



# NBRRI

NEWSLETTER

Vol. 2, No.1, June 2013

The Quarterly Newsletter of the Nigerian Building and Road Research Institute

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# NEW NBRRI PUBLICATIONS

**NBRRI REPORT  
No. 28**

DESIGN & FABRICATION OF CUBE, BEAM MOULDS AND SLUMP CONE APPARATUS

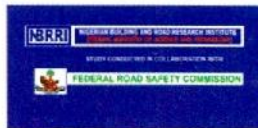


**NBRRI REPORT  
No. 28**

DESIGN & FABRICATION OF CUBE, BEAM MOULDS AND SLUMP CONE APPARATUS; 14pp

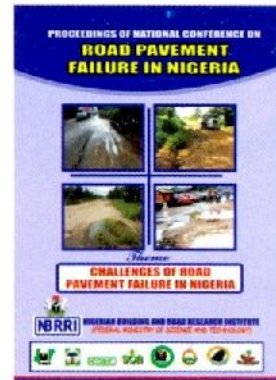
**NBRRI REPORT  
No. 31**

ASSESSMENT OF SPEED TRENDS DURING DAY-TIME AND NIGHT-TIME OF NIGERIAN DRIVERS: A CASE STUDY OF ABUJA METROPOLIS



**NBRRI REPORT  
No. 31**

ASSESSMENT OF SPEED TRENDS DURING DAY-TIME AND NIGHT-TIME OF NIGERIAN DRIVERS: A CASE STUDY OF ABUJA METROPOLIS; 60pp



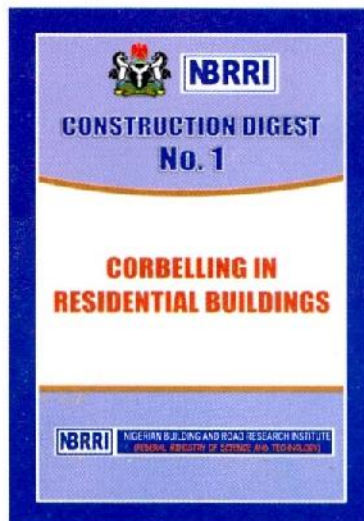
**PROCEEDINGS OF NATIONAL CONFERENCE ON  
ROAD PAVEMENT  
FAILURE IN NIGERIA**

*Theme:*  
CHALLENGES OF ROAD PAVEMENT FAILURE IN NIGERIA

## NBRRI introduces "CONSTRUCTION DIGEST"

The Nigerian Building and Road Research Institute (NBRRI) has introduced a new technical publication christened NBRRI CONSTRUCTION DIGEST to service the Nigeria construction industry and to encourage scholarly discuss on various trending issues in the construction industry.

The *NBRRI Construction Digest* is designed to be an umbrella publication for sharing and disseminating technical information and knowledge on topical issues in the construction industry in the local and international construction arena. The areas of coverage span all disciplines of the built environment such as Civil Engineering, Geotechnical Engineering, Traffic Engineering, Highway Engineering, Geology, Transportation, Structural and Bridge Engineering, Building, Architecture, Quantity and Estate Surveying, Road Construction, Maintenance and Safety, etc.



Papers for the NBRRI Construction Digest are expected to be technical in content, original in scope and scholastic in presentation; in the form of technical discourse, critique, reviews, original works, etc. on topical issues such as on alternative construction materials, technologies and innovations; product improvement; new trends in the construction industry including construction processes and practices; R&D in the construction industry; construction and road safety; etc.

The NBRRI Construction Digest is another publication that complements existing NBRRI publications such as NBRRI Technical Reports which provide information on R&D activities in the Institute; Seminar Proceedings and the quarterly NBRRI Newsletter. The maiden *NBRRI Construction Digest No. 1* has been published.

## EDITORIAL

*NBRRI Annual Conference has come to stay!* In 2011, the management of NBRRI commenced a new experiment with the commitment to organize Annual Conference on topical issues in the construction industry. The aim was and still is to bring to the attention of stakeholders in the construction industry and the general Nigerian public, NBRRI achievements and topical issues relevant to the Nigerian construction industry. Between 2011 and 2013, NBRRI successfully held its Annual Conference in May of every year.

In 2011, the Conference was tagged NBRRI STAKEHOLDERS FORUM and had its theme on *Bridging the Gap between Building & Road Research and Stakeholders*. The Conference focused attention on addressing the re-engineering of NBRRI to service the construction industry more effectively. In 2012, the Conference which had its theme on *Curbing the Incidences of Building Collapse in Nigeria* focused attention on the hydra-headed challenge of building collapse in Nigeria.

In 2013, the Conference had its theme on **Challenge of Road Pavement Failure in Nigeria**. This year's Conference focused attention on the challenges of the unacceptable and poor state of Nigerian roads and the negative impact on Nigeria's socio-economic development. Just like in the previous two editions, the Conference which took place between May 7<sup>th</sup> and 9<sup>th</sup> 2013 in Abuja was a huge success, as the objectives were largely achieved. The

Conference was highly interactive and was well attended by a cross-section of Stakeholders from the construction industry, academia, professional bodies and associations, technocrats, the National Assembly, the Federal Ministry of Works, Federal Road Maintenance Agency, Federal Road Safety Commission, National Emergency Management Agency, the Transport Research Laboratory UK, Dupont from South Africa, and a host of others.

As a result of the current and poor condition of Nigerian roads and the critical relevance of good road infrastructure in fast tracking the attainment of the Transformation Agenda of President Goodluck Ebele Jonathan, GCFR to achieve the desired socio-economic development of Nigeria, *NBRRI Newsletter* decided to dedicate this edition of the Newsletter to the *Challenges of Road Pavement Failure in Nigeria*. Consequently, the highlights of the 15 papers presented at the Conference are featured in this edition. This is without prejudice to the Proceedings of the full papers which is currently in press. The Communiqué of the Conference which has been circulated is also featured. This edition, which can be aptly tagged *ROAD PAVEMENT Edition* is not only informative, but educative and agitates the mind to the need to, individually, collectively, as Government or private organizations, pull efforts and resources together in addressing the challenge of road failure in Nigeria. It promises to be an interesting read..... Welcome on board and read on.

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*All coresspondence to the  
 Director-General/Chief Executive*

### NBRRI (VISION, MISSION & CORE VALUES) BUILDING CAPACITY & SETTING THE PACE IN INDIGENOUS CONSTRUCTION TECHNOLOGY DEVELOPMENT VISION

To evolve and use a comprehensive and integrated approach in appropriate technology development and transfer, sustainable capacity building and investment promotion.

So as to foster the application of environment-friendly and energy-efficient innovation construction materials, manufacturing technologies and cost-effective building and road construction practices.

Which will enhance job-creation, wealth generation and poverty reduction as well as nurture the emergence of vibrant, knowledge-based and highly competitive indigenous construction companies capable meeting global standards.

### MISSION

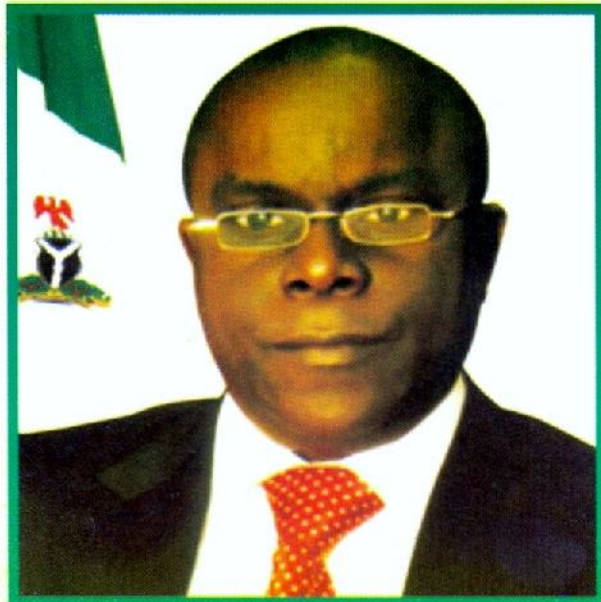
Integrated R&D, capacity building and robust extension services in which technological innovation and knowledge-based practices in the fields of building, road, and engineering materials will be used to provide adequate and affordable housing and road infrastructure as well as increased economic empowerment.

### CORE VALUES

- Professionalism
- Commitment and integrity
- Resourcefulness
- Innovativeness

# ROAD IS THE PRIMARY MEANS OF TRANSPORTATION IN NIGERIA

---Prof. Ita Okon Basse Ewa, Hon. Minister of Science and Technology



*Below is the summary of the Address delivered at the conference*

The Hon. Minister of Science and Technology, Prof Ita Okon Basse Ewa has stated that just as road is the primary means of transportation the world all over, it is the preferred mode of transportation in Nigeria because water, air and rail transportation have their limitations. The Hon. Minister stated this through his representative, Professor Sunday Thomas, the DG/CEO, Sheda Science and Technology Complex (SHESTCO) in his address as Chief host of the National Conference on Road Pavement Failure in Nigeria, organized by the Nigerian Building and Road Research Institute in Abuja.

Prof. Ewa noted that Road accounts for transporting an estimated 95% of National Passenger and Freight Services in the country. This means that Nigerian Roads are overstretched in relation to its designed capacity. The scenario is further compounded when roads are not maintained or suffer delayed maintenance due to paucity of funds. This, according to the Hon Minister is in addition to other related issues which included the nature of soil and terrain on which the road is founded; the challenge of ensuring quality control in the maintenance of roads, etc. He further stated that the net effects of these included the following:

- The prevalence of failed roads in the country;
- The negative influence on commerce and trading;
- The attendance high vehicle operating costs;
- Long travel time;
- Discomfort; and a host of other issues.
- The high rate of road traffic accident fatalities associated with failed roads.

