Skid-resistant Airport Pavement Surfaces

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Chapter 1. Overview

Learning Objectives

By the end of this section, you will be able to:

- **Identify** the primary causes of runway friction loss, including mechanical wear and contaminant accumulation.
- **Evaluate** the historical effectiveness of surface treatments such as grooving and Porous Friction Courses (PFC).
- **Distinguish** between the capabilities of Friction Measuring Equipment (CFME) for maintenance planning versus its limitations in predicting aircraft braking performance.

Executive Summary: *Managing runway skid resistance is a continuous lifecycle process, not a one-time construction task. While proper design techniques like transverse grooving and Porous Friction Courses (PFC) provide the foundation for safety, the inevitability of rubber accumulation and polishing requires a rigorous evaluation program. You must use Friction Measuring Equipment (CFME) to detect surface degradation before it compromises aircraft directional control.*

1-1. Purpose

This course provides guidelines for **designing, constructing, and maintaining** skid-resistant airport pavement surfaces. It establishes the protocols for conducting evaluations and surveys of runway friction specifically for pavement maintenance purposes.

Additionally, this module covers:

- Performance specifications for friction measuring equipment.
- Guidance on pavement friction measurement for aircraft operational purposes during winter weather.
- Performance standards for decelerometers.

1-2. Background

The introduction of turbojet aircraft brought significantly greater weights and higher landing speeds to aviation. Consequently, braking performance on runway surfaces—particularly under wet conditions—became a critical safety consideration.

Research driven by the FAA, NASA, and the USAF has focused on two major areas to address these risks:

1. **Original Surface Design:** Maximizing skid resistance through material selection and construction techniques.
2. **Maintenance and Evaluation:** Detecting the deterioration of skid resistance and restoring it to acceptable levels.

1-3. Pavement Design Research

Research has identified specific surface treatments that significantly enhance wet-weather performance.

Pavement Grooving

Pavement grooving represents the first major advancement in safer wet-weather operations. Studies conducted by NASA and the FAA demonstrated that forming or cutting **closely spaced transverse grooves** on the runway surface allows rainwater to escape from beneath the tires of landing aircraft. This mechanism drastically reduces the potential for hydroplaning.

Porous Friction Course (PFC)

Research from the United Kingdom and the United States validated the effectiveness of **Porous Friction Course (PFC)**. This is an open-graded, thin hot-mix asphalt (HMA) surface course.

- **Mechanism:** PFC allows rainwater to permeate *through* the course and drain off transversely to the side of the runway.
- **Result:** It prevents water buildup on the surface, creating a relatively dry pavement condition even during rainfall.
- **Performance:** FAA studies confirmed that PFC overlays maintain high friction levels along the entire runway length.

Additional Surface Treatments

Ongoing research into the behavior of Hot-Mix Asphalt (HMA) and Portland Cement Concrete (PCC) has led to other effective texturing methods:

- **HMA Treatments:** Asphaltic chip seals and aggregate slurry seals.
- **PCC Treatments:** Wire combing the surface while the concrete is still in the plastic condition to improve texture depth.

1-4. Pavement Maintenance and Evaluation Research

Regardless of the initial design or surface treatment, runway friction characteristics **will degrade over time**. This deterioration is driven by aircraft activity frequency, weight, weather, and environmental factors.

Contaminants and Friction Loss

Beyond mechanical wear and polishing, the collection of contaminants is the primary driver of friction loss. Common contaminants include:

- Dust particles
- Jet fuel and oil spillage
- Water, snow, ice, and slush
- **Rubber deposits**

The Rubber Deposit Problem

Rubber deposits accumulate heavily in runway **touchdown areas**.

- **Impact:** Heavy deposits can completely fill the pavement surface texture.
- **Consequence:** This results in a loss of aircraft braking capability and directional control when the runway is wet.

> ⚠️ **Safety Constraint:** Rubber accumulation is insidious because it smooths the macrotexture required for water drainage. You must monitor touchdown zones frequently, as visual inspections alone are often insufficient to quantify the loss of friction.

FAA Surveillance Data

In 1978, the FAA conducted a comprehensive survey of 491 runways to analyze friction characteristics. This data confirmed that rigorous field observations and friction testing are required to identify areas falling below minimum acceptable levels. Airport owners must use this data to trigger corrective measures, such as rubber removal or re-texturing.

1-5. Friction Measuring Equipment Research

Starting in the 1970s, agencies conducted traction studies to correlate aircraft performance with Friction Measuring Equipment (CFME).

Correlation Findings

- **Device-to-Device:** There is a fair correlation between different types of friction measuring devices.
- **Device-to-Aircraft:** Tests attempting to correlate friction devices directly with aircraft stopping distances were **inconclusive**.

Practical Application

Despite the lack of direct correlation to aircraft stopping distances, CFME is highly effective for **engineering and maintenance purposes**. These devices allow engineers to trend data, identify deterioration rates, and schedule maintenance before conditions become unsafe.

In 1990, the FAA concluded tests to evaluate tire performance on approved devices. This ensured that devices of different manufacture and design could provide comparable results in the field, establishing the basis for the performance specifications found later in this course.

1-6. Additional Background and Information

For engineers seeking deeper technical data on the design and evaluation of skid-resistant pavements, refer to the appendices of this course, which list pertinent reading materials and standards.

Checkpoint Quiz

1. What is the primary mechanism by which transverse grooving improves runway safety? A. It increases the structural strength of the pavement slab. B. It provides a reservoir for rubber deposits to settle without affecting tires. C. It allows rainwater to escape from beneath aircraft tires, preventing hydroplaning. D. It increases the microtexture of the aggregate particles.

> **Answer: C. It allows rainwater to escape from beneath aircraft tires, preventing hydroplaning.** Grooving provides channels for bulk water evacuation (macrotexture), which is critical for high-speed braking on wet surfaces.

2. Which of the following best describes the relationship between Friction Measuring Equipment (CFME) and aircraft braking performance? A. CFME results correlate perfectly with aircraft stopping distances in all weather conditions. B. CFME is effective for maintenance evaluation but correlation with aircraft stopping performance is inconclusive. C. CFME is only useful for dry pavement testing. D. CFME data is used by pilots to calculate exact landing rolls.

> **Answer: B. CFME is effective for maintenance evaluation but correlation with aircraft stopping performance is inconclusive.** CFME is an engineering tool for monitoring pavement condition, not a real-time operational tool for calculating aircraft braking distance.

3. In which area of the runway are rubber deposits most likely to compromise friction characteristics? A. The rollout end. B. The taxiway intersections. C. The touchdown zone. D. The runway edges.

> **Answer: C. The touchdown zone.** The heat and friction generated at wheel spin-up during landing leave significant rubber deposits in the touchdown areas, filling the pavement texture.

PDH-PRO

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