

ANTI SKID METHODS AND MATERIALS-SKID EFFECTS AND THEIR REMEDIAL METHODS

Dr.G. Venkata Rao S. Chandra Mouli Narendra Kumar Boddeti

Dept of civil Engineering, GMR Institute of Technology, Rajam, Andhra Pradesh

ABSTRACT

Skid resistance is the force developed when a tyre is prevented from rotating along the pavement surface. Skid resistance is thought of as a pavement property, it is the antonym of slipperiness. Among other road surface conditions, slippery pavement during precipitation is of great concern to road safety authorities. Some statistics indicate that the number of accidents increases by up to two folds during rainy conditions. Loss of skid resistance affects driver's ability to control vehicle. In addition to increasing the stopping distance while braking, lower skid resistance reduces steering controllability since both braking and steering depend on tire-pavement friction. In this paper mainly the methods of proper laying of pavements, various materials used to improve skid resistance, measurement of anti skid values such as PSV etc, Discussed .

Key words: Skid resistance, Pavements, Speed, texture and wet surface.

INTRODUCTION

Skid resistance is known to be a function of pavement construction materials, pavement roughness, and surface conditions. Road engineers & users are concerned with the safe passage of vehicles that operate over them. Safety on road is assessed by its skid resistance. Slippery pavements are known to be the cause of many road accidents and fatalities. Skid resistance involves the complex interaction of pavement, vehicle and environment factors. Skidding is the jerking of the wheels of the vehicles when it locked due to the sudden breaking, if the frictional resistance offered is too low. The friction that can be mobilized is greater than the decelerating force; the vehicle comes to a safe halt within a certain distance. If the friction developed is much smaller than the decelerating force, the vehicle cannot be controlled by the driver.

In places where there are long periods between precipitations, the number of accidents increases during the first precipitation after a dry

period. Then, with more precipitation, the number of accidents falls again. Eisenberg has found that, "if it rained a lot yesterday, then on average, today there are fewer crashes". His analysis also showed that "the risk imposed by precipitation increases dramatically as the time since last precipitation". These findings may indicate that the accumulation of pavement contaminants could be a suspect in loss of skid resistance.

An important function of a road surface course is providing skid resistance. Periodically, after polishing by traffic, this layer needs replacing to restore skid resistance to an appropriate level. UK, materials specifications require premium aggregates with a good resistance to polishing. These are becoming increasingly expensive and sources are few. Sustainable development demands consideration of alternatives such as industrial by-products. Some characteristics are: Skid resistance is invariant whether wet or dry, No decrease of the skid resistance with increase in speed, No reduction of skid resistance with time, Resistance to wear, Structural durability, Low noise generation, Low cost.

The term anti skid surfacing is usually taken to mean the road surface treatments that include calcined bauxite as the high PSV aggregate, and a resin rather than bitumen to hold the aggregate to the road surface. It is generally recognised that anti skid surface should have a minimum Skid resistance value (SRV) of 70.

FACTORS DETERMINING SKID RESISTANCE

The following factors determine the skid resistance developed at the pavement interface:

Pavement: Different types of pavements have different skid resistance properties. For instance, surfaces like open texture premix carpet have a better skid resistance property than mastic asphalt. The texture of the surface is provided by:

1. Macro texture which the determines the large scale roughness provided by the size and shape of the coarse aggregates
2. The micro texture which refers to the fine scaled roughness caused by the asperities on the individual aggregates

The macro texture helps in providing a good drainage of surface and also in the deforming the rubber of the tyres, which brings into play the hysteresis component of the friction. The macro texture aids in puncturing the thin film of water on the surface and in mobilising the adhesion component of friction

How Does Texture Depth & Micro Texture Effect The Skid Resistance?

