EFFECTS OF SURVEY AND ASSESSEMENT OF FLEXIBLE PAVEMENT: AN OVERVIEW REHABILITATION AND RECONSTRUCTION ALONG SERTI-MAISAMARI NGUROJE ROAD, TARABA STATE

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Abstract

This study focuses on effects of survey and assessment of flexible pavement along Serti-maisari Nguroje road. The road lies in the north eastern part of Nigeria in Taraba State. It is existing single carriage way which is federal road with total carriage length of 100+400m road width of 7.3m and 2.75m shoulder width. Visual inspection and conditional survey are methods used for data collection in this study for their relativity, appropriacy and effectiveness. As a case study, the effects of Serti-maisamari Nguroje road is selected for investigations due to some challenges commuters observed to be under-going vehemently. Comprehensive field work is conducted for existing pavement condition of this road. it is found out that must of the damaged sections suffers from severe cracking, depressions, rutting and various failure condition. From visual condition survey, discovery proves that there is no drainage even at the critical sections of the alignment. More to that, there is a significant proportion of heavy goods vehicles which might not been adequately considered during the design. Therefore, the effects could be attributed to fatigue, lack of timely maintenance, inadequate design and construction and improper pavement materials used. Based on the significant findings discover in this study, some useful suggestions are made as: rehabilitation/reconstruction method to be used at each of the chainage of the road. the rehabilitation/reconstruction of the road will ensure safety of the road users, free flow of traffic easy access for security personal, transportation of agricultural products and reduction of travel time.

Keywords: Survey, Assessment, pavement, Flexible Pavement, Rehabilitation, Reconstruction

INTRODUCTION

Highways constitute an essential mode of transportation. They offer individuals and vehicles to commute to a variety of areas and assist them in arriving at their destination without delay. The process of carrying products or people from one location to another via roadways is known as road transport. Roads and other modes of transportation play a major role in economic development and growth, as well as providing significant social benefits

Framework for evaluating a typical road pavement structure should incorporate asset functionality, technical applications, environmental effects, safety, economic and institutional considerations [1]. Over the years, it has been observed that road pavements constructed at the same time and subjected to similar traffic and climatic exposure perform differently. This responsiveness is as a result of varying conditions which may include assumptions in the designs, environmental conditions, approach, the type of pavement structures and maintenance system adopted. As the road pavement structures are open to traffic, their deterioration would start. At the early stage of the opening of the road to traffic, the rate of

deterioration is slow but deteriorates faster after a period of time. According to Hass et al. [2], poor road condition can make the maintenance cost to be 4 to 5 times higher than the initial cost of construction. Maintenance cost is also reduced when the road is in good condition. Studies have been carried out to determine the thickness of the base, subbase and subgrade materials by imposing an Equivalent Single axle load of 80KN on the flexible road pavement structure. This is to determine the structural responses such as stresses, strains and deformations generated on the multi-layered flexible pavement structures at different chainage points along the length of the road using Visual Basic program [3]. In pavement failures, excess moisture is the main cause of failure or a contributing cause. Queensland Transport [4] reported the effect of moisture content changes on the strength and stiffness of pavement materials. They found that excess moisture reduces the strength and stiffness of pavement materials, being worse for the subgrade material, than for the subbase or base. Excess moisture and particularly high degrees of saturation result in significant pore pressures within the material. Depending on the degree of saturation, failure may occur as any of rapid shear or bearing failure, premature rutting, lifting of wearing course due to positive pore pressures, or embedment of cover aggregate due to weak base [4]. It can be seen that for nearly all types of pavement failure, moisture is often the primary or a contributing cause of failure. As clearly seen in Plate 3, moisture entry through the surface may be caused by inadequate pavement surface drainage during construction, exposure of surface to rain during construction, or porous or open graded asphalt, [5]. He found moisture entry from the side may be caused by pondage in pits or poorly constructed surface drainage, and lateral movement of water into pavement. Other factors affecting the moisture in a pavement include the general drainage condition, such as the effectiveness of drainage structures, shoulder cross-fall and condition, longitudinal grade, and whether the pavement is constructed on cut or fill. Mubarak [6] investigated recently buildings and streets in old Omdurman City were noted to deteriorate. These deteriorations were attributed to the presence of penetrated water at foundation level, accumulated on impermeable strata of mudstone at shallow depths. She also noted this type of failure in major main roads. Several researches on the causes of flexible pavement failure, some of the various factors have been categorized. Evidence suggests that the most common cause of flexible pavement failure is attributed to the pavement materials, especially the soil. [7] suggested that attention should be paid to mixture of highway materials, to forestall flexible pavement failures. [8,9,10] blamed soil materials of inadequate strength for flexible pavement failures. Similarly, [11], deterioration of flexible pavements is primarily caused by traffic loads exceeding the limits considered during the design of such roads. Studies by [12,13] suggested that these frequent flexible pavement failures are certainly a function of poor design.

