

Optimizing Post-Construction Lifeline of the Nigerian Road Network System: Failures and Causes, Preventions and Remedies

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Abstract: The growth and progress of any nation can be measured to a large extent by its socio-economic development and these largely depend on its road network system and as such, the development and management of roads have always been topical issues of discourse in developed and developing countries of the world. During the oil boom years of the seventies, a period of unprecedented road construction was witnessed in Nigeria to such an extent that road transport now accounts for 80% of passengers and goods movement in Nigeria. However, 85% of the approximately 200,000 km Nigerian road network is now in a deplorable state and as such, this calls for drastic actions to be taken, part of which is to declare a state of emergency on the road network system in Nigeria. This study discusses road network system failures and their causes, preventions cum remedies for total recovery.

Key words: Road maintenance, failures, prevention and remedies

INTRODUCTION

It is estimated that over 10 billion Pounds Sterling are spent annually on roads in developing countries by Smith^[1]. In Nigeria for example, about 4.44 billion Naira is spent annually on direct labour allocation for minor road maintenance through the Federal Roads Maintenance Agency (FERMA). This excludes rehabilitation/major maintenance and development of new roads described by Eyo^[2]. This amount is justifiable and should in fact be urgently and drastically reviewed upwards on the ground that Nigeria road network system which was about 200,000 km in year 2000 with a value of about 1.85 trillion Naira is indeed, one of the nation's single largest asset by Idowu^[3]. More importantly the road network system of any nation is the commercial nerve that fosters socio-economy by Oke^[4]. For example, when we have good roads, higher GND and GDP are achieved, since less money is spent on the rehabilitation of such. In the same vein, the per capita income is improved upon since expenditure will now be relatively lower to the income of the nation. By virtue of good road network system as well, the vehicle per capita is greatly reduced, as the demands for new vehicles will be low, so far the old ones are still in good order. Good road network system will ensure the effective distribution of economic activities. Apart from these, a good road network system will bring about a decrease in cost of living and thus enhance the standard of living of the populace, since people will have goods and services delivered to them at reduced cost. Good road network system brings about enhanced export-import ratio, improved agriculture and

industrial production, access to social amenities, improved communication system, reduced unemployment rate, enhanced tourism, easy access to health care delivery services, reduced road traffic accidents and among other things the uplift of the nation's educational standard and cultural values.

The implication of these is that a nation is at the risk of serious underdevelopment when the road network system is in a bad state. This clearly defines the state of Nigeria as 60% of the about 200,000 km of the road network system is in a bad state, while only 25% of the network could be rated as fair, just 15% of the network could be passed as good. Table 1 and 2 show respectively the breakdown of the Nigerian road network system and the current condition and use of the road network.

Table 1: Breakdown of the road network system in Nigeria Idowu^[3]

	Federal roads	State roads	Local Govt. roads	Total
Paved roads	26500	10.400	-	36.900
Unpaved main roads	5.600	20.100	-	25.700
Urban roads	-	-	21.900	21.900
Main rural roads	-	-	72.800	72.800
Village access roads	-	-	35.900	35.900
Total percent	32.100	30.500	130.600	193.200
	17%	16%	67%	100%

Table 2: Current condition and use of the Nigerian road network system in % Idowu^[3]

	Good	Fair	Poor	Share of Network	Use of the Network (Vehicle/km)
Federal	50	20	30	17	50
State	30	30	40	16	25
Local	5	20	75	67	25

This situation calls for drastic and urgent measures to be taken since the importance of the road network system to the socio-economy development of any nation cannot be overemphasized.

This study thus looks into road network system failures and their causes in Nigeria, the means of preventing the occurrence of such and the remedies to the current deplorable condition of the Nigeria road network system.

Road network system failures: The road transport network system of any country plays a vital role in its economy and the physical condition of the infrastructure is critical. To an unsuspecting lay man, a road has failed when it is impassable. While this is true, it must however be noted that it is not necessarily a condition for adjudging a road as failed, rather, a road has failed when there are defects on the road surface and as well the pavement structure. A classical example of a failed road that readily comes to mind from a technical point of view is the lagos-ibadan expressway. Though this road is still open to traffic 24/7, the diverse forms of defects of varied magnitude and proportion that are plaguing the entire length of the road are alarming. This situation depicts what is prevalent in other parts of the Nigerian road network system. Some of these defects are briefly discussed in the succeeding section.

Road defects and their causes: Petts^[5] and Research and Development Division Highways Department^[6], identify some of these defects as bleeding, cracks, ruts and

depressions, edge subsidence and rutting, edge damage, joint sealant defects, spalling, local aggregate loss, potholes and shoving. Fig. 1 depicts some of these defects, while Fig. 2 depicts well maintained road. These defects and their causes are briefly highlighted thus:

Bleeding: This may involve a part or the whole of the road surface. It normally results from too much binder and unsuitable binder. This ultimately causes among other things slippery road surface when wet and a separation and break away of surface layer under the action of traffic.

