

Factors Influencing Road Damage in Developing Countries

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Abstract— The main purpose of this research work is to identify the factor of influencing road damages in difference countries. To achieve this objective, this study carried out a comprehensive literature review on factors of influencing road damage, particularly emphasizing from difference countries. The factors identified, served as a guide required to achieve the types of road damage, road safety management and repairing method. This research used specific criteria to extract the factor influencing based on the main purpose of the study. A total of 111 factors were obtained from prior studies. Results obtained during the cause of study revealed that 49 factors have been identified as the most crucial factors affecting the road damages of developing countries.

Index Terms— Factor of influencing road damage, developing countries and management.

I. INTRODUCTION

Malaysia is moving towards becoming a developed country. Year by year, heavy vehicles keep increases due to the high demand from industries and it is subjected the pavement to heavy axle loads. The heavy vehicle load on the pavement subjects it to high stresses causing damage. On the other hand, not all pavement has same destructive effects (Potter, 2016). Heavy truckloads are the major cause of pavement damage however it is depending on different factor such as the vehicle loads, weather, types of soil condition, pressure on the road and other factors (Nasradeen, 2016).

Every country was aiming to promote their country to encourage tourist visit often. Provide good serviceability and have convenient road network during travel can be one of the attraction and tourist concern. With a better system network of roads, it believes that visitors could gain access to many of beautiful places in the country and they can travel without much difficulties.

Road damages are the common problem that happen due to overloading vehicle on road and depends on the traffic condition during climax time (Magdi M, 2015). The causes of pavement failures are separated into two types, which are an internal and external failure. Internal failures of pavement are frequent because of lack of pavement mixture, weaknesses of component materials and poor construction (Ndefo, 2012). In

the meantime, external failures are as a result of overloading, diesel spillage, flooding, sinkholes and other unforeseen reason such as earthquake, volcanoes and others. The failures of flexible pavement are separated into four categories, which are surface deformation, surface defects, cracking and patching and potholes (AASHTO, 2001).

So this paper tries to provide answers to the research question: "What are the factors influencing road damage in developing countries?" To answer the research question, the authors explored the most crucial factors that affect the road damage in different countries.

The first step to determine such list of factors was the identification and listing of all the reported factors in the included set of studies. The literature review suggested 111 factors extracted from 45 published papers in journals and conferences. The second step is to filter the factors by reorganizing, alphabetizing, consolidating and then eliminating the factors from other researches that identified the same factors with different terminology. Then, the set of consolidated factors were determined and mapped to information of all authors who studied every variable and eliminated the factors at the individual level, found in the list. At the end, 56 factors were categorized based on the frequency with which the factors were reported in the literature and the research findings reported the relative importance.

II. DEFINITION AND METHODOLOGY

The primary aim of this study is to identify the most factors influencing road damage from developing countries (Ndefo, 2012). In order to meet this objective, this research reviewed the literature on the road damages in developing countries. The research focused mainly on articles published in academic journals specialised in construction of road management, factor of damages, and road safety.

In many cases, reviewing the papers helped in identifying related papers. There was no time restriction when searching the databases. As a result, around 187 articles were reviewed. Eventually, 50 ones were considered as most relevant to the research aim and were subject to a detailed review, as this approach has been used.

A developing country are countries with economies that have high growth and security when looking at the domestic product per capita income, and general standard of living,

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among other factors (Justin, 2018). Developing countries will involve various industries starting to rise, including factories, shops, infrastructures, housing areas and most of which will involve increased construction development and will increase the quantity of road use for the purpose of goods transporting.

On the other hand, Malaysia is the world's largest palm oil producer and the largest industry in Malaysia is in the agriculture sector of 39% (Utusan Newspaper, 2016). Hence, plant oil palm plantation need a place for processing, storage and collection before being sent to other manufacturing factories. Hence, every district or area with an oil palm plantation will have a processing plant and will result in truckloads coming in factories and estates to transport oil palm.

III. FINDINGS

The findings of this study will be presented in this section. The high wheel loads of heavy trucks are a major source of pavement damage by causing fatigue, which leads to cracking and permanent deformation, which produces rutting. Malaysia, as one of the developing country has high level of road pavement damage. Upon reviewing and analysing the articles, 48 factors have been extracted and employed on a frequent basis in prior researches.

