural defects (cracking or spalling, bumps, depressions, or significant ruts), should not be grooved until adequately repaired or replaced.
- Stability of the mix, aggregate properties, maximum pavement temperature, tire pressures, & braking action in given areas.

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A grooved **runway** vs a non-grooved runway, shown after being flushed with water during the grooving process

Photo credit: St. Louis Downtown Airport

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Why it was done

Runway intersections require a decision as to which runway continuous grooving is to be applied. Normally, the entire length of the primary runway should be grooved.

Despite all of the measures taken to improve the profile and frictional properties of the runway a decision was made to groove the runway to provide redundancy in this critical safety element. YOW is a leader in safety and innovation and continues to participate in new opportunities.

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Who done it?

It gives me great pleasure to introduce our co-presenter and "*master of the groove*"; ***Mr. Philip Zuzelo***.

Philip is the president of ***Cardinal/International Grooving & Grinding*** a company that has grooved more runways than any company in the world. They hold over fifty patents in the field of sawing and design and build most of their own equipment. Their largest groover is over 700 horsepower and can groove up to 2.85 metres in a single pass.

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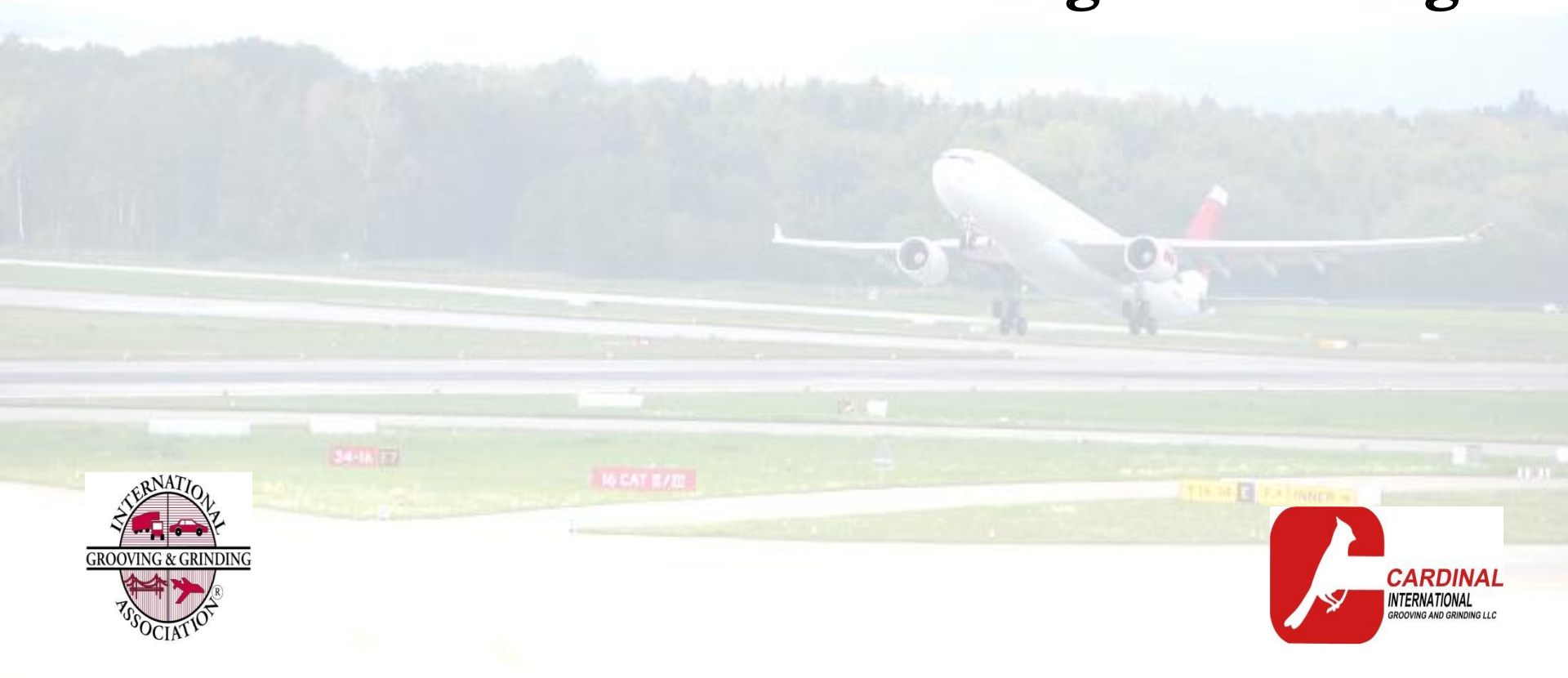
The Benefits of Runway Grooving