1. Texture Depth assists in the rapid removal of water from the contact point allowing the Micro Texture to penetrate the vehicle tyre.
2. In wet conditions, the greater the texture depth the better the contact point
3. Micro Texture defines the degree of friction between the tyre and the contact surface and thus the degree of skid resistance
4. The longevity & effectiveness of the Micro Texture is defined by the aggregate's resistance to polishing
5. An aggregate's resistance to polishing is defined by its polished stone value (PSV) or Polished Aggregate Friction Value (PAFV)

Aggregates which polish under traffic into a smooth shape are not desirable when resistance to skidding is being sought. For this purpose, limestones are regarded with suspicion. The

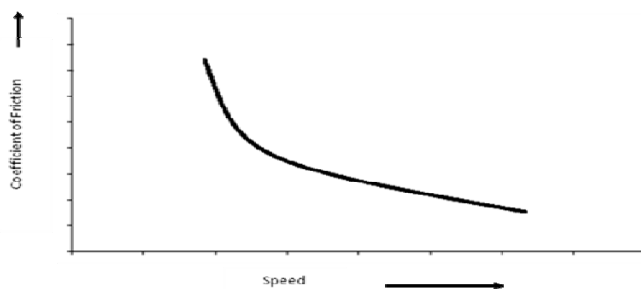
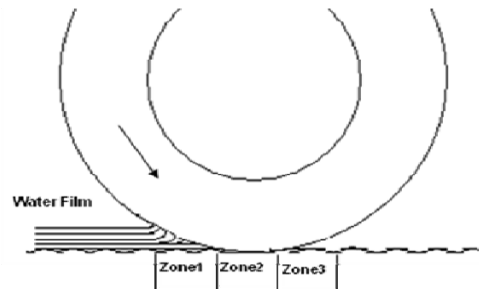


Fig 1: Water interaction with tyre

Effect of water on the surface: The greatest danger of skidding is where the pavement is wet and the frictional resistance drops down consequently. The action of the film of water can be understood from figure 1 given below.



The tyre surface on the strip is divided into three zones. Zone1 represents the zone of bulk displacement of water. Zone 2 represents the zone where the water film is much thinner and where the water carries a portion of the load of the tyre. In zone3, the water has been squeezed out and the tyre is in contact with the surface. As the speed of the vehicle increases, not enough time is available for the water to be squeezed out and the boundaries of zone move backwards. When the speed is very high a stage is reached when zones 2 and 3 completely vanished and only zone 1 is present. This stage represents the condition when a full film is present between the Tyre and the road surface and the phenomenon is called as “aquaplaning” or “hydroplaning”.

The remedy is to drain of the water from the road surface as quickly as possible. This is achieved by providing adequate camber on the road and a rough surface texture which has numerous channels for the quick exit of water

Speed: As speed increases, the skid resistance dropped down, markedly figure 2 indicates the general trend

Fig 2: Relation between coefficient of friction and speed

ministry of transport (U.K) specify the following minimum polishing stone values (PSV) when measured by the portable tester:

Description of site	Recommended minimum Value of PSV
Difficult sites	62
Average	59

Tyre characteristics: For the friction which develops between the tyre and the road surface is governed to a great extent by the tyre characteristics. There are two components of this friction:

- Adhesion component
- Hysteresis component.

The former is caused by the shear forces induced at the Tyre pavement interface, and is important on dry roads. The hysteresis component is developed

by energy losses caused by the deformation of the rubber when it comes into contact with the irregularities of the surface. Hysteresis becomes important on wet roads and attributable to macro texture. There composition of rubber is important in determining the extent of mobilisation of friction. The thread depth and pattern of tyres influence the skid resistance to a great extent. Drainage of surface water is facilitated by the grooves in the tyre.

METHODS TO IMPROVE SKID RESISTANCE

Composition of the wearing course

- ⊙ Must limit the binder content to a designed optimum level ; ensures safety and durability performance requirements
- ⊙ Must aim at the upper limit for the recommended range ; reduces the tendency of bleeding due to compaction under the action of traffic and increase in temperature
- ⊙ The dimensions of the aggregate chips and the laying must be such that the aggregates form sufficiently sharp projections ; attain a gritty surface texture
- ⊙ Sand content should be increased but still within limits according to ASTM Standard D 3515 ; micro roughness of the pavement surface texture is ensured
- ⊙ Aggregate must be strong enough to withstand early fragmentation or wear from traffic.
- ⊙ Compromise between providing an adequate micro-roughness and macro roughness may be achieved by choosing a maximum grain size of 12.5mm
- ⊙ Composition of the wearing course must be designed to have sufficient stability ; Aiming at a value of a stability of 5.0 reaches a compromise between the skid resistance and resistance to cracking

Anti-Skid & Coloured Surface Treatment Materials

With the added choice of a range of highly visible colours, high friction surfacing materials are also specially suited for many common coloured surfacing applications - from successful traffic calming schemes such as village gateway entrances to the demarcation of bus lanes, bus boxes, cycle lanes, parking bays and walkways.