[14] The combined effects of traffic loading and the environment will cause every pavement, no matter how well-designed/constructed to deteriorate over time. Maintenance and rehabilitation are what we use to slow down or reset this deterioration process. Maintenance actions help slow the rate of deterioration by identifying and addressing specific pavement deficiencies that contribute to overall deterioration. Rehabilitation is the act of repairing portions of an existing pavement to reset the deterioration process. Reconstructing an entire pavement, however, is not considered rehabilitation but rather new construction because the methods used are generally those developed for new pavement construction.

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slow down or reset this deterioration process. Maintenance actions, such as crack sealing, joint sealing, fog seals and patching help slow the rate of deterioration by identifying and addressing specific pavement deficiencies that contribute to overall deterioration. Rehabilitation is the act of repairing portions of an existing pavement to reset the deterioration process. For instance, removing and replacing the wearing course in a pavement provides new wearing course material on which the deterioration [14]

OBJECTIVES OF THE STUDY

(a) . To investigate effects of flexible pavement along Serti-Maisamari Nguroje road
(b) . To provide an appropriate solutions for the effects of the entire road sections

LITRETURE REVIEW

SURVEY: This is an operation that involves assessing and recording details about a road or area of land. These observations can then be used to help plan construction projects. The main purpose of surveying in civil engineering is to determine dimensional relationships between different locations [16]. **Surveying**: is the science and art of making all essential measurements to determine the relative position of points or physical and cultural details above, on, or beneath the surface of the Earth, and to depict them in a usable form, or to establish the position of points or details. [19] **Surveying**: is the process of determining relative positions of different objects on the surface of the earth by measuring horizontal distances between them and preparing a map to any suitable scale [12]. Survey: this is an Engineering operation that involves assessing and recording detail of an area.

Assessment: The act or judging or deciding the amount, value, quality, or importance of something, or the judgment or decision that is made [7]. **Assessment:** systematic evaluation of an intervention its design, implementation and resulting outcomes both during implementation and most importantly afterwards [17]. **Assessment:** is a procedure utilized to check the adequacy, structural integrity and soundness of structures and their components [18]. Assessment is the process of evaluating the situation or quality of an object.

Pavement: this is the hard layer structure that forms a road carriageway, airfield runway, vehicle park or other pave areas [8]. **Pavement**: is an essential component of proper road construction. Its primary function is to allow for the steady flow of traffic, moderate load distribution, and allow for safe passage of vehicles and pedestrians alike. Even in asphalt parking lots [15].

Pavement is one type of hard surface made from durable surface material laid down on an area which is intended to carry vehicular or foot traffic. its main function is to distribute the applied vehicle loads to the sub-grade through different layers [2]. Pavement: this is a durable or hard surface used to transmit load to underlying layer.

Flexible pavements or roads are areas of asphalt that "bend" or "deflect" due to traffic loads, making them less susceptible to damage and requiring fewer repairs **over time**. [2]. **flexible pavement** structure is composed of several layers of different materials which together enable the road to accommodate this flexing. **Flexible pavement** is composed of a bituminous material surface course and underlying base subbase courses. The bituminous material is more often asphalt whose viscous nature allows significant plastic deformation [15]. Flexible pavement; this is a Bituminous or asphalt aggregates are used to apply this pavement. The structure of the pavement is designed to bend and deflect according to external

factors like traffic loads and the weather. Essentially, flexible pavement is more adaptable to the elements to which it's exposed.

Rehabilitation is the act of repairing portions of an existing pavement to reset the deterioration process. For instance, removing and replacing the wearing course in a pavement provides new wearing course material on which the deterioration[14]

Rehabilitation is defined as "a set of interventions designed to optimize functioning and reduce disability in individuals with health conditions in interaction with their environment [9]. Rehabilitation works is **the most comprehensive type of road project that Council undertakes**. It involves ripping up the bitumen seal, removing the top layer (pavement) of the road base and then stabilizing the subgrade below that. The pavement is then filled with new material and sealed with bitumen and stone [4]. Rehabilitation this is the act of renewing demerited road by maintaining its existing failures.

