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An Investigation on the Effects of Asphalt Rutting in Traffic Collision (Case Study: Ghorveh-Hamedan Route)

Hooshmand Khaledyan

Department of Civil Engineering, University of Zanjan, Zanjan, Iran.

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ABSTRACT

In this study, we investigate the effect of asphalt rutting on road Traffic collision. Rutting is one of the most important and customary failures in flexible pavements, not only impose heavy costs on custodians and road users, but also cause lots of safety hazards. rutting occurs by permanent and irreversible aggregate changes in surface layers of pavement under the under repeated traffic loading Among all the involved layers in rutting, the permanent movement in surface layer of the pavement allocate a great deal of fractures, so it is necessary to pay close attention to the permanent changes in asphalt mixtures in aggregation plans. By having view to the climatic conditions, the slipping potential of vehicles in rainy or snowy weather leads to reduction in roads safety, and consequently increase in Traffic collision. The statistical population in this research is 45 randomly selected drivers of crew members in public transformation fleet, freight, and passengers' cars. The applied data collection method in research is questionnaire and SPSS Statistical software used to data analysis. In this paper, we investigate the phenomenon of asphalt rutting in Ghorveh-Hamedan route and its correlation with Traffic collision.

Introduction

A great deal of pavements in our country are of the flexible asphalt pavements, and one of the most common failures in, is rutting. The occurrence and development of such failures depends on several factors, including the characteristics of the pavement layers, constituent materials, traffic volume, axles weight, vehicles velocity, climate conditions, etc. Asphalt rutting causes lots of safety problems, including water marching and hazardous vehicle movements. Avoiding the creation of grooves in asphalt pavement is one of the main factors to keep the roads safe, which is permanent matter of concern. Rutting is longitudinal deformation on vehicle's pathways. The rutting in pavement materials has been created gradually by increase in amount of loading, and presents usually in form of longitudinal indentations along the wheel direction, with trifle inflation in its edges (Suza et al, 1991).

Problem Statement

The greatest deal in national investment funds in transportation sector dedicates to the construction of roads and pavements which most of them are asphalt in Iran Nowadays. But by the passage of time pavements faced to fracture because of traffic load and climate changes and they are not only involving structural fatigue, but also many other failures are in account. These failures are the outcome of various factors such as traffic, climate, material, and time. Damages are the indicators of change in road performance over the time, and roads accountability for traffic load and environmental condition in design phase (White et al, 2002). One of the common failures in pavements is permanent deformation of asphalt pavement or rutting, and preserving road of such failures is one of the main safety factors on the road which is permanent matter of concern.

Millions of dollars spent annually to maintain pavements but by the increase in traffic load and air temperature, the risk of pavement deformation enhanced accordingly, apply improvement in asphalt concrete materials, betterment of mixture planning and evaluating methods all can lead to increase in pavement optimal performance life and significant savings in maintenance cost of pavement (White et al, 2002). Great deal of pavements in the country is of flexible asphalt pavements, and rutting phenomenon is the most common faults of this typ. The occurrence and development of such deformation in roads depends on several influencing factors, such as the characteristics of the pavement layers, constituting materials, the volume of traffic loading, axels weight, vehicles velocity and climate conditions, etc.

Rutting causes many safety problems, when the ruts trap water, steering problems for passenger cars is a definite threat; specially if the trap's depth exceed a certain amount pavement repair is required. The severity and amount of rutting varies in roads with higher and lower amounts of traffic volume and speed. the present paper tends to reveal the role and impacts of rutting on traffic collision; Since the permanent deformation of asphalt pavements appear in form of rutting therefore it can be counted as a main fracture and fault in roads so it is important to do alike research in order to provide appropriate ways to reduce the damage caused by rutting. Therefore, in this research, the impacts of asphalt rutting traffic collisions have been evaluated.

Ameri et al (2015), in evaluating on the effects of Nano Clay on the permanent deformation behavior in hot mixed asphalt (HMA), found that the rutting in the vehicle pathway is of the fundamental failures happens due to the lack of bearing power in Flexible pavement layers. Hot asphalt mixture consists of aggregates and viscoelastic materials;

Tele:
E-mail address: Hooshmand.khaledyan@gmail.com

materials properties play a significant role in structural features of pavement. Although the weight of bitumen in asphalt mixture is trifle, but it makes important effective role on asphalt mixtures performance, and any change in bitumen performance affects the overall performance of the pavement.