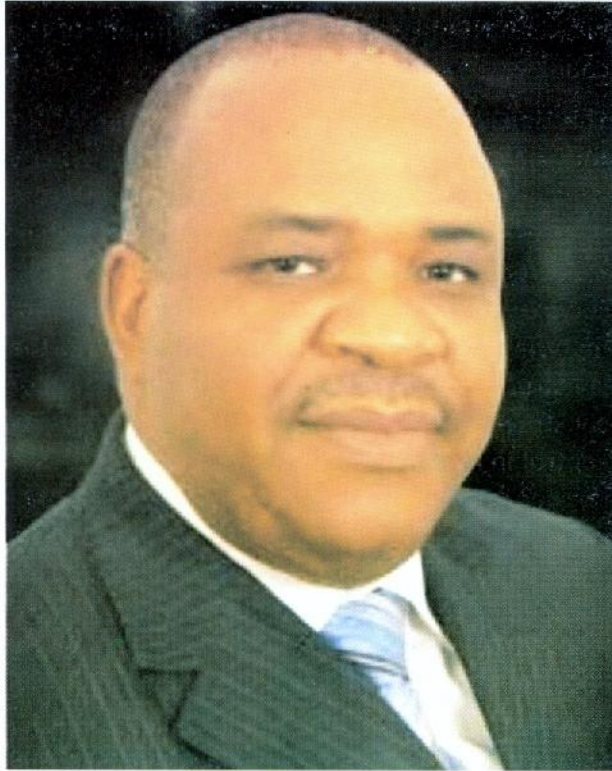
The Hon. Minister noted that the Government, as part of the Transformation Agenda, has taken the provision of good and motorable roads as one of the critical infrastructures needed to drive the socio-economic development of the nation. Consequently, Government has been taking necessary strategic steps in addressing the failure of roads.

In analyzing the road network in Nigeria, the Hon. Minister of S & T opined that the Nigerian federal road network constitutes a great national asset, spanning an estimated 193,200km and valued at over US\$25b (N3,500bn) by a 2003 estimate. He gave statistics on the progressive growth of Nigeria's road network as far back as 1960 when the nation's road network was a paltry 6500km. It increased to 10,000km and 29,000km in 1970 and 1980 respectively. Of the total length mentioned, 39,500km is estimated to be paved while 153,700km is unpaved. While noting that the maintenance and preservation of road asset is critical, the Minister revealed the very high premium that His Excellency, the President of the Federal Republic of Nigeria, Dr. Goodluck Ebele Jonathan GCFR, in executing its Transformation Agenda, placed on the maintenance and rehabilitation of existing road, as well as the construction of new networks of roads, around the country.

The Hon. Minister of S&T noted that while the Conference will arrest the attention of all the stakeholders including professionals, technocrats, politicians, academics, contractors, consultants, researchers, banking and financial institution, road maintenance and safety agencies industrialists and the ordinary Nigerian who cannot but use the road on a daily basis; he called on all stakeholders to participate fully and contribute meaningfully to the discussion and generate a sustainable framework that will address the present state of the Nigerian road network.

# NIGERIA IS AT THE THRESHOLD OF RAPID SOCIO-ECONOMIC DEVELOPMENT

-----Arc. Mike Onolememen, Hon. Minister of Works



*Below is the summary of the keynote Address delivered at the conference*

**N**igeria is presently at the threshold of rapid socio-economic development through the implementation of the Transformation Agenda of President Goodluck Ebele Jonathan's administration which is geared towards achieving the objectives of our national vision '20:2020'. This was stated by the Hon Minister of Works, Arch. Mike Onolememen while delivering his address during the Conference on Road Pavement Failure organized by the Nigerian Building and Road Research Institute in Abuja. The Hon Minister who was the Special Guest at the Conference and ably represented by the Permanent Secretary, Federal Ministry of Works, Alhaji Mohammed Kolo, affirmed that since the primary goal of the Transformation Agenda is to place Nigeria among the top 20 economics of the world by the year

2020, critical infrastructures such as roads needed to be fully developed because of their intrinsic potential to fast track all facets of socio-economic development.

Arch. Omolememen noted that the organization of the 3-day National Conference on Road Pavement Failure is timely in view of the current state of Nigerian roads and in particular the role which good roads play in the socio-economic development of any nation. He further observed that, in addition to providing access to and for the implementation of various human endeavours, good roads have other multiplier effects on sustainable socio-economic development, be it in agriculture, industry, education, defence, commerce, trade and investment, etc. For a vast country like Nigeria with large landmass and huge population, the existing stock of road infrastructure and their current state, there is need for Nigeria's road network to be improved upon. This was what informed the special interest of the Federal Ministry of Works in the Conference.

The Hon. Minister took the opportunity to inform participants that Nigeria currently has a total of about 200,000km of roads, out of which only 39,500km are paved. This he noted are grossly inadequate when compared to figures for the United States of America (16,506,204km); India (4,109,593km); China (3,806,800km); Brazil (1,571,868km); Turkey (352,046km) and South Africa (362,099km). He further stated that for Nigeria to be among the first 20 economics in the world, our road infrastructure needs to grow from 200,000km to about 300,000km in the next five years. Noting that this will be capital intensive, the Hon Minister said that "But due to dearth of funds, government is considering intensifying its policy on public-private sector partnership (PPP)

options in the construction of these roads. In addition my Ministry is seriously considering evolving effective and sustainable strategies for recouping any investment in the road sector through user related charges”.

Giving an insight into current efforts by Government, Arch. Onolememen stated that “I am piqued by two critical issues in the road sector in Nigeria. The first stems from fact that Nigeria’s Federal road network of 200,000km is one of the largest in Africa. I can, however, confirm to you that government is not complacent with this record because of our commitment to the ideals of vision 20:2020 and the need to provide the appropriate infrastructure to kick start and sustain Nigeria’s rapid socio-economic development. To this end, government has in recent years embarked on the construction and rehabilitation of strategic roads in the six geo-political zones of the country. The Hon. Minister further stated that “until the recent aggressive intervention by the Federal Government, over 70% of Nigerian roads were in different states of disrepair. Secondly, and probably of more critical importance is the sad observation on the general state of most Nigeria roads, which has been a cause of concern due to the high occurrence of perennial road pavement failures.”

The state of the Nigerian roads, according to the Hon. Minister, gives him concern for two seasons: firstly, as a result of delayed or lack of maintenance, the level of service delivery expected from the road infrastructure is not met. The consequence is the reduced socio-economic activities, stunted rate of returns on investment, high operational costs of vehicles which impact on Nigeria’s foreign exchange, etc. Secondly, significant numbers of lives of productive Nigerians are lost annually as a result of failed roads through road mishaps.

He acknowledged that one of the major problems with the road sector is the lack of adequate and timely maintenance. In most cases, huge resources are spent on the construction of roads while no provision is made for their maintenance. In the light of this, he stated that, the Federal Ministry of Works has adopted a policy of

incorporating maintenance schedules at the design stage in all major roads contracts in the country.

The Hon. Minister of Works, Arch. Onolememen further commended the initiative of NBRI for organizing the conference on road pavement failure in Nigeria and called closer collaboration between NBRI and FMW for the benefit of the country.

The Hon. Minister emphasized that in order for the roads to attain their service lives, quality control should be a continuous process right from the design stage through the bidding, materials procurement and testing, construction and in-service stages. He noted that the dearth of materials testing laboratories to service the construction industry effectively is another major constraint militating against ensuring quality control in road delivery. Closely linked to this is the need for quality professionals and personnel in the road sector. He opined that while there might not be problem with the professionals such as engineers, etc. who are under the ethics of their professional bodies, the same cannot be said of artisans engaged in road construction. He therefore took the opportunity, while promising Ministry assistance, to commend NBRI initiative to commence setting up Bitumen/Asphalt Testing Laboratory to service the Nigerian construction industry and also initiating the development of a curriculum for the training of the artisans in the construction industry in order to ensure delivery of quality jobs; and prevent road failure.

In concluding his address, the Hon. Minister challenged NBRI and other stakeholders to use workable strategies that will guarantee sustainable design, construction and maintenance of our roads. He further stated that one of the major challenges before NBRI and the stakeholders is the need to embrace the adoption use R&D to drive the economy and move the country’s economy from a typically consumer-driven to knowledge and production-driven one. The success of the Transformation Agenda of the Federal Government of Nigeria depends largely on the adoption and application of science, technology and innovations in driving Nigeria’s economy.

# NBRRI/FMST SET TO SOLVE ITCHING CHALLENGES IN THE ROAD SECTOR

----Hajiya Rabi S. Jimeta, Permanent Secretary, FMST

*Below is the summary of the welcome Address delivered at the conference*

The Permanent Secretary of the Federal Ministry of Science and Technology, Hajiya Rabi Jimeta, ably represented by the Director, Technology Acquisition and Adaptation in the Ministry, Dr. A.A Talabi gave the welcome address at the Conference on Road Pavement Failure in Nigeria. In her address, the Permanent Secretary noted that road pavement failure in Nigeria has become a critical problem affecting all stakeholders who use the roads at one stage or the other. She remarked that the Nigerian Building and Road Research Institute (NBRRI) and by extension, the Federal Ministry of Science and Technology (FMST), through the Conference, are creating the synergy for capacity building and applying research results to solve itching challenges in this critical area which is important for the realization of the Transformation Agenda and the Nigerian vision, NV20-2020.

Hajiya Rabi S. Jimeta stated that road is a critical infrastructure that is paramount in accelerating rapid socio-economic development. Almost all human activities such as movement of goods and services, inter-communal activities, socio-economic activities, etc. are linked up to road infrastructure. She therefore noted that for rapid development in all spheres of socio-economic activities in the country, roads must not only be provided in good quantity and quality; but must be serviceable and be in good condition always.

The Permanent Secretary seized the opportunity to acknowledge and inform participants that the National Conference on Road Pavement failure put

together by the Nigerian Building and Road Research Institute, NBRRI, is the 3<sup>rd</sup> in the series of its annual Conferences which the agency instituted in 2011 on assumption of office by the Director-General/CEO, Prof. Danladi Slim Matawal. She recalled that the first annual Conference in 2011 was tagged *NBRRI Stakeholders Forum* while the second one in 2012 was tagged *National technical Workshop on Building Collapse*.



Hajiya Jimeta stated further that in recent years, failure of road pavements in Nigeria has been prevalent in all parts of the country and has become a source of concern to the public and the government of the federation. This, according to her, is because our roads which should provide smooth safe drive ways to

commute men, goods and services from one place to another have deteriorated in several places across the country. It has caused a lot of discomfort, dislocated socio-economic activities, increased vehicle operating costs, increased travel time, and in many cases have resulted in high rate of road traffic accidents, among others.

She opined that the collaboration and cooperation between NBRRI and major stakeholders in the construction industry to tackle the road problem is a welcome development at synergizing efforts to solve this national problem. According to her "I am confident that with fertilization of experts and ideas from a cross-section of these Stakeholders, the solution to perennial road pavement failure in the country will not elude us".

# NBRRI HOLDS NATIONAL CONFERENCE ON ROAD PAVEMENT FAILURE IN NIGERIA

By George N. Omange

As part of its evolving tradition over the last three years (i.e. 2011 to date), the Nigerian Building and Road Research Institute (NBRRI) held its Annual Conference between 7<sup>th</sup> and 9<sup>th</sup> May 2013 at the Nicon Luxury Hotel in Abuja. The 2013 edition of the National Conference is on *Road Pavement Failure in Nigeria* with its theme on **Challenges of Road Pavement Failure in Nigeria**. The choice of this topic and theme is predicated on many factors.