Based on the table listed in ranking below, it can be seen that heavy vehicles rank on the first factor that affecting road damage in developing country. Followed by delamination, cracking and potholes in second rank (Felix Enigo, 2016). This damage is sometimes happening continuously in road especially during rainy season because it can lower the joint between road pavement and decrease the workability of the pavement (Srinivasa, 2013).

Table 1. Factors affecting road damage of developing countries

Factors	Fr	Factors	Fr	Factors	Fr
Heavy vehicle	8	Poor supervision	3	Old age of the road pavement	1
Delamination, cracking and potholes	7	Climatic effect	4	Damage to structure	1
Poor construction quality	6	Low quality materials in construction	2	Environmental condition	1
Rainy weather/heavy rainfall	5	Natural disaster	2	Mismanagement road by the government	1
Poor drainage system	5	Expansive subgrade soil	2	Flooding	1

From Table 1 above, heavy vehicle is the main factor influencing road damage in developing country (Zayyana, 2014). Developing country means a vibrant country with

development that lead to increasing of transportation used on road (Koch, 2011). Heavy vehicles such as big lorry and truck function on sending the goods at a place. The differentiation of types of vehicles will effect on the durability of the road pavement. Furthermore, construction of road will consider number of residents it certain places, so if a factory, industrial fields and plantation that involve transportation system.

The condition of the road infrastructure has severe impacts on the road safety, driving comfort, and on the rolling resistance. Therefore, the road infrastructure must be monitored comprehensively and in regular intervals to identify damaged road segments and road hazards (Jamil, 2013). Hence, the factors such as poor supervision, poor construction quality and low quality materials in construction need to be monitored times by times (Sultan, 2013). In certain time, road pavement can receive high load from vehicles due to the current situation in the area likes building construction, collection of oil palm tree and others.

The most important factors according to the table above are heavy vehicle, delamination, cracking and potholes followed by rainy weather/heavy rainfall intensity that defines the level of road damage in the country. The picture of road damages can be seen in diagram 1 and 2 below. For instance, the force majeure used to describe the act of god like flood, earthquake, but other studies put every one of them as separate factors, and others called them as national disaster (Michal, 2015). With the variety of the damage caused inconvenience for road users (Fatma Sarie, 2015). The maintenance needs of a road network can be predicted fairly accurately from a set of structural characteristics, such as age, climate, traffic, design standards, construction quality, and subsequent maintenance. Of these, age, traffic, and construction quality are of particular importance in the developing countries (Ali, 2016).



Fig. 1: Heavy vehicles using the road



Fig. 2: Potholes and cracking



Fig. 3: Cracking road



Fig. 4: During rainy days

From the developing countries research in past, heavy rainfall and rainy weather also play an important factor on road damaging. The rainfall intensity will define the level of road damage in the place (Rowland, 2006). Flood water and prolonged heavy rainfall are endangering road surface and impact on delamination, cracking and potholes (Tamilvanan, 2016). Stagnant water will reduce the strength of the bond between pavement.

In order to prevent and reduce road damage, this steps that can be taken into account are use applicable design of roads, avoiding unnecessary congestion of the roads with traffic especially heavy traffics that were not meant for the roads in the first place, prompt maintenance of the roads, application of suitable construction material in the construction of the roads, applying appropriate tests to the soil in road construction, use of qualified engineering personnel in road construction and the application of sanctions for highway failures (Ndefo, 2012).

The finds of this study can be considered as the most influencing factors that affecting the road in the developing countries as all of these factors have been extracted from the past studies from most of the different countries in the developing world, which the validity of this study comes from the validation of those studies. So these factors will be as a guide for researchers who is interested in the field to save time and resources, they only need to add the new factors or specific factors for specific project. The research is helpful in highlighting the end result, and in avoiding of these causes or

mitigating their effect during pavement design, construction of road, and maintenance through operation (Tarawneh, 2013).

IV. CONCLUSION

The literature review on road damage helps researcher to identify what had been discovered about the most influencing factors in road damage and to what extent the topics have been studied. This study reviews literature on road damages, focusing specifically on the factors that affecting the damage from others developing countries. These factors act as a set of guidelines that are needed by project participants for the successful and comprehensively implementation of risk management to achieve the projects objectives. 111 factors extracted from the literature review stage. 56 risk factors are the most extensively used in literature that affect construction projects of developing countries.

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