Reconstruction.

Reconstruction is completely redoing the asphalt pavement. This requires installing a new subgrade asphalt base and a top pavement overlay [14] Reconstruction. means the process of making an inactive or closed road useable, including reinstalling drainage structures, removing vegetation, and reinstalling other features [4]. Reconstruction means the maintenance, repair, or re-opening of pre-existing, non-drivable or abandoned road [9]. Its means of maintenance, repair, or reopening of pre-existing non drivable or abandoned road bed.

MATERIAL AND METHOD

The road start at Serti with existing of chainage 90+200 and terminates at Nguroje [chainage 190+600] with total carriage length of 106+600. Compressive conditional survey was carried out along the entire road. It was discovered that, different level of damages exists within the road, like pot holes, cracks, depression, rutting, loss of shoulder material, loss of subbase and sub grade materials and such has contributed to failure of some aspect of road sections where it makes it difficult to commuters.

Serval investigation were made and identified various Road failures as listed below:

- Transverse cracking
- Alligator cracking
- Longitudinal cracking
- Block cracking
- Pot holes
- Reveling
- Rutting
- Depression

Transverse Cracking

Courses of Transverse Cracking

a. reflection of shrinkage cracking
b. construction joints

Alligator Cracking

Causes of Alligator Cracking

a. Weakness in base, surface or sub-grade
b. Thinning of a surface course or base course
c. Poor Drainage
d. Excessive vehicular loads
e. Vehicle stopped for a relatively long period

Block Cracking

Causes Block Cracking

1. Use of improper mix
2. Fine aggregates mixed with low penetration asphalt
3. Poor asphalt binder
4. Ageing of asphalt
5. Temperature cycling

Longitudinal Cracking

Causes of Longitudinal Cracking

a. Pavement fatigue
b. Reflective cracking
c. Poor construction of joints

Potholes

Causes of Pot Holes

a. Pavement fatigue
b. Untreated alligator cracks

Raveling

Causes of Raveling

a. Excessively porous asphalt
b. The untimely placing of asphalt

Rutting

Causes of Rutting

a. Lateral movement or consolidation of consecutive layers under traffic load
b. Insufficient layer thickness
c. Lack of compaction
d. Improper mix

Depression

Courses of Rutting

a. Isolation Consolidation

b. Settlement of service trench of embankment
c. Volume change of subgrade


Raveling


Alligator Cracking


Longitudinal Cracking


Pot Holes/ Depression

RESULTS AND DISCUSSION

During conditional survey, different type of failure ware discovered at various chainages of the road. In this study is been classified in to two categories. The first category is known as functional failure, in this case the pavement does not carry it intended function without either coursing discomfort to the passengers or high stress to vehicles, but does not affect the underlying layer like subgrade, subbase and base course. The second known as structural failure, include collapse of pavement section of wash away of some section of pavement, which affect the subgrade, subbase base course and wearing course, this pavement section becomes incapable of sustaining the load impost on its surface and in most section of this road it becomes not motorable and sometimes is describe as failed section.

In summary this research is addressing pavement functional failure and structural failure as discovered during survey with rehabilitation and reconstruction methods respectively. [see table 1.0 and fig. RH and RC].

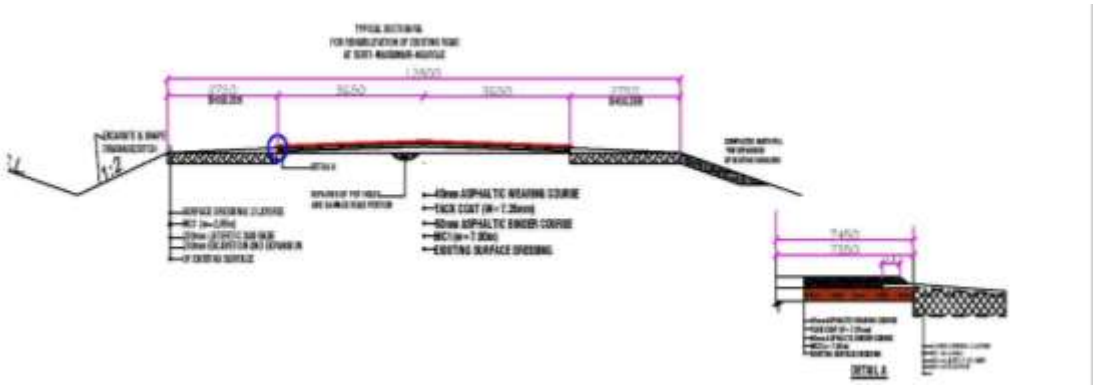
Reconstruction [RC] requirement: sit clearance and earth works, scarification of existing shoulders and carriage way, excavation of unsuitable materials. Provision of suitable approved lateritic materials as fill, 200mm thick naturally occurring lateritic materials as sub-base throughout the stretch, 200mm thick