Philip Zuzelo

Cardinal/International Grooving & Grinding



Primary Reasons for Grooving

- Reduce Hydroplaning
- Reduce Stopping Distance
- Provide Greater Aircraft Safety

Grooving's Effect on Braking & Hydroplaning

- Grooves Provide Channels for Water to Escape
- Restores Tire Friction Coefficients on Wet Pavement to Near Dry Pavement Friction Levels
- Increases Braking Coefficient in Wet Conditions

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Other Benefits of Grooving

- Helps Eliminate Standing Water/Runway Drainage
- Decreases Stopping Distance in Dry Conditions

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Runway Grooving

In the Presence of Water, Totally Worn Aircraft Tires Experience Better Braking on Grooved Pavement than Newly Treaded Tires on Non-Grooved Pavement.

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What is Runway Grooving?

Transverse to the Direction of Travel

FAA Standard:
6 mm wide x 6 mm deep x 38 mm c-t-c

Other:
10 mm wide x 10 mm deep x 80 mm c-t-c

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Mechanics of Grooving

- Grooving terminates within three meters of pavement edge
- Transverse to the direction of travel
- Can take place day or night

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Factors Affecting Cost

- Type of Material to be Grooved: Concrete or Asphalt
- Type and Size of Surface Course Aggregate (i.e. Limestone, Granite, Basalt, Gravel, etc.)
- Age and Condition of Runway Surface
- Work Window for Grooving
- Dimensions of Area to be Grooved and Overall Size of Project
- Slurry Disposal
- Other Local Factors (fuel costs, support equipment, mobilization costs, etc.)

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Typical Production Factors

- Type of Material to be Grooved
- Type and Size of Surface Course Aggregate
- Work Window
- Staging Area Location Relative to Runway

- In Concrete – Expect Grooving Production of 190/380m2 to 500/1000m2 per hour
- In Asphalt – Expect Grooving Production of 260/520 m2 to 750/1500 m2 per hour

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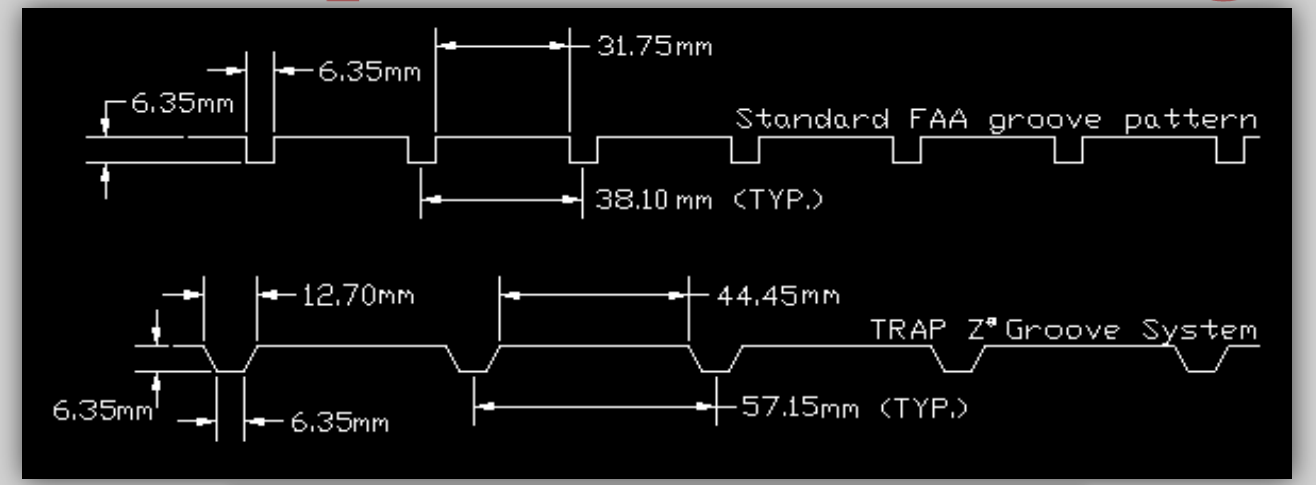
Trapezoidal Grooving