Cracks: These could occur in both the road surface and in the pavement structure. They could be slippage, block, longitudinal (i.e. parallel to the centre line and often along the wheel tracks or along the edges of the surfacing), transverse (i.e. perpendicular to the road direction and normally cuts across the whole or part of the cross section), or mesh/crocodile (i.e. intersecting cracks dividing the pavement surface into isolated elements of different sizes down to the small elements involved in crazing). The main causes of these types of defects are poor quality materials, poor workmanship, insufficient pavement thickness for the traffic being carried, shrinkage and pavement age, they could lead to a general or isolated destruction of the pavement.

Ruts and depressions: These usually occur along the wheel tracks of vehicles (ruts) and in some cases local areas (depressions). The main causes of these defects are insufficient foundation of pavement strength for the

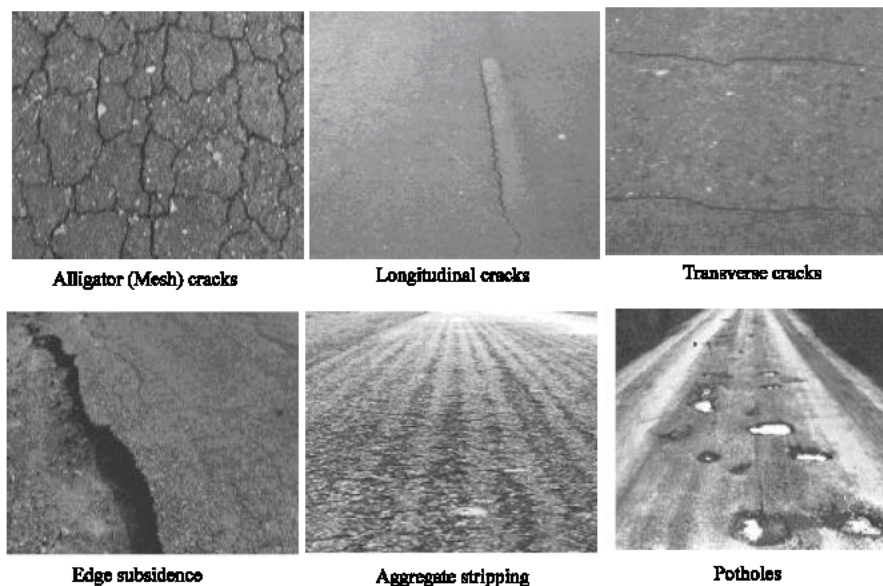


Fig. 1: Some common road defects



Fig. 2: Well maintained roads

traffic being carried and inadequate stability of the bituminous surfacing materials. When these defects are left unattended to, water easily penetrates into the body of the pavement, which consequently leads to rapid increase in the degree of rutting. This eventually results in cracking and break-up of the pavement.

Edge subsidence and rutting: These occur along the edges of the pavement where it borders unsealed shoulders. The main causes of these defects, which may lead to disintegration of the edges of pavement during the rainy season, are: inadequate or badly maintained shoulder, penetration of water into the pavement structure or foundation and resulting loss of bearing strength, poor drainage and narrow carriageway.

Edge damage: This is the disintegration of the pavement structure along the edges of the road pavement. This problem is normally caused by shoulder wear, eroding action of runoff, insufficient compaction of the edges of bituminous pavements and narrow carriageway.

Local aggregate loss: This occurs due to loss of surface aggregate principally because of insufficient binder due to faulty spray jet, aggregate dirty when laid, insufficient penetration of aggregate and poor premix quality or workmanship. The culminating effect of this defect could be minor stripping, fretting or streaking.

Potholes: These often occur in areas showing cracks, deformation or aggregate loss. Use of marginal materials for construction of the pavement, water infiltration, breakaway of material under the action of traffic and final stage in the development of crazing or of a depression, are the main causes of these defects. Progressive enlargement of the hole and formation of additional potholes develop when such potholes are neglected.

Shoving: This is a defect of both the road surface and pavement structure. This usually occurs on either side of the wheel tracks and the irregularities are usually associated with deformation and subsidence. The main causes of this defect are; ingress of water which impairs bearing capacity of the pavement, poor quality materials, poor constructional practices and passage of vehicles which are too heavy for the pavement structure. The result is that, weak materials are forced up as deformation occurs and this is coupled with progressive disintegration of the pavement.