As the surfacing materials are all hot applied, the quick setting and versatile nature of Kestrel's

safety surfacing products means minimum disruption to traffic and makes year round application a possibility.

Kestrel's high friction surface treatment materials are classified under 2 different product categories, according to varying levels of traffic density or application purpose.

Thermogrip - Specifically designed for use in areas of high traffic density where reaching the higher echelons of skid resistance performance is important. In its unpigmented form, thermogrip Buff anti-skid surfacing utilises a premium (calcined?) Chinese bauxite aggregate system to dramatically increase the braking efficiency of vehicles. In coloured grades of thermogrip, the use of high PSV coloured aggregates and pigmented binder makes it the preferred choice for many heavy duty traffic calming measures – coloured surfacing for village gateways, bus lanes, bus boxes or creating audible rumble bars on approaching roundabouts.

Cyclegrip – With the capability of being mixed in a conventional vertical thermoplastic road marking boiler, this versatile coloured surfacing material offers excellent coverage rates whilst still providing a good level of skid resistance. Suited for areas of light to medium traffic density, Cyclegrip can be used in conjunction with Preflex Preformed Thermoplastic Symbols to give a complete demarcation solution for cycle lanes, walkways or car park bays.

Slag Aggregate: The by-product of the Basic Oxygen Steel (BOS) process is the main type of steel slag produced in the UK (approximately 1.2 million tonnes annually), with about 10% utilisation in roads and agriculture at present. BOS slag has been used in surface courses for many years, but mainly within steelworks complexes or on local roads nearby. Consequently, most performance information is anecdotal, with no independent, systematic study of the skid resistance of the material.

Shellgrip: Cold applied processes such as "Shellgrip" and similar named processes, using epoxy resin, or increasingly a polyurethane resin, these are thermosetting resins. They are supplied as separate components that when mixed together undergo a chemical reaction producing some heat and setting hard after a number of hours. The term "Shellgrip" is often used to describe all high friction surfacing, so be very careful when using this term in its broad meaning.

Calicined bauxite: The Calicined bauxite and the resin (in granular form) are supplied premixed in poly bags, the resin in this case is a thermoplastic resin, so the material is heated in a boiler and

Average texture depth (mm)	Texture classification
<0.25	Fine
0.25-0.50	Medium
>0.50	Open

screeded out onto the road surface whilst it is hot, using a 300mm wide bottomless "shoe".

MEASUREMENT TECHNIQUES

Skid resistance is measured by a number of methods, which can be grouped as follows:

1. Methods employing the stopping of test vehicle by braking and measuring the stopping distance or by the deceleration caused. Though simple, these methods involve considerable risk if braking is done and speeds
2. Methods employing braking of the trailers towed by vehicles. In the N.A.S.A method, the trailer wheel is made to rotate under slip. In the A.S.T.M method, the wheel is made to lock.
3. Methods for measuring the sideway force developed when a wheel placed at an inclination to the direction of travel is made to side slip. The classic example of this method is the SCRIM (sideway force coefficient routine investigation machine) developed by the R.R.L., U.K., Their the fifth wheel is set at an angle of 20 degrees to the direction of travel
4. Portable and laboratory instruments The most famous of this category is the British portable tester which is handy and versatile instrument

Skid resistance measuring methods

1. Texture Depth
2. Skid Resistance Test
3. Locked Wheel Tester
4. Spin Up Tester

Texture Depth

Select the spot on the road to be tested, normally in the nearside wheel track. Ensure that the area to be tested is dry and free from loose materials. A known volume of sand is spread on the road surface; the average macro-texture depth is calculated from the area of the circular patch produced.(The sand particles are those passing a No. 52 sieve and retained on a No.100 B.S. sieve).

