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EVALUATION AND ANALYSIS OF MATERIALS FOR REPAIRS OF POTHOLES: a case study of Calabar Metropolis

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ABSTRACT:

Roads are among the most pressing public needs in Cross River State which bring immediate and dramatic benefits to road users through improving access to Hospitals, Schools, and Markets; it also improves comfort, safety, and little vehicle operating cost. However, for these benefits to be sustained road improvements must be accompanied by a well-planned programme of maintenance, with a regular and rapid maintenance of roads. Five different locations within Calabar Metropolis were selected, and potholes measurement were carried out in the five areas namely, Housing Estate, Atimbo, Uwanse, Yellow Duke and Ediba Road and potholes scatter graph was plotted. The total volume of asphalt used for patching of the five locations was approximately 3.7 to 3.9 m^3. Potholes are typically 'repaired' by mostly unskilled or badly-trained teams on an ad hoc basis. The development of potholes and fatigue cracking for these different locations are as a result of thin bituminous surfacing and insufficient preventative maintenance which are dependent on the driving patterns and routine maintenance, the rate of speed, deceleration, and acceleration as well as the vehicle kinetics. This paper attempt to distinguish the primary role of road maintenance, like that of preserving the condition of our roads and its ability to carry the intended traffic. This paper also provides a guide to identify the causes of the problems of potholes in Calabar metropolis and reviews repair techniques relevant to the specific type and cause of each problem.

KEYWORDS*: Potholes, Metropolis, Hot-mix asphalt, Road Maintenance,Patching,*

I. INTRODUCTION

The existing road network in Calabar Metropolis is in a deplorable state,and the drainage system and the culvert, especially in the capital of Cross River State are worrisome and usually, found to be silted and then carrying runoff water to the road which destabilises the subgrade and base course which results in wearing away the asphaltic surface and also permits potholes on the road surface. Maintenance makes a crucial contribution to the economic developmental growth and brings substantial social benefits to the state. Roads are among the most critical public needs in Cross River State which bring immediate and dramatic benefits to road users through improving access to Hospitals, Schools, and Markets;and it also improves comfort, safety and low vehicle operating cost. However, for these benefits to be sustained road improvements must be followed by a well-planned programme of maintenance, with a regular and rapid maintenance of roads.Road maintenance also contributes to national development in the areas of employment generation, improved agricultural production, enhanced industrial growth and stimulate technological growth.

[2],assert thatwhen the asphalt pavements age deteriorates, there exist a need for corrective measures to rehabilitate safety and rideability rises.

[1],maintained that the underlying approaches of patching involve the replacement of materials that have been lost due to localised pavement distress or disintegration. The complete removal and replacement of continuous portions of failed pavement, or the application of a thin layer of hot mix asphalt(HMA) material over segments of pavement that exhibit more surface-related distress/distortion, [6].

According to, [5,2], they emphasizes that, once the stressed is patched, the distressed area is repaired or strengthened such that it can carry a significant traffic level with enhanced performance and lower rates of degeneration.

However, patching might be transient, semi-permanent, or continuing treatments. The suitable technique to be used depends on the traffic level, the time of the year during which the repair is carried out, the time until scheduled rehabilitation, and the availability of equipment and personnel, [6].

[1], reported that emergency repairs might require patching to be carried out during poor weather condition and usually patching is best done during clear, moderate weather.

In these instances, the durability of the patch is likely to be inadequately, and the patch should be considered to be temporary. However, it is a good strategy to plan for a more semi-permanent repair of these areas when moderate weather conditions prevail [6, 3].

Potholes are the form of a disintegration of the pavement that might be associated with inadequately compressed material, ravelling, cracking, base failure or aging of the pavement.

Accordingly, [1, 4], observed that potholes often appear after rain or during flow periods when pavements are weaker.

If water infiltrates the surface layers of the asphalt, it softening the underlying pavement layers, which increases deflections and the fines aggregates from the underlying pavement layers are lost, reducing overall structural strength and support for the pavement surface.

11. Materials and Methods for Patching of Potholes

The affected road pavement area is habituallycut to a regular shape withan asphaltic cutting machine. Usually, an offset of 15cm is used in getting a proper shape as shown in figure 3 below. The boundaries of the distressed area are marked. The repair edges are usually as square as imaginable and take into consideration the dimensions of the equipment that will be utilised for the replacement of the old material and compaction of the new material.

The affected pavement sides of the hole are square up, to provide sound pavement. This method is frequent, and incredibly very ease if the edges of the patch area were cut with a diamond saw or stabilised with cold milling equipment, [6]. It is only required when manual techniques of material removal are employed. It is recommended that the depth of the patch be 50% thicker than the thickness of the failed layer [6].

Apply a tack coat of asphalt emulsion to the sides and bottom of the hole at a rate of approximately 1 litre/m^2 of slow or rapid setting emulsion. The tack coat should either be sprayed or brushed on the edges of the repair, never poured.

