

# A Review on Effect of Pavement Surface Failure on Road Traffic Accident

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## **Abstract**

Pavement surface condition was parameter used to define quality of road traffic system. In this review pavement surface condition inspected were pavement friction, roughness and rutting. In order to analysis the study considers all previous paper done by researcher in specified and related title. Due to data constraints and other related issues to signify the outcome this review randomly selects forty-five researches paper. As per the examination most researchers argue that affinity of pavement surface condition for the occurrence of road traffic accident was irrelevant in respect to another related factor (Vehicle speed, Road geometry, Wet pavement surface, Pavement edge and etc.). Even though; the impact was insignificant the number of people dies and injured kin with other accident triggering factor was significant. As a result; stakeholder must play substantial role to overcome road traffic accident due to lack of proper maintenance and management of pavement surface condition.

**Keywords:** Effect; Friction; Pavement Failure; Skid Resistance; Rutting; Road Traffic Accident.

## **1. Introduction**

Effect of pavement surface failure on road traffic accident was the concern of our globe. Researchers define road pavement structure in different approaches. Jorge et al. (2019) define road pavement structure was made of multiple layer processed and compacted material in different thicknesses; primarily supports vehicle loads as well as providing a smooth riding quality (Jorge de Brito, 2019). Other researcher supports (Jorge de Brito, 2019) pavement was hard and high strength surface that separates the underlying well-compacted foundation of road from the weight of vehicles (Jalal Asfar, 2012). Even if, pavement layers was well compacted and highly qualified to bear traffic load, due to that and other related factor pavement may be under risk of failure. Pavement failure occurs as soon as pavement surface no longer holds its original shape and develops material stress (Lone Star Paving, 2017). When pavement reaches its terminal life the pavement surface suffers from distresses which unable to provide smooth surface for users (Chu L and Fwa T F, 2016). Categorically; pavement failure includes cracking, potholes, depressions, rutting, shoving, upheavals and raveling. That caused by a number of factors like: water intrusion, stress from heavy vehicles load, enlargement and shrinkage from seasonal temperature changes, and sun exposure (Lone Star Paving, 2017).

Pavement failure was a process by which weakness developed on pavement under the combined effects of traffic load and environmental condition (The Engineering Community, 2018). Due to the presence of pavement failure; particularly, surface condition in line with other factors road traffic accident happen immensely. Most pavement failures primarily reflected at the wearing course or surface of the structure. As a result; pavement surface condition was a commencement and indicator for the occurrence pavement failure that contribute their own impact for the incidence of road traffic accident. This review considers failures on pavement surface those contribute road traffic accident, particularly; pavement friction, roughness and rutting. In different research paper scholars consider factors causes road traffic accident differently. Sharma and Lozano (2000) stated that road traffic accidents were usually caused by three major error originators, namely: human, environment and vehicle (Sharma and Lozano Krug, 2000). According to Komba (2006) environment factor causes road traffic accident encompasses natural and built environments (Komba, 2006). In spite of this; environment, particularly; road pavement surface was one

parameter incorporated as causes for road traffic accident. As a result; this paper tries to review the effect of pavement surface failure on road traffic accident.

## 2. Effect of Pavement Surface Failure on Road Traffic Accident

Different researchers argue that traffic accident depends on the pavement type and pavement condition. There were many studies showing that pavement condition can significantly increase chance of accident on different road types in relation with other factors causes' road traffic accident. Particularly; pavement surface condition play vital role for the incident of traffic accident in relation with speed of the vehicle, geometric condition of the road, presence of wet, road pavement edge and etc. There were multiple variables of pavement surface condition those causes road traffic accident. However; the possible contributors to road traffic accident were pavement friction (skid resistance), roughness (ride quality) and rutting (Hussein, R.A., & R., 18-21 May 2015) (Vinayakamurthy M., 2017).

Pavement friction was force developed when a tire prevented from rotating slides along the pavement surface (Highway Research Board, 1972). Whereas; pavement roughness was irregularities in the pavement surface that adversely affect the ride equality of a vehicle (Ksaibati, 2002). Similarly; rutting also defined as a longitudinal depression of paved surface in the wheel path(s) (U.S. Department of Transportation/Federal Highway Administration, 2014). As a result; pavement friction, roughness and rutting was the concern of this review to examine effect of pavement surface failure on road traffic accident. The review indicated below emphasize on those depicted factor causes road traffic accident intensely.