Spalling: This is a condition where distinct, usually angular pieces of concrete have flaked (cracked), or are showing a tendency to flake from the concrete surfaces. This occurs usually at joints, edges, corners of forms directly over reinforcing steel particularly when the steel has inadequate cover. Spalling can have a variety of causes and unless rectified is likely to impair the effectiveness of the joint seal. This will allow water and detritus to enter the joint which in turn may lead to further deterioration so that both the functioning of the joint and riding comfort will be adversely affected.

Reasons for deplorable condition of the nigerian road network system: The alarming decline in the condition of the road network system of Nigeria is due to a combination of factors:

Network and traffic: There have been large increases in the lengths of road networks in Nigeria. At independence, the total length was 67.704 km, by 1972 it had increased to 96,000 km and in 2000, it was already 200.000 km by Idowu^[5]. Roads built at the beginning of the post colonial period tended to be designed for a 20 year life, whereas, because of financial constraints, roads built more recently have been designed for only 10 year denoted by Robinson^[7], World Bank^[8]. This has resulted in many

roads coming to the ends of their lives at the same time, thus, increasing the need for reconstruction. Traffic growth over this period has been rapid too and deterioration has been accelerated because of the large numbers of overloaded vehicles.

Funding: In the years gone by, available funds have been invested on less profitable investments both in the road sub-sector and elsewhere. Furthermore, funds meant for maintenance are most of the time subsequently diverted to non maintenance projects. Idowu^[3] to this end noted that, only 5% of the fund requirements for road maintenance are usually made available for such demanding tasks and even this meagre allocation might not be released to time as the rigid civil service procedures and bureaucracy are bound to slow down budgetary procedure. Another problem is that funding, is often irregular which makes planning difficult and uncertain^[7,8].

Efficiency: The prevalent situation in the country suggests that, even if funding levels were reviewed upwards, the level of maintenance that could be carried out would still be limited because of inefficiencies in maintenance. Idowu^[3] recorded that there are about 600 maintenance organisations in the country. Most of these organisations are bedevilled by large labour force, which are unproductive because of poor management, lack of training, lack of incentives and lack of resources to carry out maintenance. This has been compounded by the failure to establish priorities both by governments and the maintenance authorities. There seem to be cultural difficulties resulting in lack of discipline and the wish to do a good job and worse still, supervision is normally absent or ineffective. These give room for non adherence to proper engineering and procurement procedures, resulting in low quality, high cost works. Poor attitudes to maintenance are sometimes displayed by politicians, planners and engineers who often prefer to be associated with glamorous construction projects rather than the day-to-day problems of maintenance. A good example of this is the upgrading of the Lagos-Ibadan expressway from two lanes to three, while the existing pavements are crying for urgent attention. Maintenance is normally carried out by public sector (FERMA) which because of lower salaries and lack of ability to pay incentives, often finds it difficult to attract and retain quality staff. Lack of continuity in government also often leads to frequent changes in staff. Equipment availabilities have been found to be generally very low as well due to high costs of such^[7]. Also attributable to this is the absence of structural mechanism for enabling the public to express

concern on the management of road services undertaken. The synergy of these highlighted problems ultimately results in low output/inefficiency and most of the time, the few activities of the maintenance agencies are only based on reactions to crisis.

Prevention of road network system failure and remedial measures for recovery: Though there are still some technical problems associated with road failure in Nigeria, but the bulk of the problems are managerial rather than technical. The bane of the road network system is primarily one of getting the right personnel, materials and equipment on to the right piece of the road to carry out the remedial or preventive work at the right time. However, there are several areas where improvements could be achieved in order to lessen the burden of road network system failure in Nigeria.

Network optimization: In order to drastically reduce the annual loss of the network, a sustainable financing system should be put in place. This could be achieved by cutting back on the amount of new construction and improvement that government undertakes. The funds saved from this action should thus be expended on preventive and periodic maintenance. Any funds available after this changeover should be used for reconstruction of pavements that have failed due to lack of maintenance. New construction and improvements should normally follow only after the above are done satisfactorily. Also, reasonable interventions that will assist in restoring the road network to a good condition such as reallocation of funds from new investments to maintenance could be given a consideration. However, if resources are not enough to constantly maintain the present road network system, it is better to abandon some parts of the network, while available funds are invested on those of priority, else continuing deterioration throughout the entire network is inevitable.

Also, it is obvious that the problem of pavement damage is compounded further by overloaded vehicles. In Nigeria, over loading is rife and thus, its control would reap significant dividends in terms of road maintenance savings. As such, the control of vehicle dimensions on imports should be looked into. There are many vehicles plying our roads, which normally are illegal in the developed countries because they possess insufficient number of axles to spread the loads on the road.