The 2012 Conference had its focus on the challenge of building collapse in Nigeria with its theme on *Curbing the Incidences of Building Collapse in Nigeria*. The Conference elicited a lot of interests from professionals, all Stakeholders and Nigerians. Between May 2012 and the second quarter of this year, there appeared to be a slump in reported cases of building collapse. In addition, some of the actions taken as a consequence of the Communiqué of that Conference has given rise to some intervention initiatives being taken by NBRRI, especially in the Development of Curriculum for the training of Artisans in various construction trades, preparatory to running statutory capacity building programmes for Artisans; in order to improve their competences and proficiencies in the discharge of their duties.

As a follow-up on the above, the Institute decided to focus attention on Road Failure in Nigeria. It has been noted that the general state of most Nigerian roads has been a cause of concern due to the high incidences of perennial road pavement failures across the length and breadth of the country. Of more critical importance is the attendant negative impact of high level of failed roads on Nigeria's socio-economic development. To address this hydra-headed phenomenon, the Nigerian Building and Road Research Institute (NBRRI) organized and held National Conference on ROAD PAVEMENT FAILURE IN NIGERIA as indicated above. The Conference was held in collaboration with the Federal Ministry of Works (FMW), the Federal Road Maintenance Agency (FERMA), the Federal Road Safety Commission (FRSC), the National Emergency Management Agency (NEMA), the Standards Organisation of Nigeria (SON), Council for the Registration of Engineering in Nigeria

(COREN) and the Nigerian Society of Nigeria (NSE) which constituted the Conference Planning Committee under the Chairmanship of the Director-General/CEO, NBRRI, Professor Danladi Slim Matawal. There were also other collaborators from Stakeholders in the Construction Industry.

The event had as Special Guest of Honour, the Honourable Minister, Federal Ministry of Works, Arch Mike Oziegbé Onolememen represented by the Permanent Secretary, Dr. Kolo Muhammed who declared Conference open. Other eminent dignitaries present included the Chairman, Senate Committee on Science and Technology, Senator (Prof.) Ajayi Boroffice; the Honourable Minister of Science and Technology, Prof. Ita Okon Basse Ewa, FMSN represented by the Director-General, Sheda Science and Technology Complex (SHESTCO), Prof. S. A. Thomas; the Permanent Secretary, FMST, Hajia Rabi Shuaibu Jimeta, mni represented by Dr. A. A. Talabi and Director-General, National Emergency Management Agency (NEMA) Alhaji Sidi Sani.

The workshop attracted a wide spectrum of stakeholders from the professional regulatory bodies and associations, the academia, practitioners in the built environment, researchers, Federal and State Ministries of Works, Construction companies, consultants International regulators and researchers like the Transport Research Laboratory (TRL) UK, Imperial College London, and Engineering Forum of Nigerians (EFN) UK, Dupont (South Africa), etc. also participated.

The lead paper titled *Road Pavement Failures: Classification, Causes and Remedies* was delivered by the Director-General, NBRRI, Prof Danladi Matawal, with a total of 14 technical papers presented by eminent and erudite professionals and scholars from the construction industry, academia, finance sector, technocrats, etc. on the following topics:

- a) Road Pavement Failures: Classification, Causes, and Remedies
- b) Strategies for Effective Maintenance of Nigerian Road Networks

- c) Application of Road Asset Management System (RAMS) for improved Road Maintenance and Management in Nigeria.
- d) Quality Control in Road Construction and Maintenance
- e) Road Pavement Failure: Case Study of Enugu – Port Harcourt Expressway (By NBRI)
- f) Nanotechnology and Civil Engineering
- g) Digitized Sub grade Soils Map as a tool for the Design, Construction and Maintenance of Nigeria Roads
- h) Concrete Roads as Solutions to Road Pavement Failure in Nigeria.
- i) Influence of Axle Loads on Road Pavement in Nigeria
- j) Road Safety Audit of Nigerian roads: Implications for design, construction and maintenance
- k) Influence of Pavement Distress on Travel Time
- l) Emergency Response Services Related to Road Accidents
- m) Effect of Pavement Condition on Traffic Safety: Case Study of Bauchi, Bauchi State
- n) Evolving a Framework for Appropriate Form of Road Contract in Nigeria.

The presentations which were based on policy issues, practical examples and experiences, causative factors and proffered solutions, quality control issues, new trending in the industry, road management, strategic road asset management and audit, etc. were eloquently delivered. These generated robust discussion sessions which were highly participatory and productive. A well articulated Communiqué was evolved and adopted by all participants. The highlights of the Communiqué are presented elsewhere in this Newsletter. It is intended to bring the content to the attention of the Federal Executive Council, the National Assembly, the relevant Road Management Agencies in the country such as FERMA, the Federal and State Ministries of Works, professional bodies and associations and indeed all Nigerians. This is not only to create awareness but to enable these organizations to kick start interventions that will effectively address the national challenge of Road Failure in Nigeria. On its part, NBRI is setting up machinery to evolve practical action plans based on the Communiqué.

As a way of educating Stakeholders and the general populace, the Abstracts of the Papers are also presented elsewhere in this edition of NBRI Newsletter

## NIOB ABUJA CHAPTER VISITS NBRI TO STRENGTHEN PARTNERSHIP

The executive of the Nigeria Institute of Building (NIOB) Abuja chapter paid a courtesy visit of the Director-General/Chief Executive Officer of the Nigerian Building and Road Research Institute, NBRI, Professor Danladi S. Matawal. The Chapter executives were led by their Chairman, Builder Musa Yakubu, MNIOB.

Speaking during the event, Builder Yakubu called for a strong partnership between NBRI and NIOB adding that the activities of the Institute of Building is similar to the mandate of NBRI, hence the need for both organs to work together for the benefit of the nation in the building sector. He noted that over the years, quality and standards have been downplayed. He therefore threw a challenge to NBRI to evolve strategies that will ensure that standards and quality are sustained in housing delivery in the country; noting that this will go a long way to prevent building collapse phenomenon that is currently plaguing the nation.

Builder Yakubu used the occasion to intimate the DG/CEO, NBRI of the 43<sup>rd</sup> Annual General Meeting of the NIOB which the Abuja chapter will be hosting. The Chairman of the Chapter revealed that the event which will feature a Building Expo, will provide the forum for interactions and collaborations with key stakeholders in the building industry such as policy makers, builders, contractors, building materials producers, etc. towards evolving solutions to the numerous challenges faced in the sector. He further used the opportunity to formally invite NBRI to partner with NIOB in organizing the AGM as well as to deliver state-of-the-Art paper during the event.

Responding, the DG/CEO NBRI, Prof. Matawal welcomed the NIOB delegation to the Institute and expressed delight over the role NIOB is playing in the development of the Building industry in Nigeria.

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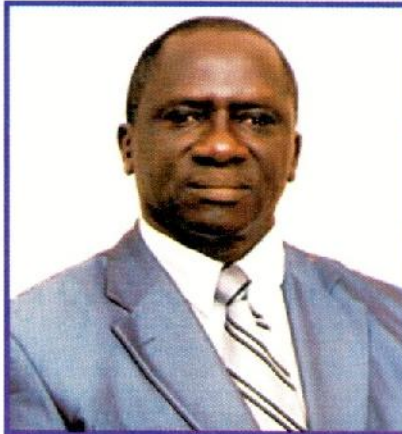
**LEAD PAPER**

# ROAD PAVEMENT FAILURES: CLASSIFICATION, CAUSES AND REMEDIES

**Prof. D.S Matawal, DG/CEO NBRRI**

The performance of the Nigerian roads sector has not been satisfactory despite its enormous potentials for growth and development. Traditionally, the poor transport facilities and infrastructure have severely delayed economic development which weakened Transport infrastructure and contributed negatively to attempts to alleviate poverty in the country. Yet John F. Kennedy was once quoted as saying: "It is not strong economies that give good roads; but rather that it is good roads that give rise to strong economies!" Consequently, this paper gives a clear picture of the meaning and types of road pavements, modes of failures and possible remediation processes that may be adopted for solution when there is failure. It

emphasizes that Nigerian roads are not different; and must not be seen to warrant special solutions.



**Danladi Slim MATAWAL,**  
DIC, PhD, Ceng, FNSE, RE, FAEng.  
(Professor of Civil Engineering)

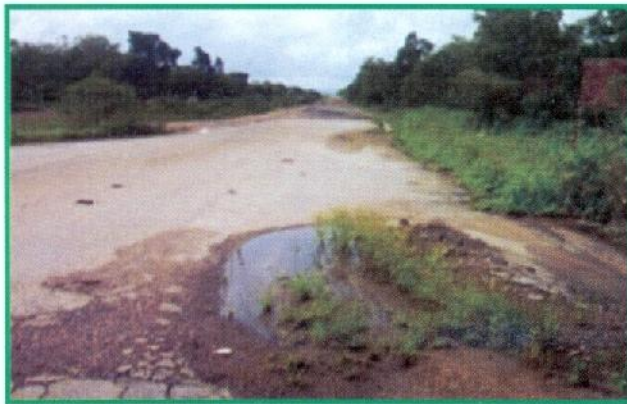
**DG/CEO, NBRRI**

All that our roads need is proper construction modalities that use proper materials and construction techniques. The distinction is made between general failures and pavement-specific failures. Emphasis is made of early detection of failures and the provision of prompt solutions. Indeed, the Nigerian Building and Road Research Institute, NBRRI, and other stake-holding Institutions need to be given enhanced research support in the form of funding, equipment, laboratory infrastructure, and training sponsorships to research peculiar solutions for the Nigerian

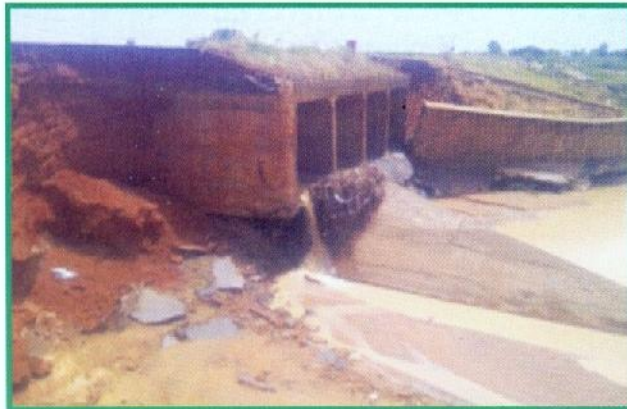
road network failures.