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Advantages of Trapezoidal Grooving

- Comparable Coefficient of Friction
- Reduced Tire Wear
- Reduced Rubber Buildup
- Increased Pavement Life
- Reduced Chipping & Closing
- Superior Drainage Capacity

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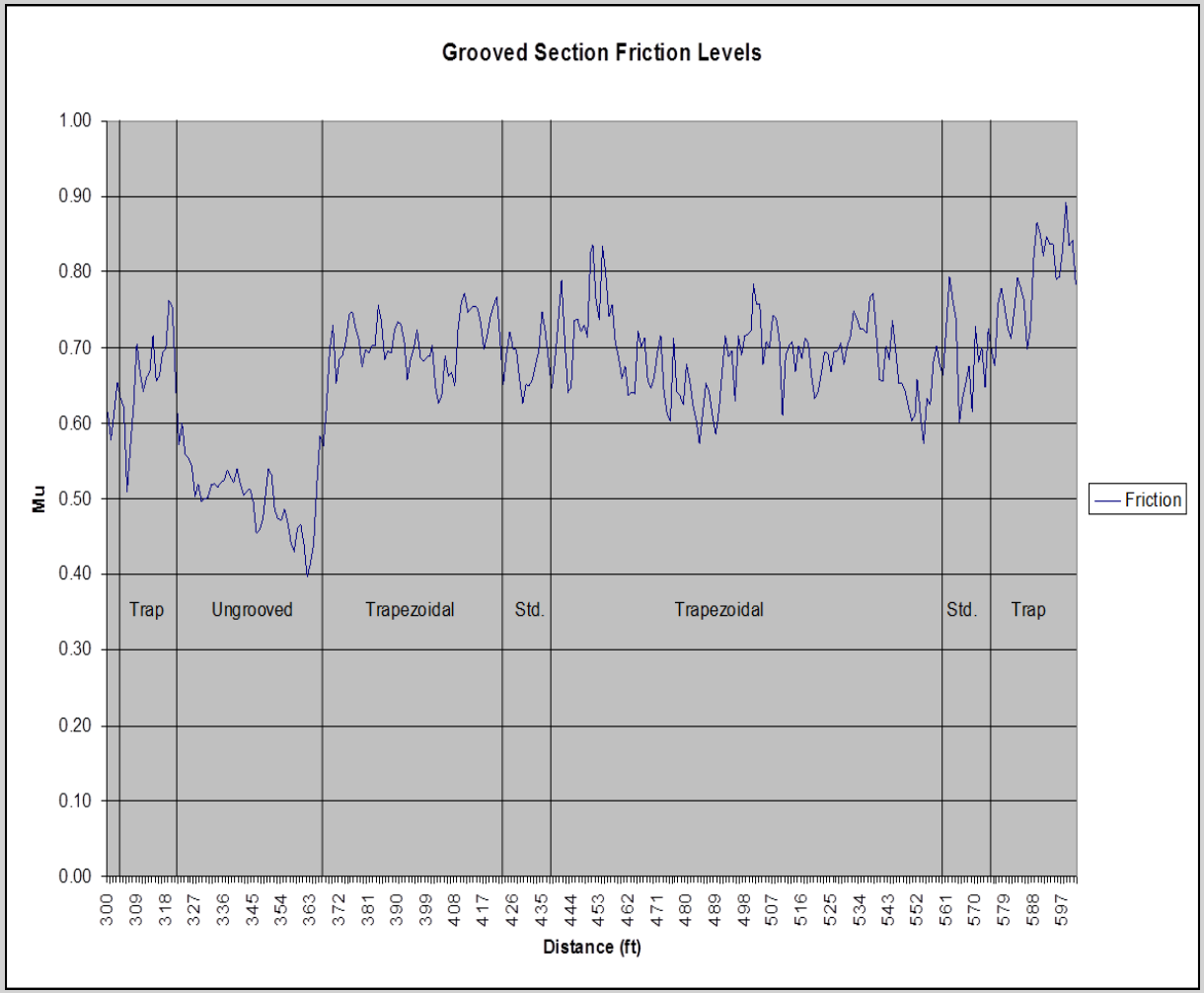
Comparable Coefficient of Friction