Figure1

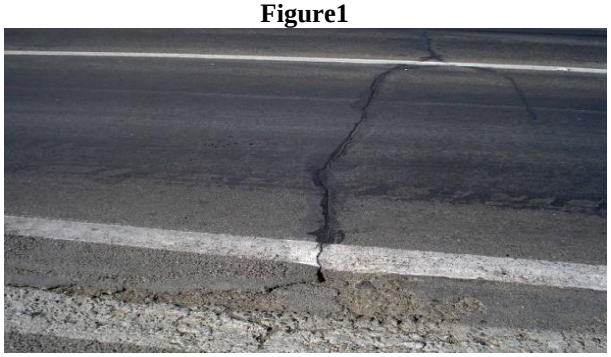

Figure2

In recent decades, to overcome the problems and deficiencies of customary pure bitumen and enhancement of the performance in asphalt mixtures some bituminous modifier materials have been used. One of the additives that has recently been used to modify the behavioral properties of bitumen is Nano Clay. In the present research, by the assumption of the sufficient bearing resistance of substrate and layers underlying the foundation, the Nano Clay additive has been used to improve the properties of bitumen to increase the bearing strength of the asphalt and to improve its technical properties against rutting in flexible pavements. For this purpose, two types of Nano Clay including: MounMorlinet Cloisite 15A and Cloisite 30B have been used. Marshall and dynamic creep tests in two tensions of 300 and 450 Kpa and rutting of wheel trace in 50 ° C temperature on asphalt mixtures containing 2, 4 and 6 % Of each Nano Clay samples and control sample executed. The results of these experiments show improved performance of asphaltic mixtures which contains nanoparticles.

Mohammadi and Mahmoudi (2006) studied the impact of climate changes on traffic and road collisions in Sanandaj-Hamedan route. At first, the critical thresholds of the Sanandaj-Hamedan route were determined, then accidents frequency during cold months of year analyzed and found that March with 22.2 percent has the highest frequency of occurred accidents in comparison with other months in year. Ultimately, the importance of this research showed the role of climatic factors on enhancement of accidents probability in mountainous conditions.

Moghadas Nezhad and et al (2006), made a transactional analysis among the properties of pavement surfaces and vehicle characteristics in creating and controlling the hydroplaning phenomenon. One of the factors that reduces the safety of traffic in case of rainfall is the occurrence of hydroplaning or water marching phenomena. Hydroplaning, also known as aquaplaning in Asia and Europe, usually occurs when water trapped on impervious layers of the road surface and pulled up in the front of the wheels and their weight cannot pull them over, water pressure can lift the car and separate it from the road surface and place the wheel on a layer of water between the car's tires and road surface. In this situation, steering becomes increasingly difficult and possibility of overturning or collision enhanced too. Although this phenomenon is really rare but in case of happening leads to dangerous and catastrophic results, so the occurrence of pre said phenomenon is one of the effective factors in reduction of road safety on wet, rainy conditions. Pavement surface, tires' condition and vehicle velocity are among the most effective factors in collision probability with resulting detriments.

Lee et al. (2015) examined the rutting behavior of asphalt pavements in mountainous highways. They used Kelvin's model for constituents of asphalt aggregate as a new approach. So, they used the tangential difficulty matrix to construct the Kelvin model with fix assumed amount of vehicle loads in a finite element model. Their finding showed that overload, speed, tangential and vertical forces of vehicles make drastic impact on the pavements surface rutting.

Shabaz Khan et al (2013) studied the rutting in flexible pavements. The majority of roads in India are of flexible pavement. two major detriments in these routes are: cracks (fatigue) and rutting (permanent deformation), longitudinal shear deformation in pathways of the wheels in bitumen pavements leads to additional consolidation due to the accumulation of permanent deformations caused by heavy loadings, or lateral movement of the materials or cracks in asphalt or concrete layer or a combination of Both above mechanisms. Pavement rutting is a serious detriment along with fatigue in areas with high temperature areas which may leads to early failure and crack in pavement, and resulting in costly renovation. The aim of the present paper is to investigate the effect of asphalt rutting in road accidents, identification of effective factors in road rutting and potential solutions in collusion avoidance methods.

Hypothesis

There is a correlation between asphalt rutting and traffic collisions.

Assumptions

There is a correlation between the rutting and collisions in pathways.

There is a significant correlation between affecting factors of rutting and collisions.

There is a correlation between rutting and solutions to prevent collision.

Methodology

Methodology is a way to achieve knowledge in depth and methodic quest for theorizing, methodology consists of applied techniques and methods compile and analyze data. The applied research method used in this paper is descriptive-analytic and to analyzing the findings and testing the hypotheses among statistical methods Correlation tests applied.

