Evaluation of Performance of Aircraft Tire on Trapezoidal-Shaped and Rectangular-Shaped Runway Grooving

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Introduction

- Pavement surface grooving has been widely used as an effective procedure to improve skid resistance and prevent aircraft hydroplaning during wet weather conditions.
- Early experiments were conducted at the Langley Aircraft Landing Dynamics Facility to study the effect of groove configurations. However, the costs for construction and maintenance of field-testing facility were enormous.

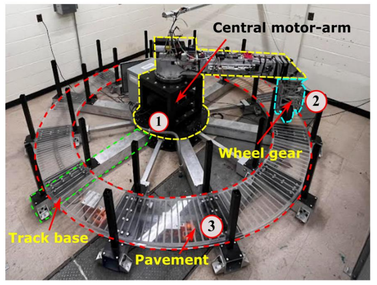
https://flyflapper.com/stories/can-a-wet-runway-become-a-hazard/

Objective and Scope

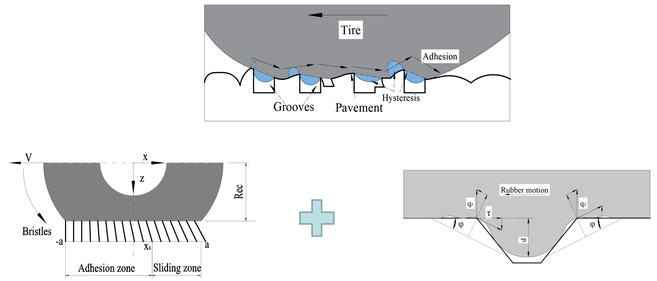
- Evaluate safety performance of aircraft tire on wet runway pavements with different groove configurations through laboratory testing and numerical modeling
  - Design and build a laboratory test platform for braking test of a reduced-scale tire.
  - Measure friction coefficients with different grooves and water depths on the laboratory test platform.
  - Develop analytical and numerical models for simulating aircraft tire-water-pavement interaction.
  - Evaluate the influence of groove configurations on safety performance of aircraft tire based on experimental and modelling results.
- Determine if trapezoidal grooves should be included in FAA Advisory Circulars as an acceptable alternative to standard square grooves on runway pavements.

Research Methodology

Laboratory Testing Platform

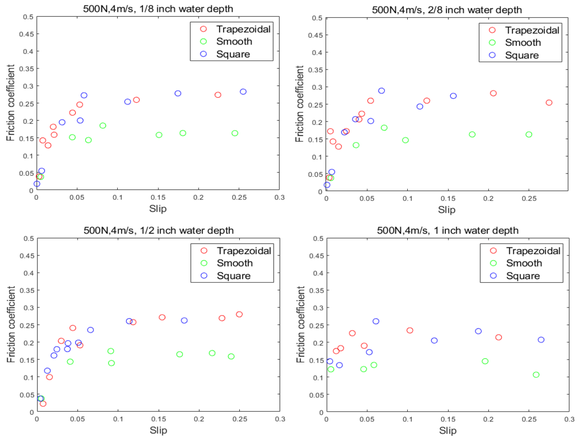


Analytical and Numerical Models

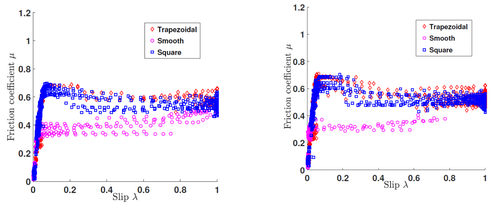


Data and Results

Experimental Results



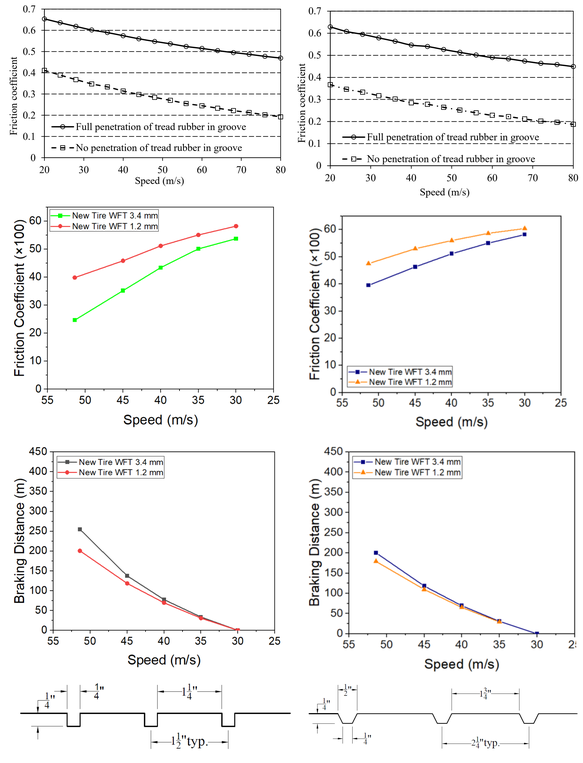
Testing on smooth acrylic plates



0.25-inch water depth | 1.0-inch water depth

Testing on concrete coated surface

Simulation Results



Current Practice

- Trapezoidal grooves performed structurally well after 8 years in operation at Singapore Changi Airport.

- UFGS 32 01 18.71 includes an option for specifiers to choose trapezoidal grooves in lieu of standard grooves

Conclusions

- Laboratory experiments show that the friction coefficients at various slip ratios on square and trapezoidal grooves are close at different water film depths.
- Analytical model solutions show that trapezoidal grooves have similar friction coefficients compared to square grooves without standing water.
- Finite element models are developed to simulate tire-water-pavement interaction for braking aircraft tires on grooved runway pavement at wet conditions.
  - Trapezoidal grooves result in greater friction than square grooves at high speeds and thick water depths, but the difference becomes smaller as speed or water depth decreases.

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