Different types of Potholes on Nigerian roads



**Failed Pavements due to Poor Drainage along some Nigerian roads**



**Failed Roadways due to Erosion and Poor Drainage on some Nigerian roads**

## PAPER ONE

## STRATEGIES FOR EFFECTIVE MAINTENANCE OF NIGERIAN ROAD NETWORK



**Engr. Godson C. AMOS**  
Federal Roads Maintenance Agency (FERMA)

It is widely acknowledged among Road Maintenance Engineers that the process of road deterioration commences after a newly constructed road is open to traffic. Such a process can be reduced considerably depending on adequacy and efficiency of measures put in place by the Road Agency. An important and necessary measure towards the preservation of road asset is

an effective Road Maintenance strategy.

The paper present the mandate and activities of the Federal Roads Maintenance Agency (FERMA) in the maintenance of Federal roads network with highlights on the Agency's short, medium and long term road maintenance strategies.

FERMA's experience on the adopted maintenance approach in the past, were found to be more of reactive repairs to recover collapsed roads. The new approach to preventative maintenance strategy alongside the corrective efforts has been found to be successful by reducing the rate of critical sections of the network transiting to backlog.

## PAPER TWO

## APPLICATION OF ROAD ASSET MANAGEMENT SYSTEM (RAMS) FOR IMPROVED ROAD MAINTENANCE AND MANAGEMENT IN NIGERIA

By **Dr. Emeka AGBASI** Federal Roads Maintenance Agency (FERMA); and  
**Engr. Ibrahim BUGA** DFID funded Nigeria Infrastructure Advisory Facility Programme (NIAF)

The federal road network in Nigeria is an asset of national and strategic importance. Adequate maintenance and management of this asset is central to the overall socio-economic development of the country. A programme of work has been designed to implement an integrated road asset management system (RAMS) for an efficient and cost effective maintenance and management of Nigeria's over 37,000 km federal road network and 1,671 bridges with a total length of 177 km; thus enabling asset managers meet their overall business and operational objectives. The system is intended to assist road network managers to rationalize decision making in planning, programming, procurement and execution of works, and in the allocation of resources in order to make the best use of public funds in preserving the road network at an acceptable level of serviceability. RAMS will enhance the capabilities of asset managers by providing a source of readily accessible, relevant and valid information and data on the road as well as improved support for decision-making by providing analytical tools. The paper outlines

current approach to maintenance and management of federal roads, describes the concept of an asset management system, and highlights the benefits of deploying an asset management system on Nigerian roads. It presents the different phases and work status

currently being undertaken to implement an integrated road asset management system incorporating GIS-based Road Information System (RIS) & Bridge Information System (BIS), Pavement Management System (PMS), and Bridge Management System (BMS). Implementation issues including critical success factors and implications for road management and maintenance in Nigeria are discussed. The paper concludes by re-emphasizing the potential benefits of deploying an



**Dr. Emeka AGBASI**

integrated road asset management system such as improvement in maintenance management and data collection, better network performance, monitoring and improved budgeting processes. Other expected benefits include human capacity development and improved communication.

# COMMUNIQUE OF THE TECHNICAL WORKSHOP ON ROAD PAVEMENT FAILURE

ORGANISED BY THE

## NIGERIAN BUILDING AND ROAD RESEARCH INSTITUTE

7<sup>TH</sup> TO 9<sup>TH</sup> MAY, 2013 AT THE NICON LUXURY HOTEL, ABUJA, NIGERIA

### A. INTRODUCTION

The Nigerian Building and Road Research Institute (NBRRI) in collaboration with Stakeholders: COREN, FERMA, FRSC, NSE, FMW, FMST, SON and NEMA organized the National Technical Workshop on Road Pavement Failure with the theme *“Challenges of Road Pavement Failure in Nigeria”* from 7<sup>th</sup> – 9<sup>th</sup> May, 2013 at the Nicon Luxury Hotel, Abuja.

2. The event had as Special Guest of Honour, the Honourable Minister, Federal Ministry of Works, Arch Mike Oziegbe Onolememen represented by the Permanent Secretary, Dr. Kolo Muhammed who declared it open. Other eminent dignitaries present included the Chairman, Senate Committee on Science and Technology, Senator (Prof.) Ajayi Boroffice; the Honourable Minister of Science and Technology, Prof. Ita Okon Basse Ewa, FMSN represented by the Director-General, Sheda Science and Technology Complex (SHESTCO), Prof. S. A. Thomas; the Permanent Secretary, FMST, Hajia Rabi Shuaibu Jimeta, mni represented by Dr. A. A. Talabi and Director-General, National Emergency Management Agency (NEMA) Alhaji Sidi Sani.

3. The workshop attracted a wide spectrum of stakeholders from the professional regulatory bodies and associations, the academia, practitioners in the built environment, researchers, Federal and State Ministries of Works, Construction companies, consultants, International regulators and researchers like the Transport Research Laboratory (TRL) UK, Imperial College London, and Engineering Forum of Nigerians (EFN) UK, Dupont, etc also participated.

4. The lead paper titled *“Road Pavement failures: Classification, causes and Remedies”* was delivered by the Director-General, NBRRI, Prof Danladi Matawal, with a total of 14 technical papers presented on the following topics:

- a) Road Pavement Failures: Classification, Causes, and Remedies
- b) Strategies for Effective Maintenance of Nigerian Road Networks
- c) Application of Road Asset Management System (RAMS) for improved Road Maintenance and Management in Nigeria.
- d) Quality Control in Road Construction and Maintenance
- e) Road Pavement Failure: Case Study of Enugu – Port Harcourt Expressway (By NBRRI)
- f) Nanotechnology and Civil Engineering
- g) Digitized Sub grade Soils Map as a tool for the Design, Construction and Maintenance of Nigeria Roads
- h) Concrete Roads as Solutions to Road Pavement Failure in Nigeria.
- i) Influence of Axle Loads on Road Pavement in Nigeria
- j) Road Safety Audit of Nigerian roads: Implications for design, construction and maintenance
- k) Influence of Pavement Distress on Travel Time
- l) Emergency Response Services Related to Road Accidents
- m) Effect of Pavement Condition on Traffic Safety: Case Study of Bauchi, Bauchi State
- n) Evolving a Framework for Appropriate Form of Road Contract in Nigeria.

### B. OBSERVATIONS

From the presentations and discussions on the challenges of road pavement failure in Nigeria, the forum recognizes the efforts of government in alleviating the deplorable conditions of our roads, and observed that:

- i. Nigeria has the largest road network in West Africa (about 200,000km total road network, 39,500km paved roadway) but the second highest road accident record in the world.
- ii. Nigeria's economy is highly dependent on road transport system due to the neglect of rail and water transportation in the haulage of people, goods and services;
- iii. Nigerian roads are overstressed with a paved

- road density of 0.15km/ 1 million people compared to, for example, 4,500km/1 million people in Malaysia.
- iv. Collapsed road infrastructure is one of the major impediments to the proper development of the Nigerian economy and the aspiration of the National Vision NV 20:2020;
  - v. The pressure on roads and poor investment in other transportation infrastructure is largely responsible for the chaotic transportation problem in Nigeria.
  - vi. Lack of adequate and timely maintenance has been a major challenge with the road sector;
  - vii. Research and Development (R&D) is important in the design, construction and maintenance of roads in the country, it is however inadequately funded;
  - viii. Despite the poor funding of Research Institutes, remarkable achievement has been recorded by NBRI in the development of labour based road construction equipment as well as conducting research valuable for road transport development;
  - ix. Structural base failure of Nigerian roads is mainly caused by insufficient strength due to poor design and construction, overloading, the use of sub-standard materials, inadequate drainage and poor periodic maintenance;
  - x. Many roads in Nigeria are designed, constructed and rehabilitated without adequate consideration to safety thereby resulting to road traffic crashes;
  - xi. Digitised Sub grade Soil Maps of some States of the Federation showing defined distribution of soil types in the country have been developed and can be useful in the design of roads;
  - xii. Quality control in road construction requires measurements and data acquisition technology as well as knowledge of detailed compaction processes on non-linear soil and visco elastic hot mix materials;
  - xiii. There is inadequate collaboration and partnership between the Research Institutions, Academia, Government and Industries in the development of road networks in Nigeria;
  - xiv. There are inadequate Materials/Asphalt testing laboratories in Nigeria for R&D and to check the quality of bitumen and other

- materials used in the construction of roads;
- xv. Non strict adherence to quality control during construction contributes to early failure of roads in the country;
  - xvi. There is a deliberate cutting of road pavement by individuals and organisations for laying of cables and pipes.
  - xvii. There is inadequate funding for the development of road infrastructure and maintenance
  - xviii. Undue delay in the completion of road projects due to the lack of continuity of government policies thereby leading to the escalation of project costs.
  - xix. Poor pavement conditions contribute to increase in travel time and high incidence of road traffic accidents.

### C. RECOMMENDATIONS.

In view of the above observations, the forum resolved that;

- i. Nigeria is in dire need of more road networks as well as capacity expansion (lane widening, dualization, etc) of existing roads
- ii. Regular, routine and preventive maintenance of the Nigerian roads be undertaken by the relevant agencies in order to reduce the level of deterioration on our roads.
- iii. The deployment of Asset management system in road maintenance and management should be intensified to preserve the national road asset.
- iv. Adequate drainage should be provided on Nigerian roads to protect pavement from premature deterioration.
- v. To address issues of quality control, FMW, consultants and road construction companies should have full-fledged and constant quality control in a unified guideline called Quality Manual/Handbook to be developed by FMW.
- vi. The Federal Government through the Federal Ministry of Works should control axle load using weigh bridges on major roads in the country.
- vii. As an informed safeguard to the effect of recommended axle loads on our national road ways, it is recommended that no surface course should be lower than 120mm thick.
- viii. Base and sub-base course must, in no circumstances, violate the minimum national specifications of 150mm each, but should also be specifically designed to address axle loads projections and environmental conditions for the roads.