Statistical Population

Population is a set of all possible observations that can be made by repeating a test. In general, "population is a set of individuals or units that have at least one common attribute or shared feature, and the description of the statistical population must be clear cut and complete (Saramad, 2006). The statistical population in this paper is of 45 randomly selected drivers of crew members in public transformation fleet,

freight, and passengers' cars who works in Ghorveh-Hamedan route.

The main tool for data collection in this research is a questionnaire. A researcher-made questionnaire was used for this purpose. The applied spectrum in questionnaire is Likert spectrum and the answers are presented in multiple form with 5 options. In order to analyze the statistical data of the present study, the obtained information from the questionnaires was first extracted and then analyzed by making use of Pearson correlation test.

Table 1. Correlation between traffic collisions and route rutting.

Significance level	Pearson r Amount	*Quantity*	Variables
0.000	0.515**	45	Asphalt Rutting
			Traffic collisions

Main hypothesis

H_0 assumption: there isn't any relationship between road rutting and traffic collisions.

H_1 assumption: there is relationship between road rutting and traffic collisions.

For the main hypothesis of research, the results of Pearson correlation coefficient shown in table (1), by having view to the table correlation coefficient in P<0.05 equals to r= 0/515 so it is statistically significant, therefore with sig= 0.000 in Pearson test, H_0 assumption rejected and H_1 assumption betoken to the significant relationship between variables approved.

Table 2. The relationship between rutting spots identification and traffic collisions.

Significance level	Pearson r Amount	quantity	Variables
0.009	0.385**	45	Rutting spots
			Traffic collisions

Assumption One

H_0 assumption: there isn't any relationship between rutting spots and traffic collisions.

H_1 assumption: there is relationship between rutting spots and traffic collisions.

For the first assumption of research, the results of Pearson correlation coefficient shown in table (2), by having view to the table correlation coefficient in P<0.05 equals to r= 0/385 so it is statistically significant, therefore with sig= 0.009 in Pearson test, H_0 assumption rejected and H_1 assumption betoken to the significant relationship between variables approved.

Table 3. The relationship between rutting and traffic collisions.

Significance Level	Pearson r Amount	*Quantity*	Variables
0.035	0.316**	45	Affective factors onrutting
			Road collision

Assumption Two

H_0 assumption: there isn't any relationship between Affective factors on rutting and traffic collisions.

H_1 assumption: there is relationship between Affective factors on rutting and traffic collisions.

For the second assumption of research, the results of Pearson correlation coefficient shown in table (3), by having view to the table correlation coefficient in P<0.05 equals to r= 0/316 so it is statistically significant, therefore with sig= 0.316 in Pearson test, H_0 assumption rejected and H_1 assumption betoken to the significant relationship between variables approved.

Table 4. The relationship between method to prevent road rutting and road collisions.

Significant Level	*Pearson's r Amount*	*Quantity*	Variables
0.032	0.320*	45	Rutting Avoidance Methods
			Traffic collisions

Assumption Three

H_0 assumption: there isn't any relationship between relationship between method to prevent road rutting and road collisions

H_1 assumption: there is relationship between relationship between method to prevent road rutting and road collisions.

For the third assumption of research, the results of Pearson correlation coefficient shown in table (3), by having view to the table correlation coefficient in P<0.05 equals to r= 0/320 so it is statistically significant, therefore with sig= 0.032 in Pearson test, H_0 assumption rejected and H_1 assumption betoken to the significant relationship between variables approved.

Discussion and conclusion

According to the results obtained from testing the hypotheses:

1. The most important factors affecting the safety and sustainability of roads are climate changes. Climatic factors and elements play a significant role on surface transportation and being aware about pre said factors and elements, is a great help in transport safety and reduction in road collision and financial and life losses respectively.
2. Characteristics of aggregate materials in pavement play a significant role in properties of the pavement too. The use of high quality materials in asphalt mixtures is trifle, but it plays important effective role on asphalt mixtures performance, and minimizes the amount of rutting on road surface.
3. Rutting on pavement surface caused by increase in gradual amount of applied load and dint in wheel direction, although this phenomenon is really rare but its results dangerous and catastrophic, but study and understanding of vehicles tire behavior during such occurrence is one of the most important factors to reduce traffic collisions.
4. In accordance with obtained results, the correlation between Asphalt rutting and collision approved with significant level 0.001in relevant test and corresponding answers by respondents.
5. Identification of rutting spots are effective in accidents and help to reduce them by identifying these points renovation.
6. Among other influencing factors on this phenomenon climate changes can be named, but they are avoidable conditions and so forth, which can be prevented by the application of some efficient ways

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