Square vs. Trapezoidal Grooving



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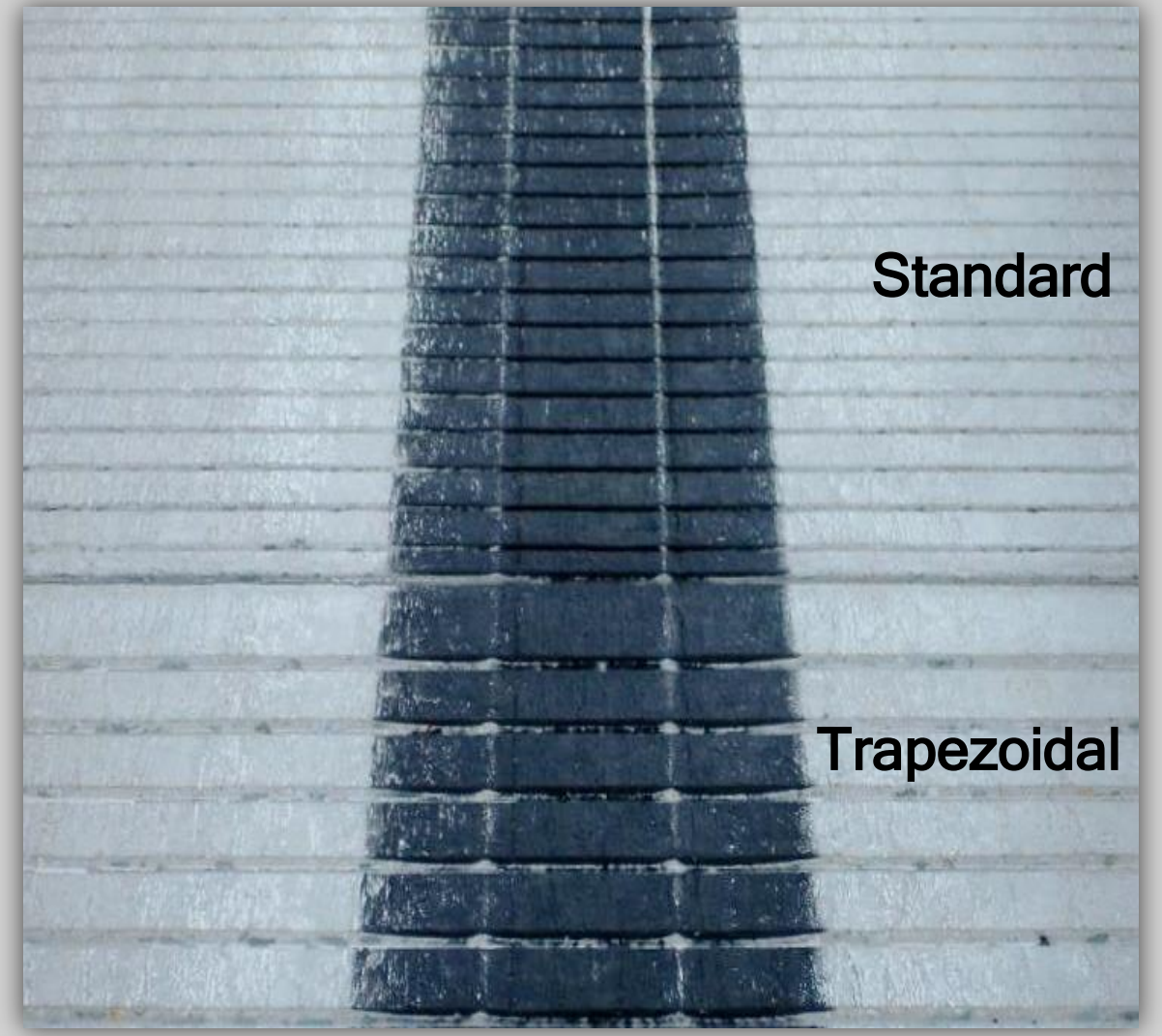
Reduced Tire Wear