- ix. In order to reduce accidents on Nigerian roads, the Federal Government should institute Road Safety Audit for all roads in the country at all stages of road development.
- x. Government at all levels should consider the possibility of adopting concrete road technology, nanotechnology and other emerging technologies in construction and maintenance of some road construction projects.
- xi. Federal Ministry of Works should provide guidelines and sanctions for deliberate cutting of road pavements in the country.
- xii. There is the need to initiate, and if available strengthen the collaboration between the FMW and NBRRRI, and to also engage the services of NBRRRI in innovative R&D on the design and construction of roads.
- xiii. NBRRRI should initiate the development of a Nigerian Deflectograph machine through its R&D activities.
- xiv. Professionals in the road construction industry should be adequately trained to meet up with the advancement in road construction and maintenance, while the capacity of artisans, technicians and technologists should be adequately developed and regulated by relevant institutions.
- xv. Government should formulate clear policy on local content to support operators by deliberately encouraging indigenous professionals in the construction industry
- xvi. Government should strengthen Public Private Partnership (PPP) arrangement in the construction and maintenance of roads in the country.
- xvii. Equipment used for road works should be assessed and be made to conform to minimum recommended requirements as specified in the road construction manual.
- xviii. In road design, there should be an increase of 20% on the standard axle in order to strengthen the roads and reduce road pavement failure in the country.
- xix. Road failure case studies by NBRRRI should be encouraged on all major roads in the country. Funding should be provided to NBRRRI for these studies
- xx. Manufacturing companies should sponsor research on the application of their various and specific nanotechnological solutions on Nigerian materials and environment before deployment to the field.
- xxi. NBRRRI digitized sub-grade soil map program is commendable. Government should continue funding the program and complete it for all states of the country and encourage its use for road design and construction
- xxii. Cement Manufacturers Association of Nigeria (CMAN) should partner with NBRRRI to fund the skilled labour curriculum development program and other related programs for the country
- xxiii. NBRRRI efforts in the development of Standards, Codes and Specifications in collaboration with SON, COREN, NSE, FMW, FERMA industry and tertiary institutions etc, is commendable and should be sustained.
- xxiv. NBRRRI should develop up-to-date and comprehensive laboratories in the country for pure, applied, integrated and bespoke research in road, engineering and construction sectors of the economy
- xxv. Weighbridges and speed counters should be developed through the R&D activities of NBRRRI in collaboration with relevant organizations
- xxvi. Long term pavement performance test sections should be constructed by NBRRRI for testing of materials and construction techniques
- xxvii. Those who infringe on the integrity of roadway sections should not be taken lightly; regulations should be in place and enforced on defaulters
- xxviii. The International Federation of Consulting Engineers (FIDIC) model forms of contract should be adopted in road design, construction and maintenance projects in Nigeria.
- xxix. Road construction companies should contribute a percentage of their road contract sum for the development of R&D.

#### D. CONCLUSIONS

The participants at the Workshop commended the effort of NBRRRI and its collaborators in organising a successful conference and recommended that such conferences should be more frequently organised. It urged that the recommendations should be brought to the attention of the policy makers for implementation. It specifically mandates the Host Minister of Science and Technology as well as the Special Guest of Honour, the Minister of Works, to present the recommendations to the Federal Executive Council as well as NBRRRI publicising the communiqué extensively to the National Assembly, all implementing and regulatory bodies and the public in general.

## PAPER THREE

## QUALITY CONTROL IN ROAD CONSTRUCTION AND MAINTENANCE

Roads are built to provide safe passage of vehicles. They must be properly designed and constructed. After construction, roads deteriorate with age as a result of use and therefore, they need to be maintained to ensure that the objective of safety, strength and durability are met. The rate at which roads deteriorate in service depends on the quality of materials used, workmanship standard and the quality of supervision during the road construction. If roads are not maintained, functional defects will degenerate to structural defects that will require rehabilitation or reconstruction. The objective of quality control in road construction and maintenance is to achieve a well built pavement that conforms to the required horizontal and vertical profiles, design thicknesses of different courses (earthwork, sub-base, base and surface) and stipulated standards of riding quality. At each stage of construction or maintenance operations, quality control is required during the preliminary design, source acceptance, job-mix and construction. Relevant quality control tests should be carried out on construction materials. The plants and equipment must be of good quality and must be consistent with the type of job to be done. Effective supervision of construction or maintenance works as well as plants and equipment by qualified engineers is

the key to the achievement of the overall objective of quality control. Engineers are to ensure that contractors comply with all the project specifications. Effective quality control leads to reduction in the cost of construction and maintenance, lowers cost of vehicles operation,



**Professor Funso Falade Ph.D**  
Dept of Civil & Environmental Engineering  
University of Lagos

transportation and maintenance. It is recommended that the option of preventive maintenance of our roads rather than reactive maintenance should be urgently embraced because preventive maintenance results in prolonged service life of roads and significant savings for the government.

## PAPER FOUR

## QUALITY CONTROL IN ROAD CONSTRUCTION AND MAINTENANCE



**Prof. Stephen Pinder EJEH,**  
Department of Civil Engineering, ABU Zaria

good management equipments, fund, down to insincerity, blurred transparency and

Quality control in Nigeria as well as in road construction and maintenance is yet to reach its excellent or highest peak (or) stage. This is as a result of many factors ranging from lack of

corruption. This paper therefore, presents some opinions on quality assurance and control in road construction and maintenance. It pointed out that quality control in road construction and maintenance can only be achieved by controlling all features and characteristics that will impact desired quality on the road; quality should be built-in and inspected-in, having a unified document called quality manual or quality hand book and using the continuous construction method in road construction and maintenance construction and re-construction. Good quality tested material cannot be overemphasized during construction and maintenance.

## PAPER FIVE

# QUALITY CONTROL IN ROAD CONSTRUCTION AND MAINTENANCE

By Engr. C. Icha,  
Federal Ministry of Works



The paper examined the role of the Materials, Geotechnics and Quality Control Department of the Federal Ministry of Works and her development partners in the construction and maintenance of Federal Highways. It identified lack of skilled manpower in the department as a major factor that has contributed to the challenges faced on our roads. It however, pointed out that this issue is presently being addressed.

The paper pointed out that the monitoring and evaluation of our roads is only conducted when the Pavement Evaluation Unit of the Department was invited by the construction and rehabilitation department. This, it stated, was unacceptable. The paper pointed out that there was the need for the department to be constantly on ground to monitor the quality control works on a daily basis. and suggestions have been made in this write up that the current staff be increased from 50 to 230. According to the paper, the submissions on soils and materials reports by majority of the design consultants needed to be improved upon. The sampling and analysis of borrow pits is one assignment that ought to be carried out with the best professional touch, because experience has revealed that where the sampling and analysis is

faulty, the chances of premature failure occurring on the road in the course of construction is very high. The paper cited as example, the premature failures that occurred on the Lagos –Ibadan expressway which could be traced to this factor. The paper pointed out that majority of the consultant's submissions were usually characterized by one point samplings, inadequate no of borrow pits and non dimensioning of the pits, contrary to extant rules.

The paper also pointed out that some contractors had formed the habit of locating their asphalt plants outside the 30km radius as stipulated by extant rules, while some do not have functional laboratories on site. In addition, poor workmanship on construction sites characterized by the inadequate compaction on fill materials; non-compliance with extant rules which specifies the use of trial sections for the construction of each component part of the road pavement and non –preparation of mix designs for concrete and asphalt at the commencement of the project, have also contributed to premature failures of our road. The historical antecedents of maintenance of federal roads was x-rayed in the paper, and the need to reposition the department of MGQC to issue the maintenance certificate on federal roads before handing over to the Federal roads maintenance Agency was also discussed. The paper concluded by making a number of recommendations to the Federal government:

- Intensify the war against corruption
- Sanction erring contractors , consultants and civil servants who are found wanting in the discharge of their legitimate functions
- Reward the hardworking contractors consultants and civil servants.
- Enhance the capital allocation to the department to be able to meet the myriad of challenges presented.

## PAPER SIX

# ROAD PAVEMENT FAILURE: A CASE STUDY OF ENUGU - PORT HARCOURT EXPRESSWAY

By

C.C. OSADEBE, A.M. FAKEYE, D.S. MATAWAL, and F.O. AITSEBAOMO

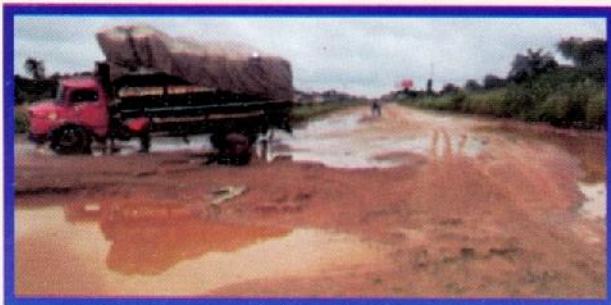
Nigerian Building and Road Research Institute (NBRI)

The purpose of the paper is to determine the extent to which Enugu-Port Harcourt Expressway has deteriorated or failed; identify causes of failure and proffer solutions. Failures of flexible pavements (bituminous roads) have been prevalent in Nigeria, a trend causing concern to both the government and road users. In this regard, it was found necessary that an investigation be initiated to determine the possible causes of such failures, and a case study was carried out on Enugu-Port Harcourt dual carriageway in South-eastern Nigeria. The investigations were conducted in several categories to determine the pavement characteristics such as properties of base, sub-base and sub-grade soils; traffic volumes by traffic counting; and characteristics of the type of the bitumen used by cutting cores and extracting the bitumen for the standard tests, such as Marshal Stability, flow, bitumen content, air voids, void mix aggregate and



**Dr. C.C. Osadebe**  
Nigerian Building and Road  
Research Institute (NBRI)

grading. The visual inspection of the pavement showed that due to the infiltration of both surface and groundwater into the plastic shale sub-grade soil and overloading, cracks and potholes and structural base failure were very common for the whole stretch of the road. Traffic count data revealed a high volume of heavy vehicles with probable high axle load. As a result, there has been a tendency to exceed the maximum allowed axle load limits. Flexible pavements deteriorate under traffic loads and climate effects. This fact, together with the revelation that the road is a very busy one as depicted in the traffic counts, poor sub-grade soil, poor drainage system and high water table, could be major causes of the road's fast deterioration. The possible solutions could be to increase the thickness of pavement, use of concrete as base/sub-base, regular maintenance of the road, design of adequate drainage system, adequate supervision etc.



Typical overloaded 2 axle single 1.2 lorry



High severity Alligator cracks on the pavement



Poor drainage design and lack of routine Maintenance



Structural failure due to poor drainage design at the foot slope of the road

## PAPER SEVEN

## NANOTECHNOLOGY AND CIVIL ENGINEERING

**N**anotechnology is an enabling technology that allows one to develop materials with improved new properties. It can be used for design and construction processes in many areas to generate products that have many unit characteristics. The paper tries to point out materials and areas where Nanotechnology has been applied in Civil Engineering to improve qualities of construction materials as well as sustainability in general construction. Nanotechnology in concrete, in pavement engineering, steel, high strength bolts, high strength steel cable, etc., were discussed and the paper concluded that the need to carry out more research on the main benefits and

barriers that allow the effect of Nanotechnology on construction to enable clearly defined role should be pursued. The advantages as well as the health implications for workers within the process of Nanotechnology were also discussed.