The patch material is usually placedin the hole, and if the patch is placed manually, a shovel is preferable instead of rake, to place the HMA material taking care to avoid segregation. The hole is ordinarily overfilled by 20 to 25 percent of its depth to provide adequate material for compaction. An asphalt rake is normally used to feather or blend the patch edges, and the patch material is typically compacted with a hand device or a small vibratory roller. It is preferable to use compaction equipment whose surface is smaller than the size of the patch.

It is tough to achieve satisfactory compaction with material that bridges the repair area. The finished patch is approximate, 3 to 6 mm crown [6].

Semi-permanent—Water and debris are removed from a hole, the edges are squared up, and cold patch corporeality is placed in the hole and compacted by rollers or vibratory compactors.

Spray Injection—Water and debris are piped out of a pothole, fresh bitumen and aggregate are spattered into the pothole, and a thickness of aggregate is placed on top of the patch.

All hard surface pavement types are categorized into groups; Flexible and Rigid Pavements as shown in figure 1.

Flexible pavements: They are pavements which are the surface with bituminous (Asphalt) materials. Such as bituminous surface treatment (BST) found on low volume traffic roads.

Rigid Pavement: They are sidewalks usually made of cement concrete and may or may not have a base course between the surface and sub-grade. They are found on high volume traffic and evacuation roads for heavy goods and equipment.

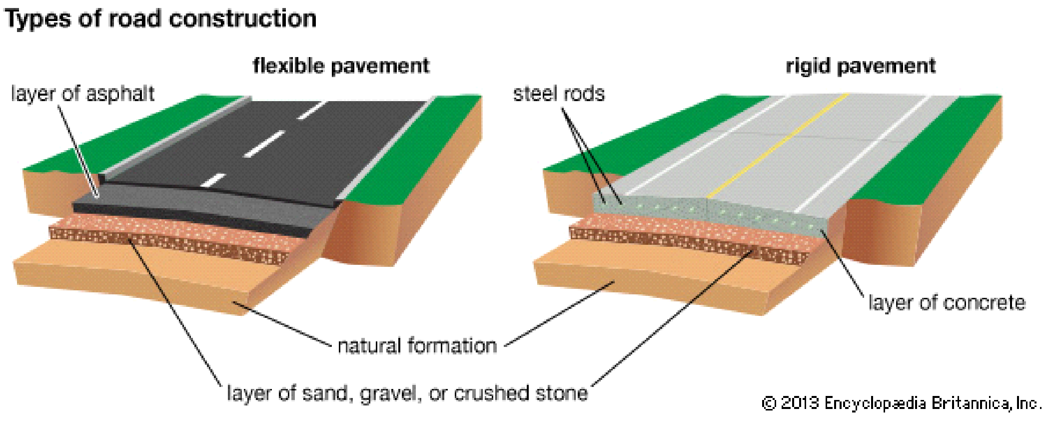

Fig.1Types of road construction

Fig 2.Development of potholes and fatigue cracking on a low-volume road with thin bituminous surfacing and insufficient preventative maintenance

Fig.3 Cutting and patching of affected road pavement

111.Results and discussion

Table 1 State Housing Estate Road Measurement

S/N	*Length (M)*	*Width (M)*	*Area (M^2)*	*Volume (M^3)*
1.	*1.2*	*3.6*	*4.32*	*0.1728*
2.	*2.5*	*1.8*	*4.50*	*0.1800*
3.	*1.6*	*2.5*	*4.00*	*0.1600*
4.	*2.5*	*1.8*	*4.50*	*0.1800*
5.	*1.8*	*3.9*	*7.02*	*0.2808*
6.	*4.1*	*3.2*	*13.12*	*0.5248*
7.	*3.7*	*3.1*	*11.47*	*0.4588*
8.	*1.4*	*0.9*	*1.26*	*0.0504*
9.	*0.9*	*2.2*	*1.98*	*0.0792*
10.	*1.4*	*1.6*	*2.24*	*0.0896*
11.	*1.5*	*1.5*	*2.25*	*0.0900*
12.	*0.9*	*3.6*	*3.24*	*0.1296*
13.	*3.2*	*3.6*	*11.52*	*0.4608*
14.	*1.7*	*1.9*	*3.23*	*0.1292*
Total Volume of Asphalt used				*2.804*

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Table 2 Atimbo Road Measurement

S/N	Length (m)	Width (m)	Area (m^2)	Volume (m^3)
1.	1.2	2.3	2.76	0.1104
2.	0.9	1.4	1.26	0.0504
3.	0.8	0.9	0.72	0.0288
4.	4.2	2.1	8.82	0.3528
5.	1.3	1.7	2.21	0.0884
6.	2.1	0.7	1.47	0.0588
7.	0.8	0.9	0.64	0.0256
8.	0.5	0.9	0.45	0.018
9.	1.2	1.3	1.56	0.0624
10.	2.3	1.5	3.45	0.138
11.	1.4	1.1	1.54	0.0616
12.	0.7	0.9	0.63	0.0252
13.	3.1	1.7	5.27	0.2108
Total Volume of Asphalt used				1.2312

