Arts and Design Studies
ISSN 2224-6061 (Paper) ISSN 2225-059X (Online)
Vol.7, 2013
www.iiste.org

Architecture and Emerging Cities: The Impact of Technological Change in Building Material

A Study of Minna, Nigeria

Mustapha .A. Raji*

Department of Architecture, Federal University of Technology, Minna. PO Box 65,Minna .Niger State.

* E-Mail:jabal87@gmail.com

Abstract

The rapid development of modern city can be attributed to the new technologies in building construction, urbanization and the need to change the urbanscape of the city, the ever changing needs of the society and persisting environmental problems has also necessitated the emergence of new cities all over the world. Thus, Architecture plays a pivotal role in the design and implementation of modern cities and towns. The Impact of industrial revolution gave rise to new materials to the Architects of the 20th century: reinforced concrete, steel and glass, these new materials were inexpensive, mass produced and flexible to use, thereby serving as main building components. The aim of this paper is to check the level of technology in regards to building materials used in construction in Minna. The paper will identify modern building materials currently used in construction and the existing local building components and materials that are visible in the buildings in Minna. Findings were appraised along with the impact of technology on building materials by analyzing the level of modern building materials that have been used in construction. The paper finally concluded that impact of technology is evident in the transformation of the Indigenous Architecture of Minna although some buildings are still built with the use of crude techniques and with the combination of modern and traditional building materials.

Keywords: *Architecture, Modern Building Material, and Technology*

1.Introduction

Architecture plays a vital role in the emergence of new cities in any country. The need for to have a modern city can be attributed to the new technologies in building construction and the need to change the landscape of the city. Technology directly affects architecture by facilitating creation of new materials with which to build. These new materials provided the Architect efficiency from engineering limitations of the past and allowed for new rational designs. Technology transformed architecture into a tool for social and cultural reform. The Industrial Revolution gave three new materials to the architect of the 20th century: reinforced concrete, steel and glass. The new materials were inexpensive, mass produced and flexible to use. The need to redevelop the urban landscape affected major cities in the world profoundly by allowing greater density through higher buildings. Over decades there has been massive development of new cutting edge building materials and this gave raise to rapid building development and confidence to innovate massive buildings, since highly needed skills where required to construct buildings.

1.1 *Statement Of Problem*

The redevelopment of urban center involves serious planning thus Architects and Urban Planners are responsible to provide guide lines to these new development. The problem identified is the inability to apply modern technologies in modernizing the indigenous building materials as thus limiting their usage in the building industry.

1.2 *Research Questions*:

The research questions are:

1. Should technology drive building design?
2. Has technology been used to modify our building materials?
3. Have Schools of Architecture and Building Technology implemented their research finding as a pilot programme?
4. Has technology influenced our spatial requirement and comfort levels?

1.3 *Study Area*

Niger state has two major ethnic groups; The Gbagyi's and the Nupe's. These groups form a major part of the population of the state. Both ethnic groups possess rich and diverse cultural heritage which finds expression in farming, arts and craft, dancing and the traditional Durbar (Horse Racing)
The area Niger state lies between latitude 09°37'N and longitude 006°32'E with elevation above level of 260m, 853'. The population is estimated to be 3,950,249 according to (2006 Census). The major occupation of the inhabitants of this State is farming of which 85% of the active labour are engaged, while 15% in other fields of occupation. The state currently covers a land area of about 76,469,903km^2 out of which 86% of the land is arable. It is characterized with a sub-humid climate with two different seasons. The soil is mainly tropical ferruginous soils with hydromorphic characteristics. Deep seated laterite crust occurs over extensive areas on the plains. The relative humidity varies between 65% - 80% in the rainy season 40% - 65% in the dry season and evenly distributed rainfall with annual record of between 100.81mm – 271.9mm.The prevailing winds the North- East Trade Wind (N.E.T.W.) and the South West Trade Wind (S.W.T.W.). The area

within the Northern Guinea Savannah which consists scattered trees and short shrubs, mostly economic trees such as Mango, Orange, Shea butter, while other trees include; Mahogany, Obeche and Iroko which are used as timber and as building materials.

Figure 1:Map of Nigeria showing the location of Niger State.