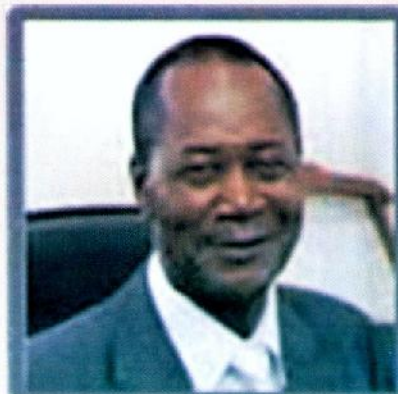


**Prof. Stephen Pinder EJEH,**  
Department of Civil Engineering, ABU Zaria

## PAPER NINE CONCRETE ROAD AS SOLUTIONS TO ROAD PAVEMENT FAILURE IN NIGERIA

**I**n Nigeria, road transportation remains the widest used means of transportation. For the nation to actualize its vision of becoming one of the top twenty economies of the world in 2020, more serious attention must be given to road infrastructure development. Presently, road infrastructure in Nigeria is not only pitifully inadequate; the few existing roads are also far from being safe. Comparison of road infrastructure in Nigeria with some other developed and developing nations reveals a huge deficit, as the total paved roads in Nigeria is not up to 1% of the paved roads in China for example. Nigeria is presently caught in the vicious cycle of road deplorability mainly because over 99% of her paved roads are asphalt roads, which fail more rapidly under some weather conditions prevalent in many parts of the country; and which requires regular maintenance that is often not done. When subjected to Life Cycle Analysis, rigid pavement stands out clearly as a cheaper alternative than flexible road. In Nigeria, even in the short run, asphalt which is imported is more costly compared

to cement which is locally available. Concrete pavement has many advantages over asphalt pavement in terms of how they both perform, ease of construction and supervision, maintenance requirement, resistance to energy, economy in terms of cost and safety and environment friendliness. With the current local installed capacity for cement production standing at 28.5mt and the potential of the capacity nudging up to 40mt in the next two years, Nigeria must begin to leverage on the success already recorded in the cement industry to launch the nation into a new lease of road network that will not only be more durable, but also safe and sustainable. If this is done and the country adopts concrete roads now, in the next 10 years the nation will be celebrating another success story; this time in sustainable road infrastructure provision that drastically reduces the carnage on our roads, minimises maintenance cost and engenders tremendous multiplier effects on economic activities, cost of goods across the nation and global competitiveness of the Nigerian manufacturer.



**Engr. Joseph O. Makoju,**  
Chairman, Cement Manufacturers Association,  
Special Adviser to the CEO Dangote Group.

**PAPER EIGHT**

# DIGITALIZED SUBGRADE SOILS MAP AS A TOOL FOR THE DESIGN, CONSTRUCTION AND MAINTENANCE OF NIGERIA ROADS

BY

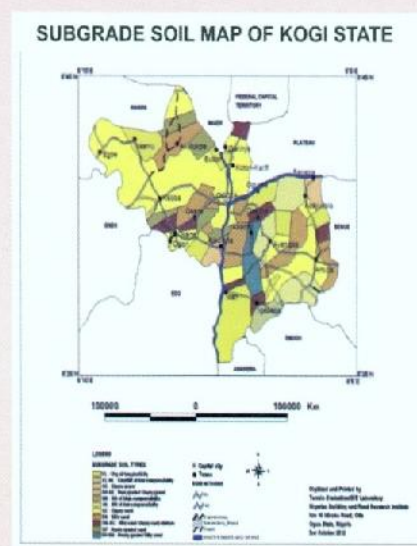
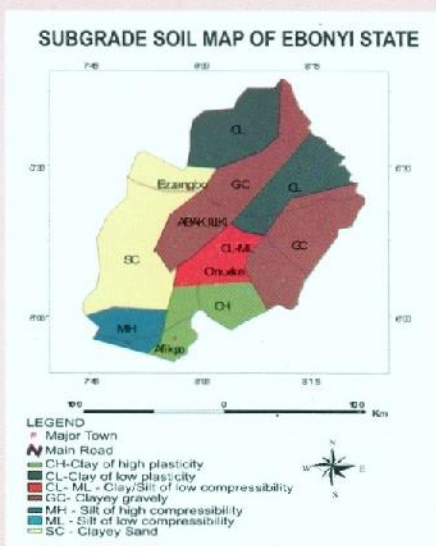
**Francis O. AITSEBAOMO, Danladi S. MATAWAL, George N. OMANGE  
and Charles C. OSADEBE**

In the planning, routing and construction of roads, it is the general experience that much input in terms of effort and costs usually go into the preliminary investigation of subgrade soils to determine their engineering properties. Over the years information and data generated on the engineering properties of subgrade soils in different road projects all over Nigeria have not been systematically documented. To arrest this uneconomic trend, the Nigerian Building and Road Research Institute embarked on a comprehensive programme in which the main subgrade soils of Nigeria are systematically investigated and documented on a State by State basis. The overall long-term objective of the programme is not to provide perfect geological or geotechnical data for each State since sub-structural details vary from one location to another, but to give a broad delineations that give overall guide as to predominating soil classifications in each of the States. Conventional soil surveys were carried out in different

States during which representative soil samples were collected from the field for comprehensive laboratory tests. The data generated were validated and analyzed to establish the engineering properties and classification of the subgrade soils and therefrom develop digitized subgrade soil maps of different States. The maps digitized in ILWIS/ArcGis environment presents data on the classification and basic engineering properties of subgrade soils. In addition, it gives fair assessment of the engineering properties of subgrade soils to be encountered in the field, and therefore comes in handy in the planning of detailed field work in the area. The digitized subgrade soil maps of the States in Nigeria so far covered and developed from conventional soil survey and laboratory test show well defined distribution of soil types. The maps are invaluable aid to the regional planner, engineer, consultant and contractor in the design, construction of Nigerian Roads.



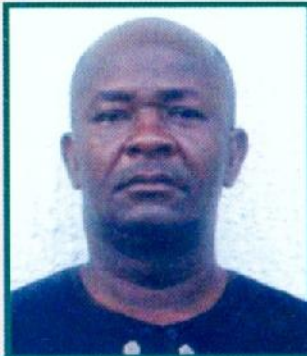
**Dr. Francis Aitsebaomo**  
Head Road Research Dept. NBRI



Typical Subgrade Soils Maps of Ebonyi and Kogi States

**PAPER TEN**

# INFLUENCE OF AXLE LOADS ON ROAD PAVEMENT IN NIGERIA



**Dr. P. N. Ndoke,**  
Federal University of Technology, Minna

Road traffic is a major factor considered in the structural design and construction of flexible pavements. Roads are designed for a specific amount of traffic, calculated as a number of passages of a standard axle having a normal

arrangement of four wheels of the axle and a weight of 80kN or 8200kg. Any axle of a vehicle has an

equivalent number of standard axles. The 4<sup>th</sup> power law is used for the conversion. By this conversion, the axles of a legally loaded heavy vehicle will have a specific E80 equivalence while an overloaded vehicle will have a higher E80 equivalence. The overloaded vehicles consume more of the life of the pavement as the damage is exponential. Nigeria has an extensive road network of which the 33000kms of Federal roads are at various levels of deterioration. Investigations into the contributions of axle loading in pavement failure and derivation of proper correlation between axle loading and pavement failure have been carried out. These relationships will help the various State and Federal Road Maintenance agencies in drawing up appropriate strategies for their maintenance operations.

**PAPER ELEVEN**

# ROAD SAFETY AUDIT OF NIGERIAN ROADS: IMPLICATIONS FOR DESIGN, CONSTRUCTION AND MAINTENANCE

The paper discusses current views on the application of road safety audit (RSA) as a tool for traffic safety improvement in the areas of design, construction and maintenance of roads and considers features that can influence its effectiveness on the field. The main questions identified were related to means of mitigating the effect of mismatch of Road environment, Vehicle, and the Road User. It also discusses the imperative for support and the degree of integration and enforcement of RSA among others. Main features observed in the study include the need for incorporation of RSA as a vital tool in the areas of design, construction and maintenance of roads in Nigeria. The paper mirrored on the success stories of countries where Road Safety Audit is embraced and discussed the national current positional assessment with a view to institutionalise such in Nigeria. The paper recommends the development of a legal framework to strengthen the practice of

R S A ,  
introduction  
of  
Standard  
Road Safety  
Audit  
Guidelines  
and  
required  
training for  
professionals  
with  
relevant  
academic  
background  
as Road  
Safety  
Auditors. Conclusively, relevant Agencies must demonstrate their commitments, support and willingness to incorporate audit findings where applicable.



**Osita Chidoka**  
Corps Marshall and Chief Executive  
Federal Road Safety Commission (FRSC)

## PAPER TWELVE

## INFLUENCE OF PAVEMENT DISTRESS ON TRAVEL TIME (A CASE STUDY OF WUSE DISTRICT, ABUJA)

By

**O.D. AKINMADE, D.S. MATAWAL, F.O. AITSEBAOMO, E.B. OJO,  
J.E. MAICHIBI, I.K. ADAMU AND U.J. BALA**



**Daniel O. Akinmade,**  
Road Research Department, NBRI

In the planning and design phases of road networks, the estimation of traffic flow parameters is crucial. Such parameters include travel time which is an

indicator or a measure of the condition of the existing road surface. In this study, travel time along a designated stretch of roadway was established using Moving Car Observer (MCO) method. A 1.2km stretch of a two-lane roadway along Wuse Zone 2 within the Wuse district of the F.C.T was used as test section. Studies were conducted on the test section before and after rehabilitation to ascertain the influence of pavement distress on travel time.

Before the rehabilitation of the road, a visual assessment of the road showed that cracks were the predominant distress type, covering about 60.29% of the roadway. Other distress types observed include potholes and patches (36.76%) and polishing (2.94%). Prior to rehabilitation, travel time and traffic flow were 3.06mins and 713veh/hr respectively from points A to B; and 3.4mins and 700veh/hr respectively from B to A with level of service LOS Category B. However after rehabilitation, the travel times reduced to 1.49mins and 1.56mins respectively and traffic flows of 1177veh/hr and 1014veh/hr were recorded respectively with LOS of C. Results show that there was 51.3% and 55.04% reduction in travel time on both ways as a result of rehabilitation and maintenance. This paper highlights the impact of pavement distress on travel time and emphasizes the need for routine and timely maintenance of all roadways.