Financing: Adequate funds to finance maintenance and to support commitment of foreign exchange resources are very essential, since failure to carry out routine/recurrent maintenance may require periodic maintenance which is

ten times more costly. Failure to carry out periodic maintenance at the appropriate time soon leads to the need to carry out road strengthening which is three times more costly than periodic maintenance. If this strengthening is not carried out soon enough, major deterioration sets in and rehabilitation will be required which is up to fifteen times more costly than periodic maintenance,^[9]. Clearly, there is considerable economic benefit in carrying out appropriate maintenance at the right time as deferring works results in a rapid escalation of costs most especially in areas such as Nigeria that are subject to high rainfall.

In addition to the transfer of funds from other sectors, there is scope for better cost-recovery through taxation to increase funding. Consideration should be given to the use of earmarked taxes or road funds (from road user charges, toll collection etc) to ensure adequate funding as well. The organized private sector should be mobilized for financing road development and maintenance in a similar approach used for revamping the communications industry.

Efficiency: there is need to strengthen management at all levels and to provide management training/retraining in order to maximize efficiency of maintenance operations. Coupled with these, staff of maintenance outfits should be adequately reimbursed and provided with incentives to perform. The payment of productivity bonuses should be introduced in the same way as is common on new construction projects.

The engagement of the private sector in these activities too will naturally enhance efficiency, most especially when it comes to periodic maintenance. This could be achieved under the auspices of Build Operate and Transfer (BOT), Maintain Operate and Transfer (MOT) and Build Operate and Own (BOO), as against concessions for the collection of road toll for rehabilitation and maintenance. In the same vein, the labour intensive (direct labour) approach which is already being used for road maintenance in the country should be intensified, since it requires little or no element of foreign exchange, however this demands greater need for management skills.

The lack of machineries and equipment is a factor that must be given a close shave too. The use of commercially-based hire charge systems would likely inculcate greater cost-consciousness and efficiency. When a plant hire organisation is self dependent through revenues generated from hiring, there will be strong incentives to keep plant serviceable at all times.

More importantly, there is need for individual responsibility and cost-accountability at all levels. Many thanks that the present government has put in place watch dogs/regulatory bodies such as Failed Contracts Tribunal, ICPC, EFCC and the Due Process Policy, to curb financial recklessness in the country. The searchlight of these bodies should cover activities going on in the road network system of Nigeria. This will go a long way in ensuring that our roads are in good shape all the time.

CONCLUSION

The bulk of the problems responsible for the present failures on the Nigerian road Network System are managerial rather than technical. They are primarily one of getting the right personnel, materials and equipment on to the right piece of the road to carry out the remedial or preventive work at the right time.

Thus, while the management of FERMA should be reorganised such that it will be proactive in nature and better prepared to effectively handle present enormous challenges of road revamping, the federal government should establish an autonomous road board which will consist of stakeholders in roads, representing users and major private sector and government organizations with an interest in good roads. In addition, a Road Fund should be created and this should be funded through tolls and other related taxes. The Road Board, under which Ferma will be operating, will be made responsible for maintaining and rehabilitating the existing road network in accordance to acceptable standards. This board should be charged with the responsibility of overseeing the administration of the Road Fund, management of road concession contracts, development of traffic management strategies, development of road safety standards, monitoring of programme execution, reviewing of road sector policies and recommending adjustments to Government as and when required.

In addition to these, the development/revamping of other means of transportation should be critically considered, as this will lessen the ever increasing traffic burden on our roads. For example, the resuscitation of the Nigerian Railway System should be rigorously pursued.

REFERENCES

1. Smith, H., 1998. Recycling of bituminous road materials, DFID Transport Newsletter, London.
2. Eyo, T.B., 2004. Retre: A readop package of commencing pavement recycling and donating asphalt recycling equipment to ferma, Readop 4, 29 , Ferma, Abuja.

3. Idowu, Y.A., 2000. Paper on road vision in the new millennium, ASCE-Nigeria International Group Monthly Technical Paper Presentation, Ikeja, pp: 1-8.
4. Oke, O.L., 2002. Pavement Recycling: A Perpetual pavement concept for sustainable development in Nigeria, an Unpublished M.Sc. Seminar paper, Department of Civil Engineering, University of Ibadan, Ibadan .
5. Petts, R.C., 1994. International road maintenance handbook, ODA and TRL, UK, 3: III-I – III-25.
6. Research and Development Division of Highways Department, 1992. Catalogue of Road Defects, Publication No. RD/GN/015.
7. Robinson, R., 1987. A view of road maintenance and policy in the third world, A study Presented at the IRF Executive conference on the Management of Road Maintenance, Arizona, pp: 11-27, 1-18.
8. World Bank, 1981. The road maintenance problems and international assistance, World Bank, Washington DC.
9. Faiz, A. and C. Harral, 1987. The road deterioration problem of developing countries: The Magnitude and Typology of the Problem, TRB, National Research Council, Washington DC.