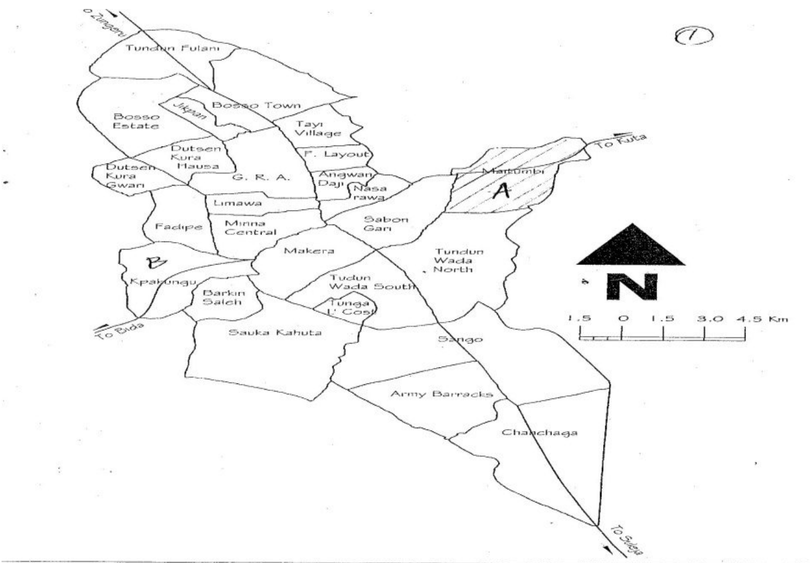


Figure 2: Map of Minna Showing the Sample Area.

2. Theoretical Framework

Modern Technology began to influence the cities by the end of the First World War in 1918. Within this period, architecture began to evolve and some notable scholars developed their style of architecture thus experimenting on new technology in materials and techniques. The different Architectural styles developed as a result of technical development and ideas of Architects. The ambition of Architects together with development requirements of clients had a repercussion on technological development. As a consequence, architectural trends can be explained not merely by changes in technology but also by changes in architectural ideas and requirements of clients.

Technological progress has always had its impact on architecture. However, so massive has been the progress of science over the recent past and so continuous the changes in architectural design that the question has now arisen as to whether we are not standing at the dawn of a completely new era. Is new science not evoking a completely new architecture? Gyula S and Chris P (2003). Are the new Computer-based design techniques and the new curved buildings not promoting the period of a new, non-linear architecture? The question has indeed been raised (Jencks, 1997). However, it is certain that technological progress has an increasing influence on architecture.

The impact of technology on building design can be visibly identified in the use of building materials which affect the architectural appearance of buildings. Architectural design at all times has had to reckon with the available technology materials and processes. Building materials and their potential performance have right from the very outset formed the starting basis for shaping buildings therefore the available technologies in stone, mud, bamboo, palm fronds and timber in earlier historical periods; in iron/steel, bricks and concrete since the nineteenth century and recently in glass and plastics have all influenced the appearance of buildings.

3. Modern Building Material

Steel sections are hot and cold-rolled, welded or bent. Aluminum sections are extruded, aluminum panels cast. Glass sheet is manufactured by different continuous automated methods with differing compositions of the glass. Plastics components are extruded and thermoformed. New sealants and fasteners have been invented. Concrete and reinforced concrete have opened up new vistas for manufacturing and construction, including the design based on up-to-date technologies. For concrete and other materials, prefabrication (off-site processes) provides new opportunities (Gibb, 1999). There exist various components which may be prefabricated: wall panels (cast as a whole or unitized from elements), volumetric units (modules or boxes), floor, ceiling and roof panels, sanitary blocks (WCs, bathrooms, kitchen units), partitions and others. Fabrication methods have to be selected; those for example for reinforced concrete panels include casting in horizontal position, casting in vertical position individually, or in batteries (i.e.

in group forms). The design of prefabricated components must solve new problems, such as transportation in the factory, on the road or by rail, on the building site.

Modern Building materials have revolutionized the nature of our built environment and enhanced the spatial arrangement of internal spaces in our Architectural designs, Much more, the external features of the building are becoming a frame shell for the use of state of the art building materials. Our role as Architects in the built environment spans beyond designs into becoming an advocate of appropriate technology in other to use the available required technological technique to produce a building material that will resolve the design problems of the specific region or country.

In Nigeria, the use of Indigenous building materials is evident in few modern buildings. This serves as a failure on the part of the professionals in built environment to integrate the use of indigenous building materials in the building construction. When compared to China and Japan's cityscape, it is evident that there is a good use of indigenous materials in their buildings. According to Isaac. O & Manasseh. J (2008), it was posited that the use of stabilized laterite brick for construction is quite economical and is environmental friendly as its good thermal properties helps to regulate the internal temperature of the interior spaces, thus its adequate to be used in building construction in temperate region.