Reduced Rubber Buildup

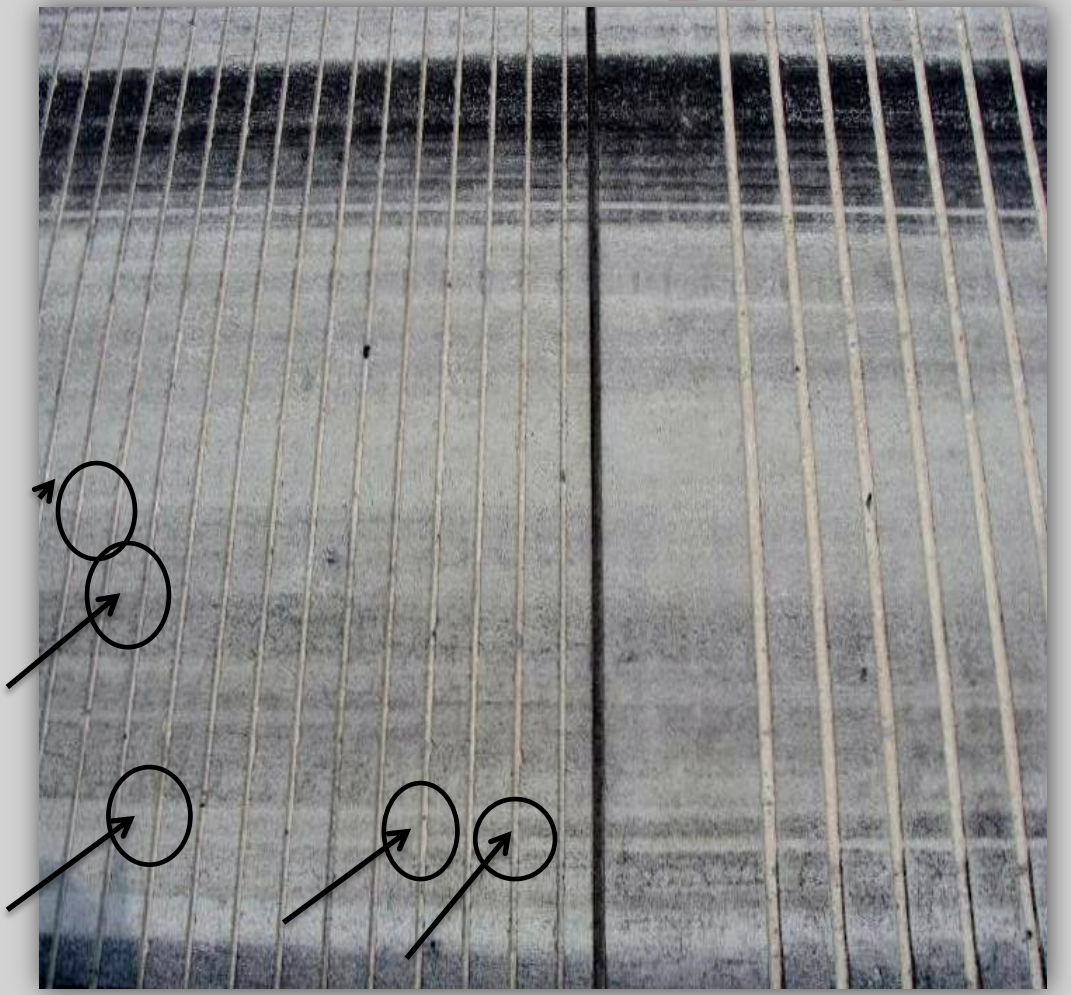


Reduced Tire Wear

Reduced Rubber Buildup

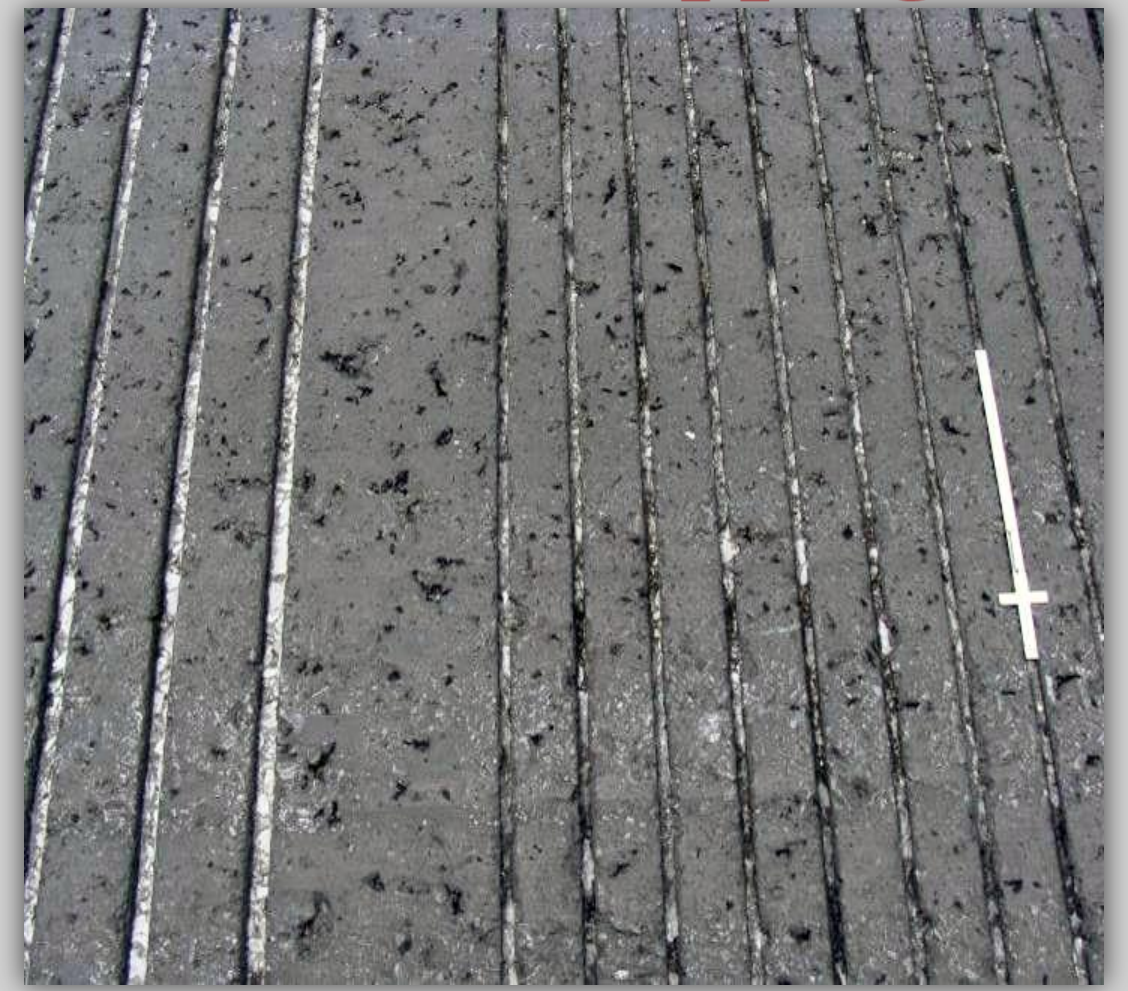
Notice Difference in Rubber on Standard Grooves

Reduced Groove Chipping & Closing



Notice Damage to Edge of Standard Grooves;
No Evidence of Damage on Trapezoidal.