Table 3 Uwanse Street Measurement

S/N	Length (M)	Width (M)	Area (M^2)	Volume (M^3)
1.	3.2	1.9	6.08	0.2432
2.	0.9	2.3	2.07	0.0828
3.	1.5	4.2	6.3	0.252
4.	3.4	2.1	7.14	0.2856
5.	3.1	1.6	4.96	0.1984
6.	1.2	1.2	1.44	0.0576
7.	2.4	5.6	13.44	0.5376
8.	3.6	1.2	4.32	0.1728
Total Volume of Asphalt used				1.83

Table 4 Yellow Duke Street Measurement

S/N	Length (m)	Width (m)	Area (m^2)	Volume (m^3)
1.	5.3	3.4	18.02	0.7208
2.	4.3	1.3	5.59	0.2236
3.	4.5	2.1	9.45	0.378
4.	1.2	0.8	0.96	0.0384
5.	3.2	1.7	5.44	0.4968
6.	5.4	2.3	12.42	0.4968
7.	3.4	2.1	7.14	0.2856
8.	4.5	3.7	16.65	0.666
9.	4.7	1.3	6.11	0.2444
10.	2.5	1.0	2.5	0.1
Total Volume of Asphalt used				3.6504

Table 5 Ediba Road Measurement

S/N	Length (m)	Width (m)	Area (m^2)	Volume (m^3)
1.	1.2	0.8	0.96	0.0384
2.	4.5	2.1	9.45	0.378
3.	4.3	1.3	5.59	0.2236
4.	5.3	3.4	18.02	0.7208
5.	7.8	2.4	18.72	0.7488
6.	3.6	1.2	4.32	0.1728
7.	2.4	5.6	13.44	0.5376
8.	1.2	1.2	1.44	0.0576
9.	3.1	1.6	4.96	0.1984
10.	3.2	1.9	6.08	0.2432
11.	0.9	2.3	2.07	0.0828
12.	1.5	4.2	6.3	0.252
13.	3.4	2.1	7.14	0.2856
Total Volume of Asphalt used				3.9396

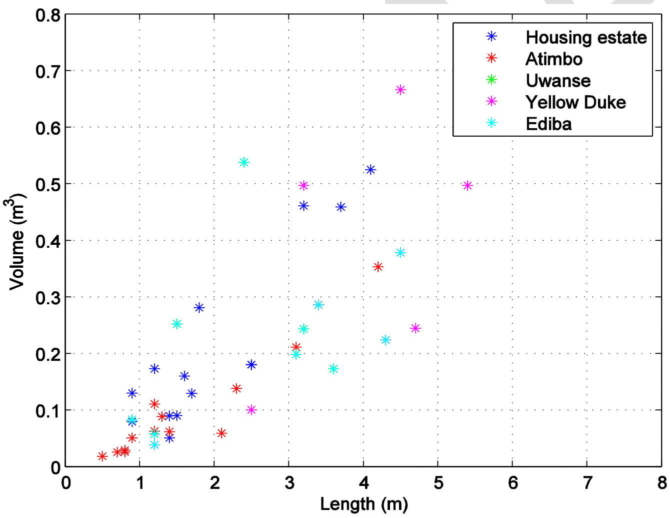

Fig. 4 illustrate scatter plot of potholes measurement of Calabar Metropolis

II. RESULTS AND DISCUSSION

Five different areas within Calabar Metropolis were selected a potholes measurement were carried out in the five areas. Namely, Housing Estate, Atimbo, Uwanse, Yellow Duke and Ediba Road andpotholes scatter graph were plotted as shown in figure 5. The estimated total volume of asphalt used for patching of Yellow Duke Road and Ediba Road were approximately 3.7 to 3.9 m^3 compared to others locations. It was observed that the volume of asphalt used in the patching of potholes in Ediba road was high compared to others location as shown in Table 5. Due to the nature of the existing drainage system and culvert in this location which is usually found to be silted and then carrying runoff water to the road which destabilises the subgrade and base course which results in wearing away the asphaltic surface and also permits potholes on the road.However, Periodic Maintenance should be carried out to covers activities on a section of the road at regular and relatively long intervals, which must be aimed at preserving the structural integrity of the road and these operations tend to be large scale, requiring specialised equipment and skilled personnel.The periodic maintenance is very profitable compared to routine maintenance work which required accurate identification and planning for implementation, and the design activities can be classified as preventive resurfacing, overly and pavement reconstruction. This involved resealing and overlay works that areinitiated in response to steady deterioration in road conditions.

III. CONCLUSION:

Potholes are typically 'repaired' by mostly unskilled or badly-trained teams on an ad hoc basis, quite some time after formation, thus leading to additional deterioration. The patches are seldom sufficient to address the underlying cause of the problem, and this usually results in the need to return to the site repeatedly for ongoing repairs. This paper provides a guide to identify the causes of the problems of potholes in Cross River State and summarizes repair techniques relevant to the specific type and cause of each problem. The aim is to minimise the need to return continually for additional repairs. A standard field rating form is provided to assist in the classification of the type of pothole and associated repair requirements. Future work to extend this analysis of the capital cost, the effect of maintenance cost and mathematical modeling of the remote causes of potholes formation.

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