4 Identified Common Modern Building Materials In Nigeria

The use of building materials affects the nature and architectural style of buildings in any environment. The advent of technological change gives room for innovation and creativity to develop new building materials. The following building materials were examined to give an insight on the properties and its effect on the environment.

4.1 Timber

Timber has long been used in construction and remains to this day a basic material in some regions although mostly in an industrialized form. Timber is an important raw material for construction but with effects to the environment. Timber and other natural materials were the earliest building materials and in its modern form timber continues to serve as a basic building material and its properties greatly influence the evolution of architectural design (Actualités, 1999). It is a known fact that timber has a high strength to weight ratio. Its strength and stiffness are dependent on the direction of load in relation to the grain. It is strong and relatively stiff parallel to the grain. However, it is prone to defect along the grain if tension stresses are perpendicular to it, the shear strength and shear modulus. Higher moisture content reduces both the strength and elasticity, and a part of the original strength will anyway be lost over time. Service-ability therefore often governs structural analysis. Detailed design and processes of technology take care of a number of the specific problems of timber structures, such as buckling, behaviour around notches, prevention of interstitial condensation, protection against moisture, insect and fungal attack, and fire (Sebestyen, 1998). The progress in the use of timber has some major effects on architecture.

New timber products, for example various types of boards (plywood, fiberboard, particleboard, oriented stranded board, wafer board, flake board), tapered, curved or pitched cambered beams, glued thin-webbed beams, sandwich panels, portal frames and arches.

4.2 Steel

Iron (cast and wrought) has long been utilized in building but steel was introduced only in the course of the second half of the nineteenth century Blanc et al., (1993). Its introduction gave rise to the construction of tall structures (skyscrapers and towers) and long-span structures in the form of bridges and spaces covered by domes, shells and space trusses. Seitz, (1995) posited that it has been used in all sorts of standard buildings as well as Industrial halls, Agricultural Buildings, Commercial Malls, Military Base, Hangers in Airports etc.

Carbon steel is the base metal used for most steel products. An increase in the amount of carbon improves the hardness and tensile strength of steel. Carbon content however inversely affects the ductility of steel alloy and the welding ability of the metal. Various elements phosphorus, manganese, copper, nitrogen, sulphur and others modify the properties of steel. Some of the most important product categories are hot-rolled, cold-rolled and cast steel products. Welding, mechanical jointing, painting, coating, enameling are some of the technologies behind transforming basic steel products. New fabrication methods, new alloys, new structural schemes and new fastenings were invented, all of which exerted varying impact on architecture.

The use of steel in the reinforcement of concrete gave confidence to Architects and Engineers to design and construct tall buildings and generated numerous advancements in the application of steel in building construction.

The construction of skyscrapers with the use of alloys of steel for exterior facade also activated the proliferation of high tech sky scrapers in developed countries which is also becoming visible in the skyline of developing countries.

Plate 1: Showing Zaha Hadid's dancing Tower this explains the use of technology in architecture. Source: Robyn.G (2008)

4.3 Aluminum and Other Metals

Aluminum is the most commonly used metal (not as chemically pure metal but in the form of alloys) as structural building materials. Copper, Lead, Zinc, Titan (titanium) and their alloys are applied for specific purposes and various surface finishing, primarily metallic or paint or plastics coatings, (Zahner, 1995). Aluminum was introduced in building construction later than steel but its use is increasing. The first spectacular architectural application of aluminum was the cast aluminum pinnacle of the Washington Monument in 1884. The architectural use of aluminum accelerated after the First World War. The range of application is broad:

- Curtain walls: the application of Curtain walls in the interior and exterior of a building eliminates 35% of live load to be transferred to the foundation of the building. It also enhances the aesthetics of the building facade. The use of Aluminum curtain walls increased the wide range of the use of glass in building.

- Suspended Ceilings: Drop down ceilings are provided to conceal service installations pipes, electrical cables, water tanks. The frames and hangers for the suspended ceilings are made up of Aluminum.

- Claddings: Building surface can be cladded with light weight Aluminum materials as they reduce the use of paint in the exterior and prevent direct impact of solar radiation on the interior of the building.