Reduced Groove Chipping & Closing



Note Closure of Standard Grooves Trap closed slightly, but still maintained ‘open’ shape.

Superior Drainage Capacity

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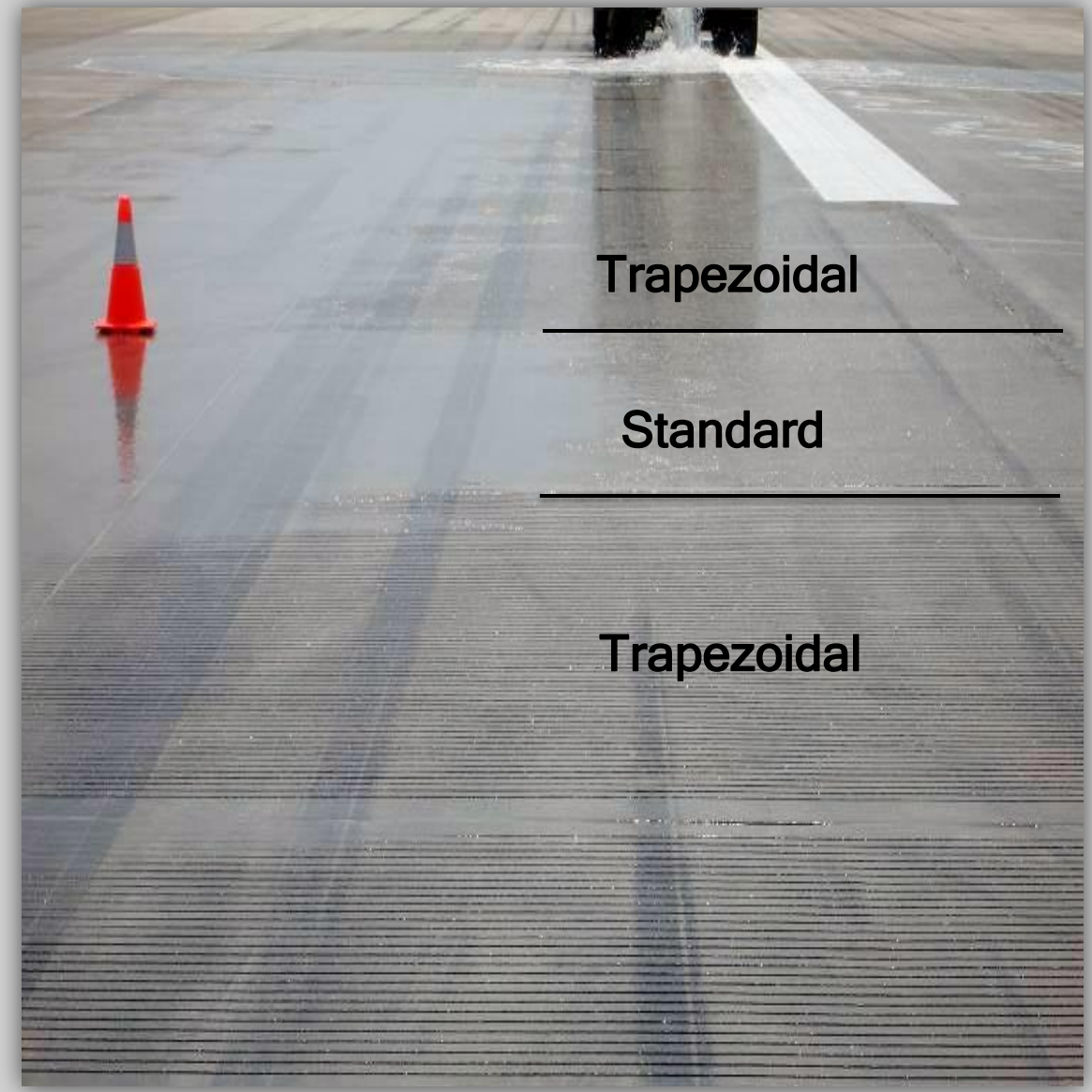
Superior Drainage Capacity



4 Runway 07-25 – After the build

OMCIAA has authorized a report on the groove performance, complete after one season.