Craus et al. (1991) conclude that effect of pavement surface condition on road traffic accidents in Nigeria has no significant unilateral correlation (Craus, 1991). Al-Masaeid (1997) inspected that pavement surface condition has significant effect on single and multiple vehicle accident rates on rural road, but has no statistical influence on the total accident rate (Al-Masaeid, 1997). Also Lee et al. (2015), poor pavement surface condition increases the severity of single vehicle crash on high-speed roads. However, in the low-speed roads, severity of single-vehicle crashes decreases for poor pavement surface condition (Lee, 2015). According to Abbagana et al. (2012) in Nigeria normalized number of crashes in the year 2012 due to Pavement surface condition has visible relationship. Even though; the researcher argue with the findings of Craus et al. (1991) and Al-Masaeid (1997) due to weaken by scatter as evidenced by the  $R^2$  value of 0.466 (Abbagana Mohammed, 2016). In China, it was shown that two substantial factors which leading to fatal accidents were traffic flow condition and pavement surface condition (Yafeng, 2011). According to Toshihiro et al. (2018) the study held in Minnesota on pavement surface condition and road crash; poor road pavement surface quality was associated with more property damage and injury crashes (Toshihiro Yokoo, 2018). The interaction of road quality and curves indicating that good pavement surface quality on curves increased the fatal, injury and property-damage crash rate (Toshihiro Yokoo, 2018). Yingfeng Li et al. (2013) stated that when the pavement condition was poor severe crashes were more likely, but when the pavement surface condition was very poor severe crashes were less likely to occur than poor pavement surface conditions (Yingfeng Li, 2013). According to Mannering (2011) the severity of traffic accident probabilities on Driver varies from one surface-condition group to the other (Mannering, 2011). Degradation of the pavement surface has a significant impact on road safety and, in particular, asphalt polishing turns out to be very hazardous for powered two wheelers (Francesco Bella, 2012). More specifically some authors agree that the deterioration of road pavement has a significant impact on road safety (Benedetto A. and Angiò C., 2002) (Tighe S., 2000). According to Jaeyoung et al. (2015) poor pavement surface condition decreases the severity of single vehicle collisions on low-speed roads whereas it increases their severity on high-speed roads. On the other hand, the poor pavement condition increases the severity of multiple-vehicle crashes on all roads (Jaeyoung Lee M.ASCE, 2015). A review by Andrey et al. (2003) found that almost all research has shown an increase in the frequency and severity of crashes during adverse surface conditions (Andrey, 2003).

Ahmad et al. (2018) signify that pavement skid resistances on roadway departure crashes cause sevier accident (Ahmad Alhasan, 2018). Among operational factors on road traffic accidents the substantial was pavement surface condition due deterioration and defects of pavement surface (Andriejauskas. T V. V., 2014). As a result; skid resistance, driving off tracks, improper maneuvering was happen on the surface of the pavement (Andriejauskas. T V. V., 2014). Regarding pavement surface friction, higher macrotexture cases safer highways and reduces accident rate (Alauddin & Susan., 2008). Similarly, higher skid resistance value decreases accident risk on dry roads due to sufficient friction force develops between tire and road pavement surface (Andriejauskas. T V. V., 2014). Noyce (2005) found that the decrease in skid resistance lead to an increase in the wet crash rate (Noyce, 2005). Similarly, Hall (2009) reported that review of various studies show that low friction factor lead to an increased crash rate (Hall, 2009). As a result; pavement friction (Skid resistance) play thier own role to define the occurrences and rate of road traffic accident. But, it has not as such powerful impact for the occurrences of that traffic accident by itself other than in cooperation with other related factors causes road traffic accident.