Test section of the road before and after rehabilitation

**PAPER THIRTEEN****EMERGENCY RESPONSE SERVICES RELATED TO ROAD ACCIDENTS**

The phenomenal increase in vehicular traffic on Nigerian roads has created a corresponding rise in road traffic accidents. Studies have confirmed that Nigeria has on the average the highest road accident rates in Africa. Response to these incidents has remained a national challenge and this prompted the development of a Search and Rescue and Epidemic Evacuation Plan (SREEP) in 2006 by the National Emergency Management Agency (NEMA). Strategies adopted, their implementation and outcomes on the execution of SREEP over the years were critically examined in this Paper. Also



**Air Commodore C.D. Otegbade,**  
Director, Search and Rescue, (NEMA)

considered in the Paper are the observed gaps and alternative strategies used in addressing effective responses to emergency situations, including those related to road accidents. The Paper concluded by making some recommendations which included but were not limited to the need to popularise and circulate 3 digit, toll-free Emergency Number; the entrenchment of Compulsory First Aid training for all citizens; Improvement of Nigeria's Road Network; promoting Improved Monitoring & Patrolling duties and adoption of global best practices in Road Traffic Management.

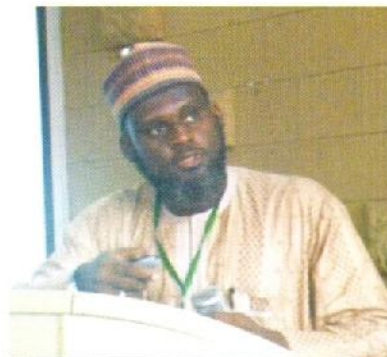
**PAPER FOURTEEN****THE EFFECT OF PAVEMENT CONDITION ON TRAFFIC SAFETY: A CASE STUDY OF SOME FEDERAL ROADS IN BACUHI STATE**

By

**A. MOHAMMED, S. Y. UMAR and D. SAMSON**

Civil Engineering Programme, Abubakar Tafawa Balewa University, Bauchi,  
P. M. B 0248 Bauchi, Bauchi State Nigeria.

The cost of highway accidents in terms loss of lives, injuries and road closures is a major strain on the Nigerian economy. It has therefore become pertinent to explore the causes of such accidents from a road condition perspective with a view to limiting their frequency and degree of severity. Three federal roads in Bauchi State were considered for this study; Bauchi - Jos, Bauchi - Gombe and Bauchi - Yobe Border, respectively. The pavement condition data indicated that Bauchi - Jos



**Dr. Abbagana Mohammed**  
ATBU, Bauchi

route has the highest Road Condition Score (RCS) while Bauchi - Gombe route has the lowest RCS. The Jos route also accounted for the highest number of accidents and fatalities despite having the best pavement condition, while the Yobe route accounted for the least number of accidents and fatalities. The results support the general view that there is no strong correlation between pavement condition and traffic safety, however some design and planning issues like the degree of curvature of horizontal and vertical curves and number of towns/villages on the routes seem to play important roles in traffic safety.

**PAPER FIFTEEN**

## EVOLVING A FRAMEWORK FOR APPROPRIATE FORM OF CONTRACT TO MITIGATE ROAD PAVEMENT FAILURES IN NIGERIA

The paper discussed and described the existing classification of roads in Nigeria which are the trunk A, F, B and C.

It also identified road as the commonest means of transportation with a network of roads estimated at 200,000 km. However, the paper noted that based on research statistics, the Nigerian road is one of the most dangerous in the world and the state of roads in most part of Nigeria today leaves much to be desired. As a result of a combination of factors, most of the roads are ridden with potholes and gullies which make road transport slow and unsafe. Indeed, Road Safety Survey in 2011 showed that Nigeria was rated by the UN as the second worst in the world in road accidents due to the deplorable state of its roads.

The paper highlighted some of the causes of road failures in Nigeria to include Poor design and construction; Use of Low Quality Materials; Poor



**Rotimi Balogun,**  
Nig. Infrastructure Bank Ltd

Workmanship; Badly executed Road Construction Contracts; Heavy Traffic loading and Poor Maintenance Culture. As remedial measures, the paper suggested a diagnosis of the weaknesses in the process through which the road construction contracts are awarded while looking at the regulatory framework of the Public Procurement Act 2007. He also stressed on the use of appropriate form of contracts which imbibes strategies to control performance of the contract; application of uniform technical specifications as well as performance bond. The use of mile-stone payment and liquidated damages clauses should be properly applied to avoid any compensation for breach.

In conclusion, the paper emphasized on the need for appropriate strategies to be devised and implemented by Government in order to ensure that the quality of roads delivered by the contractor justifies the enormous resources expended by the Government on road construction.

### *Continued from Back page*

achievements in the development of alternative building materials especially walling and roofing materials. This also involved the development of machines for the production of construction materials with high local content. At the moment, he highlighted, NBRRI is working assiduously on erecting a pilot plant on Pozzolana Cement in Ota as well as on an array of studies to ease and improve construction of building/road in Nigeria. While still briefing the team, he stressed some new technologies on affordability/energy efficiency in buildings which the institute is presently working on. He welcomed ideas and collaboration on these and other issues for the benefit of the built environment.

Prof. Matawal stated that the institute have good working relationships with several organizations including the Federal Ministry of Lands, Housing and Urban Development (FMLHUD), Federal

Ministry of Works (FMW), Council for the Regulation of Engineering in Nigeria (COREN), National Emergency Management Agency (NEMA), etc.; and is ready to partner also with GIZ.

In addition to the National Laboratory Complex of the Institute located in Ota, the DG further stated, NBRRI is presently setting up a Materials Testing Laboratory in its office in Abuja to service the construction industry in addition to facilitating the execution of its R&D programmes. The laboratory is presently equipped with more equipment being expected shortly for the testing of concrete, cement, asphalt, soil and steel.

Reacting, the representatives of GIZ expressed their satisfaction with the briefing received and promised to evolve areas of possible collaborations in line with their programmes. The guests also informed the institute's management of their proposed workshop and sought the cooperation of NBRRI towards the planning and implementation.

## NBRRI HOSTS RIGAN COUNCIL MEETING

The 46<sup>th</sup> Council meeting of Research Institutes Games Association of Nigeria (RIGAN) was hosted by the Nigerian Building and Road Research Institute, NBRRI at its National Laboratory Complex in Ota, Ogun State from 11<sup>th</sup> – 14<sup>th</sup> June, 2013. RIGAN is an association which integrates and unifies all research institutes across the Country through sporting activities.

The RIGAN President, Mr. Okolo welcomed all the Council members at the opening Ceremony and appreciated NBRRI Management and Staff for coming out en-mass to welcome council members and grace the occasion. Mr. Okolo took the opportunity to thank the Director-General/Chief Executive Officer of NBRRI, Prof. Danladi S. Matawal for hosting the 46<sup>th</sup> RIGAN Council meeting and for bringing NBRRI back to full participation in RIGAN activities after many years of absence. He finally prayed for love and unity amongst the council members. The Director-



RIGAN Members with Representative of DG/CEO, NBRRI

General/CEO, NBRRI who was ably represented by the Coordinator of the Laboratory Complex, Dr. Francis Aitsebaomo declared the meeting open. In his address, Prof. Matawal welcomed all the RIGAN Council members to the Institute. He took the opportunity to explain the activities and achievements of the Institute to the council members. He also threw more light on the importance of sports and the role it plays in making workers more emotionally balanced and fit in the discharge of their duties; and promised to support the

activities and programmes of the Association. He specifically gave assurance that NBRRI would participate in all RIGAN activities henceforth.

The various council members who took turn to give their goodwill messages appreciated the efforts of the Institute in hosting the meeting while acknowledging the assurances on the full participation of NBRRI in future RIGAN games.

## NIOB ABUJA CHAPTER VISITS NBRRI TO STRENGTHEN PARTNERSHIP

*Continued from page 9*

He noted that historically, NBRRI and NIOB have been development partners in the industry in the country. He however enjoined the NIOB to encourage and direct their members who are professional builders to use tested R&D innovations and findings especially those from NBRRI in their professional practice, noting that this will go a long way to ensure high local content in housing delivery which is critical in achieving Nigeria's vision NV20:2020

Prof. Matawal further noted that not every Nigerian has to own a house but all Nigerians must live in a comfortable homes. Hence, there should be proper

planning in the provision of houses in Nigeria which should incorporate basic and recreational facilities in residential estates. He stressed that the issue of quacks in the building industry should be properly addressed and that the NIOB has a great role to play in this respect. He specifically enjoined the NIOB to ensure that standards are maintained and to partner with NBRRI in developing a curriculum for the training of artisans in the construction industry. He informed the delegation that NBRRI will soon commence the Pilot production of Pozzolana Cement in Ota as well as open a Construction Materials Testing Laboratory in Abuja.

# NIGERIAN STUDENTS UNION HONOURS PROFESSOR MATAWAL

An offshoot of the Nigerian Students Union known as the Inter-Community Students Union of Nigeria bestowed leadership Award as **Vanguard of True Federalism of the Year** on Prof. Danladi Slim Matawal, the Director-General/Chief Executive Officer of the Nigerian Building & Road Research Institute, NBRRI.

The Union also presented a Corporate Merit Award of Excellence to the Institute. The Award was in recognition of the Institute's outstanding contribution to Building Research, Road Research and Infrastructural Development in Nigeria as well as for their immense contributions to Nation Building, meritorious Service to God, Humanity and Nigeria.

Leading the team of Students Union was Comrade James Umeze, the President-General of the Union. He informed the guests at the Award ceremony that the Union is the umbrella body for all Students of various ethnic, tribal and community groups operating in institutions outside their homelands all over Nigeria. He stated that the objectives of the Union include seeing to the welfare of her members in all institutions of learning, defending their rights as citizens of the Federal Republic of Nigeria and representing their opinions on issues of campus, State and national importance as well as celebrating the ideals of true federalism in Nigeria, etc.

Comrade James Umeze further stated that, in line with the motto of the Union 'In the Spirit of True Federalism', the Union amalgamated intellectually to contribute to the development of Nigeria. It draws its membership from all strata and hierarchy of formal educational institutions to examine, scrutinize and recognize individuals, public office holders and entrepreneurs who distinguished themselves convincingly enough in the discharge of their responsibilities. It carries out this assignment from time to time. "It was at the meeting of Inter-Community Students Executives/Senate held between 26<sup>th</sup> and 28<sup>th</sup> April 2013 at the Federal Polytechnic, Bida, in Niger State, that the immense contributions of Prof Matawal to the construction industry, the academia and humanity came to the front burner. The highlights of the attributes that earned him the Award were his disposition to patriotism, public service and national unity which were considered as incomparable" he stated.

