Experiment 12

Skid Resistance by British pendulum

Skid Resistance

Skid resistance is defined as the frictional resistance at the interface between a vehicle tire and the road surface. It plays an important part in the safety of road users. **Skid** is defined as "when a vehicle tire is prevented from rotating, slides along the pavement surface under panic braking conditions". **Skid resistance** is the force that is generated to prevent the sliding of the vehicle along the pavement surface when the vehicle tire is prevented from rotating.

Skid resistance is an important pavement evaluation parameter because:

- Inadequate skid resistance will lead to higher incidences of skid related accidents.
- Most agencies have an obligation to provide users with a roadway that is "reasonably" safe.
- Skid resistance measurements can be used to evaluate various types of materials and construction practices.
- **Skid Number:** Skid resistance is measure with the help of skid number. It is denoted by SN. Skid number is given by

SN = m x 100

Where m is coefficient of friction.

Factors Affecting Skid Resistance:

Pavement Characteristics:

Skid resistance depends on a pavement surface's micro texture and macro texture.

1. **Micro texture** refers to the small-scale texture of the pavement aggregate component (which controls contact between the tire rubber and the pavement surface, **normally less than 0.5mm**) while **macrotexture** refers to the large-scale texture of the pavement as a whole due to the aggregate

particle arrangement (which controls the escape of water from under the tire and hence the loss of skid resistance with increased speed, normally from 0.5mm to 50mm).

2. **Time**

Skid resistance changes over time. Typically, it increases in the first two years following construction as the roadway is worn away by traffic and rough aggregate surfaces become exposed, then decreases over the remaining pavement life as aggregates become more polished.

3. **Temperature**

Skid resistance is also typically higher in the fall and winter and lower in the spring and summer

4. **Speed**
5. **Pressure**
6. **Gravity**

Note: Wet pavement skid resistance is considered here, since dry pavement skid resistance is rarely a problem

- There are two types of friction, only one which with we will be dealing with. These types are known as static friction and kinetic friction. Static friction is the frictional force required to start an object moving on another surface. Kinetic frictional force is the force to keep the object in motion.
- The force to get something moving (Static Friction) is always greater than the force to get it moving (Kinetic Friction). due to the "stickiness" between the two objects while trying to move one. Once you get your car moving the tires do not need as great of a force to keep moving.
- A value known as the coefficient of friction is the value which tells how much "stickiness" is between the two objects.
- The force of friction is measured as the coefficient of friction multiplied by the normal force.

- The normal force is the force of the bottom surface (such as a road) pushing up on the other object (such as a car) as the first object (car tires) pushes down on it.

Pavement Friction Measuring Vehicles

Locked Wheel Trailer (LWT)

The Locked Wheel Trailer (LWT) is an equipment or device which is the most popular Vehicle used by different Departments of Transportation (DOTs) to evaluate pavement Condition. It operates under 100% slip conditions, which means that the wheel that is Used to measure the coefficient of friction is completely prevented from rolling during testing. It is used to simulate the emergency braking condition without an ABS system.

Runway Friction Tester (RFT)

The Runway Friction Tester (RFT) is a device that is typically used to evaluate the Frictional properties of runways. It operates at approximately 15% of slip, in order to Simulate the ABS action on the braking operation of aircrafts.

Parameters Affecting Tire-Pavement Friction Interaction

Pavement Surface Characteristics

Pavement texture is perhaps the most important parameter related to the tire pavement Friction interaction. A pavement surface should provide enough skid resistance to stop a Vehicle in a panic braking situation. However friction should not be too excessive to Produce mechanical wear in the tire structure. The pavement designer should find an Optimum point where it would satisfy both requirements

Vehicle Operational Parameters

Slip Ratio

Friction researchers use the slip ratio term to indicate the difference between tire velocities And vehicle velocity, as indicated in Equation (10).

Slip = S- wR/S

Where *S* is the velocity of the vehicle, *w* is the angular velocity of the tire and *R* is the Nominal radius of the tire. It is seen from Equation (10) that when the tire is rolling freely the slip must be 0 (*S = wR*). On the other hand when the tire is locked up the slip ratio is 1 (*wR* = 0). Locked wheels suffer severe localized wear under dry conditions since there is no rolling and subsequent uniform wear in the wheels when locked. Thus the material at the contact area between the wheel and the pavement surface is subjected to a frictional force that can lead to permanent deformation localized into one point only of the wheel. On the other hand, a rolling wheel distributes these effects in a uniform manner throughout the circumference; therefore the wear is considerably lower than that in the locked wheel condition.

Experimental work (NCHRP, 2009) shows that the maximum coefficient of friction for most surfaces is generally reached in a range between 0.1 and 0.2 slip ratio, depending on the type of surface.

This is the principle on which Antilock Brake Systems (ABS) work. An ABS system recognizes that the maximum coefficient of friction is reached at a certain slip range, and hence controls the rotation of the tires for the slip ratio to be around that slip range. Thus ABS prevents the tires from locking, which provides vehicle stability, steer ability and Improves stopping capabilities

Vehicle Speed

In general, the friction coefficient decreases with speed.

British pendulum procedure:

1) Apply water to the test area.
2) Execute one swing without recording.
3) Rewet and execute four more times and record.

Calculate the average.

The skid resistance value (SRV) or BPN (British pendulum Number) is the mean of five readings or the constant of three readings.

Skid Number	Comments
Less than 30	Take measures to correct
≥30	Acceptable for low volume roads
31 - 34	Monitor pavement frequently
≥35	Acceptable for heavily traveled roads

Note: In general, the friction resistance of most dry pavements is relatively high; wet pavements are the problem. The number of accidents on wet pavements is twice as high as dry pavements