Hashem (1997) Pavement surface condition expressed in terms of the international roughness index has significant effects on single and multiple vehicle accident rates, but it has no statistical influence on the total accident rate (Hashem R, 1997). In Iran the highest mortality rate account 3.45% was happen on oily pavement surfaces condition (Kamran B. Lankarani, 2014 ). According to Amir (2020) increasing Average Annual Daily Traffic (AADT) with higher IRI value causes higher accident frequency (Amir Bahador Parsa, 2020). Pavement surface quality decreases the risk for vehicle increases (D'Amico F., 2007). According to S N Baskara et al. (2019) in Malaysia more than 70% of the accidents happened at a good condition of road which having high Mean Texture Depth (MTD), low Rutting Depth (RD) and minimum International Roughness Index (IRI) (S N Baskara H. Y., 2019). The study held by Anastasopoulos et al (2012), the increase in International Roughness Index (IRI) increases the accident rates by 95.72% (Anastasopoulos P. C., 2012). Al- Masaeid (1997) found that the road roughness will decrease single-vehicles accidents but increases the multiple-vehicle accidents rate. The single-vehicle accident rate decreases as the pavement roughness increases due to reduced speeds. The multi-vehicle accident rate increases due to lateral shifts and speed differentials between road users (Al-Masaeid, 1997). Pavement Condition Index (PCI) related to distress in pavement surface has a direct influence on the smoothness (IRI) which was the surface irregularities that affect the ride quality of road users (Park, 2007). Study by Park depict that the lower the IRI value, the flatter the profile (Park, 2007). According to Chan et al. (2010) an increase in the Average Annual Daily Traffic (AADT) with a higher IRI value led to higher accident frequency (Chan, 2010). The study done by Miss Bernie (2014) on Effect of Road Roughness on Traffic Speed and Road Safety in South Queensland, Australia depicted that higher crash rates and increased pavement roughness has strong relationship (Miss Bernie-Anne King, 2014). The analysis done by Mounica (2017) depict that there was a positive correlation between road roughness and rut depth in all cases irrespective of crash severity level. Roughness and rut depth values for crash and non-crash segments were close to each other, suggesting that roughness and rutting were not the only factors affecting number of crashes but possibly in combination with other factors such as traffic volume, human factors and etc. (Mounica Vinayakamurthy, 2017). As a result; pavement roughness play thier own role to define the occurrences and rate of road traffic accident. But, it has not as such powerful impact for the occurrences of that traffic accident by itself other than in collaboration with other allied factors causes road traffic accident.

According to Ihs (2004) citing Sjölander et al. (1997), ruts possibly seem to had a tendency to improve traffic safety while unevenness (roughness) has the opposite effect (Ihs A., 2004). He also investigated the relation between traffic safety and road surface condition for the Swedish National Road Administration's (SNRA) and stated that accident ratio increases with increasing unevenness (International Roughness Index, IRI) (Ihs A., 2004). As the depth of in rut increases accident rates also increases by 94.27% (Anastasopoulos P. C., 2012). Strat et al. (2004) quantifies that rut accidents increase as the rut depth gets greater and greater (Strat, 2004). Anastasopoulos et.al (2012) also revealed that lower rutting depth decrease accident rates (Anastasopoulos P. C., 2012). Another study revealed that severe rutting might distract the driver that resulted into collision or running off track (Li, 1998). Chan et al. (2010) also mentioned that the occurrence of accidents increases significantly by the rutting and roughness during night and under rainy weather conditions (Chan, 2010). Both rutting and roughness on pavement surface condition increase the accident frequency with the increase of Average Annual Daily Traffic (AADT) (Chan, 2010). A study carried out in Turkey proved that rutting was the most viable road surface pavement defect that relates to traffic accidents (Bilimlerli, 2012). As a result; pavement rutting play thier own role to state the occurrences and rate of road traffic accident. But, it has not as such influential impact for the incidences of that traffic accident by itself other than in assistance with other related issues causes road traffic accident.

**In general;** as per the assessment pavement surface failure has no as such significant impact for occurrences of road traffic accident. Even though; pavement surface condition serve as a contributory factor for the occurrences of road traffic accident in relation with other factors like speed of vehicle, geometric condition of road, existence of wet substance on pavement, road pavement edge and etc. As a result; proper management and periodic maintenance of pavement surface as per specification was mandatory and has significant impact on the reduction of road traffic accident. So, the concerning body and stakeholder must play a vital role in the management and maintenance of pavement surface condition in line with standard and specification that keenly reduce road traffic accident.

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### Statement of Declaration

I declare that the research entitled “Effect of Pavement Surface Condition on Road Traffic Accident” was my review work and it hasn’t been presented for the award of any other similar titles by other researchers.

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