Norman Wells Airport, NWT have good information on their experiences.

In general;

- **The grooves work**
- They present challenges to the maintenance process and you will have to modify snow removal practice.
- They are durable with the right HMA
- We think it is the right thing to do

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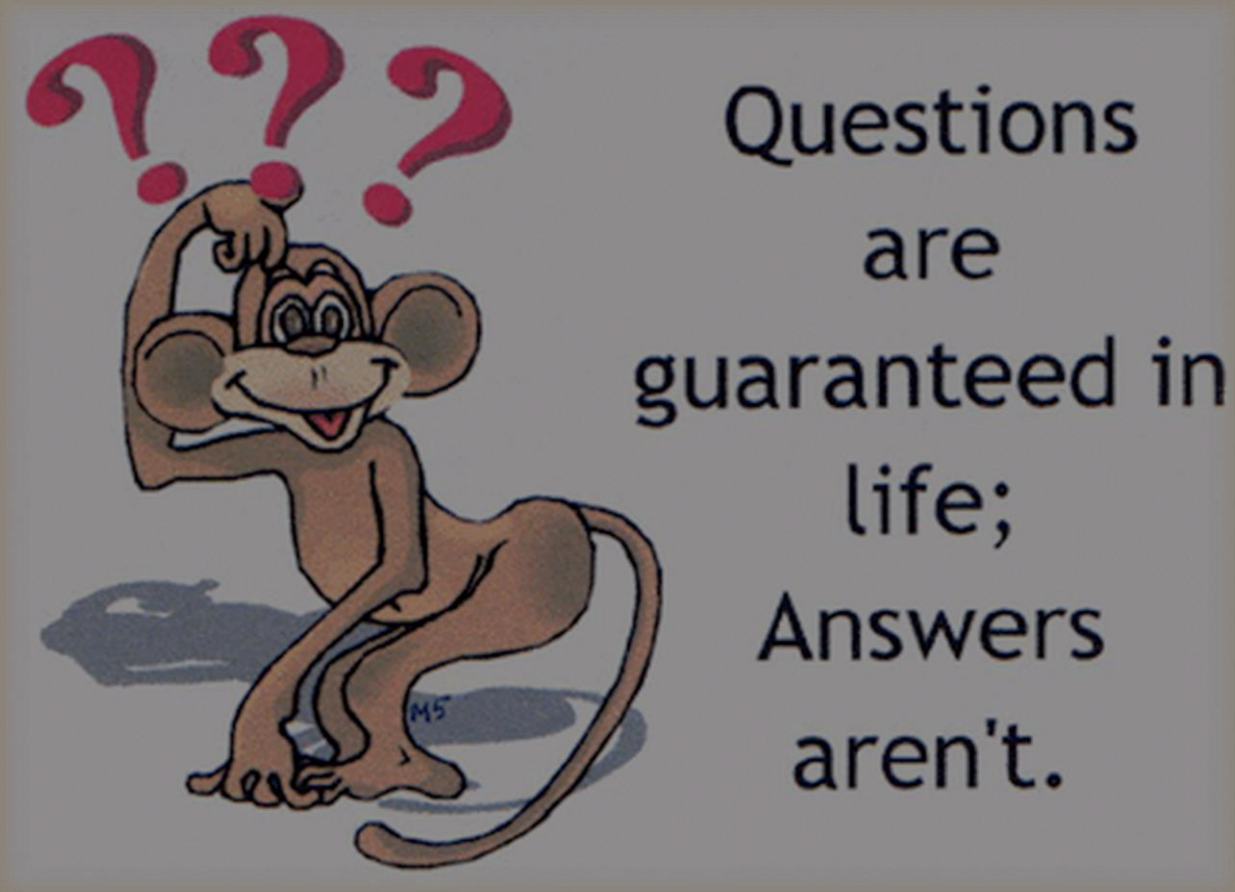
Questions?



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