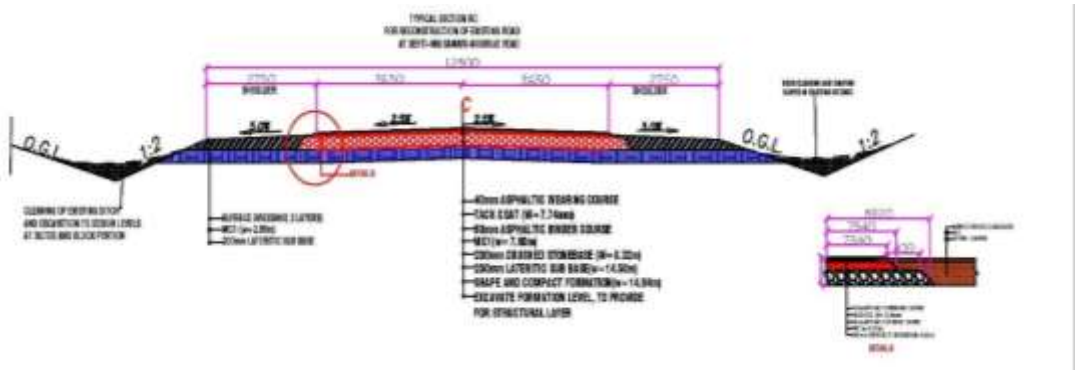
crutch stone base materials on the carriage way throughout the entire trench, 200mm thick lateritic base course on shoulders, 60mm thick asphaltic concrete binder course on the crush stone base, 40mm thick asphaltic concrete wearing course on the binder course, and 40mm thick asphaltic concrete wearing course on 2.75m shoulders.

Rehabilitation [RH] requirement: repair of potholes and damage sections, 60mm thick asphaltic concrete binder course on the crush stone base, 40mm thick asphaltic concrete wearing course on the binder course, and 40mm thick asphaltic concrete wearing course on 2.75m shoulders.

Table 1.0. Conditional Survey Results

SN	Chainages		Distance	Section	Remark Section
1.	90+200	100+600	10+400	RH	Pot holes, depression, rutting
2.	100+600	101+600	1+000	RC	Pot holes, cracks, failed section
3.	101+600	109+300	7+700	RH	Pot holes, depression, rutting, raveling
4.	109+300	110+300	1+000	RC	Pot holes, cracks, failed section
5.	110+300	115+800	5+500	RH	Pot holes, depressions raveling, absence of shoulders
6.	115+800	124+200	8+400	RC	Pot holes, cracks, failed section
7.	124+200	126+400	2+100	RH	Pot holes, depressions raveling, absence of shoulders
8.	126+400	127+600	1+200	RC	Pot holes, cracks, failed section
9.	127+600	130+400	2+800	RH	Pot holes, depressions raveling, absence of shoulders
10.	130+400	146+000	15+600	RC	failed section not motorable
11.	146+00	150+500	4+500	RH	Pot holes, depressions raveling, absence of shoulders
12.	150+500	152+800	2+300	RC	Pot holes, cracks, failed section
13.	152+800	153+900	1+100	RH	Pot holes, depressions raveling, absence of shoulders
14.	153+900	156+700	2+800	RC	Fail section
15.	156+700	160+000	3+300	RH	Pot holes, depressions raveling, absence of shoulders
16.	160+00	161+600	1+600	RC	Pot holes, cracks, failed section
17.	160+600	165+500	4+900	RH	Pot holes, depressions raveling, absence of shoulders
18.	165+500	190+600	25+100	RC	Pot holes, cracks, depression, failed section





CONCLUSION

Base on the outcomes of this study it is possible to argue that the effect of survey and assessment of flexible pavement have enamors damage on Serti-maisamari Nguroje road. Some of the effect discover in the work include, cracking, pot holes, depression and reverting. These have some serious damages contribute to complete failure of some chainages of the road section, which affect commuters, pave way for insecurity, increase travel time, high cost of vehicles operation and many more.

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