The Union leader further stated that sincere and nationalistic disposition of Prof. D. S. Matawal in executing the Institute's mandate to enhance service

delivery in the construction industry were some of the attributes considered and evaluated; and which qualified him for the prestigious Award as VANGUARD OF TRUE FEDERALISM. The evaluated service delivery criteria were in the area of building, road and engineering materials research and development; development of innovations in the construction industry; community and socio-economic development; human capacity development; youths/students empowerment; leadership qualities; commitment and effectiveness; among others.

The President-General, ICSU Comrade James Umeze took the opportunity to call on all political office holders, all administrators of national resources, managers/ key players of the economy and all leaders of Africa to give pragmatic priority to Educational development, socio-economic development, health care development, technological and scientific advancement, youth empowerment and community development; for only through these will Nigeria experience genuine development.

In his response while receiving the award, the Director-General/Chief Executive Officer, Prof. Matawal welcomed and thanked the Students body for finding him worthy for the award. More importantly for him was the recognition given to the Nigerian Building and Road Research Institute. He appreciated the Students Union for recognizing the work and achievements of the Institute.

Prof. Matawal stated he shared in the vision and objectives of the Union. For him also, he believes that education is the bedrock of the future of any nation, and should not be toyed with. He reiterated that Science and Technology is the driving force for the socio-economic advancement of any nation while citing examples from developed and developing nations like Malaysia, China and the likes that have developed because of the importance and priority placed on Science & Technology to drive all facets of national economy.

He noted that NBRRI has placed a lot of emphasis on youth/community development and empowerment through its programme of provision of rural access roads using community-based technology.

Prof. Matawal took the opportunity to encourage the Students to streamline their activities with that of other Student body with similar vision and objective to promote the ideals which they believe in. He also encouraged them to take their studies seriously and excel in their various courses of study which will make them better persons in the future Nigeria.

## BIRTHDAYS

S/N	NAME	DEPARTMENT	DATE OF BIRTH
1.	A.M Fakeye	RRD	1 <sup>st</sup> April
2.	Obidozie Ndidi Virginia	CES	4 <sup>th</sup> April
3	Okolo Idah Grace	A/F	4 <sup>th</sup> April
4.	Orkoliko Arome S.	A/F	5 <sup>th</sup> April
5.	Essien Bassey Udoh	A/F	5 <sup>th</sup> April
6.	Osuagwu P.N	RRD	10 <sup>th</sup> April
7.	Effiong Okon Edet	A/F	10 <sup>th</sup> April
8.	Makwin Paul Luka	A/F	12 <sup>th</sup> April
9.	Avre Kazzi Gaius	BRD	14 <sup>th</sup> April
10.	Taiwo Ayandapo Michael	A/F	14 <sup>th</sup> April
11.	Ojo Emerso Beckley	RRD	15 <sup>th</sup> April
12.	Mudi Bello	A/F	15 <sup>th</sup> April
13.	Ibrahim Mohammed	A/F	15 <sup>th</sup> April
14.	Diji Nduka J.	A/F	16 <sup>th</sup> April
15.	Etuk E.A	RRD	18 <sup>th</sup> April
16	Bulus Oliver Stephen	A/F	18 <sup>th</sup> April
17	Bobzum B.G	RRD	19 <sup>th</sup> April
18	Gai Friday Iliya	—	20 <sup>th</sup> April
19	Sunday Egbe	A/F	21 <sup>st</sup> April
20	Edom Atomen	BRD	24 <sup>th</sup> April
21	Okpebho Enobakhale	A/F	24 <sup>th</sup> April
22	Olorunfemi A.C	PITD	26 <sup>th</sup> April
23	Sosanolu Omoniyi	RRD	26 <sup>th</sup> April
24	Abu Sunday Paul Agwu	PIT	1 <sup>st</sup> May
25	Chimezie Onyema	A/F	2 <sup>nd</sup> May
26	Ebenezer Asala	A/F	2 <sup>nd</sup> May
27	Umar Saidu Mohammed	A/F	2 <sup>nd</sup> May
28	Ogwu Ekele	EMRD	3 <sup>rd</sup> May
29	Aka Endurance	RRD	5 <sup>th</sup> May
30	Sanni Jeremiah D.	BRD	6 <sup>th</sup> May
31	Akanbi Dayo Oluwatoyin	RRD	7 <sup>th</sup> May
32	Durojayi A.M	PIT	8 <sup>th</sup> May
33	Ojachiere Rukeuwe	BRD	9 <sup>th</sup> May
34	Ojo F.A	RRD	10 <sup>th</sup> May
35	Elisha Gelkur	A/F	11 <sup>th</sup> May
36	Ibe Kingsley e.	BRD	11 <sup>th</sup> May
37	Effiong Effiong Okon	A/F	12 <sup>th</sup> May
38	Taofiq Bello	BRD	12 <sup>th</sup> May
39	Friday Ichehu Apeh	EMRD	13 <sup>th</sup> May
40	Lamidi Rashidat Bukola	RRD	14 <sup>th</sup> May
41	Dada Kazeem	RRD	14 <sup>th</sup> May
42	Iliya Yusuf	A/F	15 <sup>th</sup> May
43	Omange George N.	PIT	17 <sup>th</sup> May
44	Onwusiri Ignatius Sunday	A/F	18 <sup>th</sup> May
45	Cecilia Agida Omari	CES	19 <sup>th</sup> May
46	Ali O.J	A/F	19 <sup>th</sup> May
47	Abubakar Khadya	CES	20 <sup>th</sup> May
48	Babatunde A.O	A/F	22 <sup>nd</sup> May
49	Makwin Mandiyong Danladi	A/F	25 <sup>th</sup> May
50	Ademosu B.	PIT	25 <sup>th</sup> May
51	Paul Isebor	A/F	26 <sup>th</sup> May
52	Igbiele Sylvester N. E	A/F	27 <sup>th</sup> May
53	Bassey Jack Edet	DG's Office	27 <sup>th</sup> May
54	Achema Felix	EMRD	28 <sup>th</sup> May
55	Chukwura Chris N.	PIT	30 <sup>th</sup> May
56	Tenimu Ahmed	A/F	7 <sup>th</sup> June
57	Oladipo T. Oluwatosin	RRD	8 <sup>th</sup> June
58	Bala Uba Jidere	RRD	9 <sup>th</sup> June
59	Atiku Sabitu Dabai	BRD	10 <sup>th</sup> June
60	Umar Enejo Yusuff	EMRD	13 <sup>th</sup> June
61	Magdalene Usen	A/F	15 <sup>th</sup> June
62	Yashi Jennifer	RRD	16 <sup>th</sup> June
63	Enenche Agbo U.	A/F	16 <sup>th</sup> June
64	Fiyebó Samson A.B	EMRD	17 <sup>th</sup> June
65	Anyimokoro E.J	BRD	18 <sup>th</sup> June
66	Fabiyi Mustapha O.	EMRD	18 <sup>th</sup> June
67	Ibhadode Osagie	BRD	19 <sup>th</sup> June
68	Salami Samshudeen	BRD	20 <sup>th</sup> June
69	Akande Cecelia N	A/F	20 <sup>th</sup> June
70	Larry Marcel Oforji	BRD	21 <sup>st</sup> June
71	Yunusa Salu	A/F	25 <sup>th</sup> June
72	Menegbe Ralph Atsumbe	A/F	27 <sup>th</sup> June
73	Thomson A.E	A/F	28 <sup>th</sup> June

## WEDDINGS



Former Miss Aka Endurance of Road Research Department got married to Mr. Emmanuel Okonufua on 16<sup>th</sup> March, 2013.



Mr. Akanbi Dayo Oluwatoyin of Road Research Department got married to former Miss Akintara Abiola Olawumi on 18<sup>th</sup> May, 2013 at Ogbomosh, Oyo State



Salifu Blessed of Planning and Information Technology Department, Ota got married to former Miss Blessing Unewku-Ojo Musa on 13<sup>th</sup> April, 2013.

## BIRTHS



The family of Mr. Sylvester Arome Okoliko of Administration and Finance Department, Ota, was blessed with a bouncing baby boy, Gabriel Ojonukphai Okoliko Jnr on 21<sup>st</sup> May, 2013.

# NBRRI TO PARTNER WITH GERMAN GOVERNMENT

**T**wo representatives of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Dr Sussane Giessler and Ene Macharm, paid a working visit to the Nigerian Building and Road Research Institute NBRRI with the aim of establishing a working relationship with the Institute. They informed the Director-General, Prof Danladi Matawal and the his Management team that GIZ is an international organization which acts on behalf of the German Government and supports the latter in achieving its objectives in the field of international cooperation for sustainable development. GIZ in cooperation and collaboration with Nigerian partner launched the Nigerian Energy Support Programme (NESP) which aims at promoting renewable energy, energy efficiency and rural electrification in Nigeria. In its quest for innovations and ideas on

renewable energy technologies, GIZ has met with various stakeholders who have promised cooperation. NBRRI, being an institute active in developing/promoting new building technologies and energy efficient technologies, GIZ thought it wise to pay a visit, discuss and explore areas of collaboration with NBRRI.

The Director General NBRRI, Prof. Danladi Matawal, welcomed the team from GIZ. He noted that GIZ is one of the groups whose objectives align with the mandate of the Institute. The mandate is

basically to build capacity and conduct integrated applied research and development (R&D) activities in building, road and construction sectors of the economy. In particular, NBRRI is required to conduct research on local building and construction materials to determine the most effective and economic methods of their utilization; architectural design of buildings to suit Nigerian climatic conditions with respect to lighting, ventilation, thermal comfort and humidity; etc. The institute, he stated, is working on uplifting the lives of the populace through the use of renewable energy.



**DG/CEO NBRRI, Prof. D.S Matawal flanked by Sussan Giessler (left) and Ene Marcham from GIZ**

The DG/CEO further reiterated that the institute conducts R and D in areas of designs that best suit the Nigerian climate and highlighted on the success stories of the Institute in capacity building and applied integrated research development.

He informed the visitors that the institute holds annual conferences and to date three

Conferences have been held between 2011 and 2013. The first Conference in 2011 was titled STALKHOLDER FORUM, the second in 2012 was on CHALLENGES OF BUILDING COLLASPE IN NIGERIA while the third in 2013 was focused on THE CHALLENGES OF ROAD PAVEMENT FAILURE IN NIGERIA. The workshops were huge successes and the objectives attained.

As a matter of emphasis Prof. Matawal told the delegates that NBRRI has recorded significant

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