Results

Report the sand circle diameter in millimetre to the nearest 5 mm. Textures Producing diameters in excess of 350 mm (which cannot be measured accurately by this procedure) are to be reported as 'greater than 350 mm'. (Kadiyali L.R text book). Report the average texture depth to the nearest 0.1 mm. A suggested classification of the surface texture is:

Skid Resistance Test

Procedure (Design Manual for Roads and Bridges, august 2004)

- Select the spot in which the texture depth has been measured.
- Set the apparatus (Figure 3) on the road so that the slider will swing in the direction of traffic flow and level the base screws.
- Raise the swinging arm clear of the road and clamp in the horizontal position. Release the arm and check that the pointer reads zero.
- With the pendulum arm free and hanging vertically, place the spacer, attached to a chain on the base of the column, under the lifting handle setting screw to raise the slider. Lower the head of the tester so that the slider just touches the road surface and clamp in position. Remove the spacer.
- Check the sliding length of the rubber slider over the road surface by gently lowering the pendulum arm until the slider just touches the surface first on one side of the vertical and then on the other. When passing the arm through the vertical, use the lifting handle so that the slider does not touch the road. The sliding length should be between 125 and 127 mm. If not, adjust by raising or lowering the head.



(a)



(b)
Fig3 - Equipment Setup

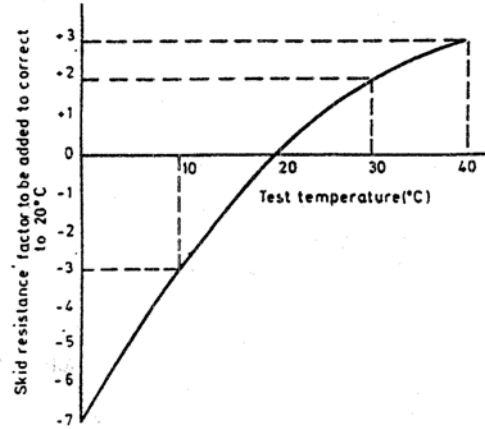


Fig 4: Skid resistance/ temperature correction relationship

- Place the pendulum arm in the horizontal and clamp in position.
- Wet the road surface and slider with water.
- Bring the pointer to its stop then release the pendulum by pressing the button. Take care to catch the arm on its return swing before it hits the ground.
- Return the arm and pointer to the release position keeping the slider off the road surface by means of the lifting handle. Repeat the test, wetting the surface between swings. Record the mean of five successive readings, provided they do not differ by more than three units. If the range is greater than this, repeat swings until three successive readings are constant; record this value.
- Record the temperature of the water on the road surface.

Results

The skid resistance value (SRV) is the mean of five readings or the constant of three readings as stated above. As the stiffness of the rubber slider will vary with temperature a correction has to be made if the temperature is not 20°C. Use the temperature curve (Figure 4) for this purpose.

Category	Type of site	Minimum skid resistance (surface wet)
A	Difficult sites such as 1. Roundabouts 2. Bents with radius less than 150 m on unrestricted roads 3. gradients 1 in 20 or steeper of lengths greater than 100m 4. approaches to traffic lights on unrestricted roads	65
B	Motorways, trunk and class 1 roads and heavily trafficked roads in urban areas (carrying more than 2000 vehicles per day	55
C	All other sites	45

Locked Wheel Tester:

- Commonly used method for testing skid resistance.
- This method uses a locked wheel skidding along the tested surface to measure friction resistance.
- A std. tyre for use is, bias-ply G78x15 tyre with seven circumferential grooves.
- The result of the test is the Skid Number (SN).

Spin Up Tester

- The basics set up of the locked wheel test and the spin up test are the same.
- At the desired speed here a locked wheel is lowered to the pavement surface.
- The force can be calculated by knowing the test wheel's moment of inertia and rotational acceleration.
- It got 2 advantages over the Locked wheel tester
- No force measurement is necessary.
- Less wear and tear.

CONCLUSION

Skidding is a major cause for most of the road accidents. In this paper the different factors affecting skid resistance has been discussed and pointed out some of the methods to improve skid resistance. By adopting all these remedial measures we can reduce the rate of accidents. A number of tests are available for measuring the skid resistance

of the pavements. The problem for those who design, build and maintain roads is to know enough factors that contribute in skid resistance To allow the later to be maintained at an adequate level under all conditions of traffic and environment

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