- Louvers: The Frames to receive the glass is usually made up of light weight aluminum, these is gradually no longer attractive in most buildings.

- Space frames: In the construction of Space Frames a high quality aluminum alloy or steel is required to cover a wide span of space. It is used to construct buildings with an un convectional shape.

- Roofing coverings: Roofing Sheets are mostly made up of Aluminum or its alloy with different varieties of roofing sheets available for construction purpose.

The two basic classes of aluminum and its alloys are cast and wrought aluminum. The modulus of aluminum is about one third that of steel. The consequence is that the deflections of aluminum members under load are greater than those of steel. Aluminum's thermal conductivity and thermal expansion also exceeds that of steel. On the other hand the corrosion behaviour of aluminum is superior to that of steel. These and some other properties have an impact on structural and architectural building designs.

Plate 2: Aluminium used for Roofing
Source: Author's fieldwork.2011

4.4 Brick, Stone and Sandcrete.

Brick and stone are among the oldest materials used in building construction. They are still materials for masonry and are used by prefabricating large panels with a thin exposed brick surface and backed by a thin reinforced concrete layer and finally gluing also provides a solution. Sandcrete Hollow Block contains cement, sand and water. It is used to build up the walls of a building. The development of sandcrete block is as a result of technological change from mud and stone although great modification has been carried out in both building material.

Masonry uses various types of bricks and concrete blocks. In recent times innovative types of masonry products have been introduced, such as flashing block, moisture control block, dry stack masonry systems, thin brick systems, new mortar additives and new masonry ties. Beall, (2000). In modern, post-modern and contemporary architecture stone has relinquished its position as a structural (load-bearing) material. However, it is much favoured in specific functions, such as cladding for curtain walls, floor paving, sculptural and decorative purposes. In curtain walls it is used as thin slabs suspended on a steel frame. In Saudi Arabia, stone (marble veneer) has seen increasing application over the last 30 years Idris, (2000).

Plate 3: Sandcrete Block used to build modern Buildings
Source: Author's fieldwork.2011

4.5 Glass and Structural Glass

Glass performs a significant function in space divisions, heat and light control. It has been present since ancient times so it fully justifies being considered as a traditional material in some countries. Glass however was expensive and so enjoyed only restricted use up to the nineteenth century. Mass production of sheet glass, the development of steel frames, cable structures, fixing devices and systems as well as of elastic and elastoplastic sealant changed this and resulted in a number of innovative solutions and systems. During the twentieth century the curtain wall emerged with new types of glazing. However on the façades of the skyscrapers, linear glass fixing components were still present. Wigginton,(1997).

In recent times glass frames (facades and roofs) have developed into high-tech components: polyvalent or intelligent envelopes. These have a role to play in the control of thermal quality such as: heating, ventilating, cooling, air conditioning and lighting.

The glass used for facade may also contribute to the improvement of environmental conditions by enabling the designer to plan green areas on various floors; Glass structures provide a more important field of cooperation between Architects and Engineers with consequences for the architectural design and the aesthetics.

Structural glass can also be used as a roof over open space such as swimming pools, gardens, staircases and internal wall partitions.

Plate 4: Showing the use of glass as curtain wall in the Dubai Grand Pyramid
Source: Robyn.G (2008)

Plate 5: showing the use of glass in window.
Source: Author's fieldwork.2011

4.6 Concrete and Reinforced Concrete

Research and innovation resulted in various new or improved types and properties of heavy and lightweight concrete, new production technologies such as pre-stressing, and new structural analysis and design methods for various loads and actions. Relatively recent is the intelligent and high-performance concrete. The use of glass, polypropylene and steel fibres (including textiles and fabrics made from such fibres in concrete) has come a long way over recent years, Sadegzadeh et al 2001.Cladding panels have been developed, which utilize the new potentials of concrete. High quality performance concrete is prepared with cement, mineral and chemical additives (fly ash, super- plasticizers, polymers, silica fume, granulated blast furnace slag, high-reactivity Meta kaolin) and is reinforced with fibres instead of steel rods Nawy, 1996, Shah & Ahmad, (1994). Some of the realizations with high-performance concrete are high-rise buildings.

New developments in concrete are concrete with resins and concrete with fibre-reinforced polymer (FRP) reinforcement. Both, eventually in a combined form, are used in repairing damaged or cracked concrete structures (rehabilitation and strengthening) as well as for some specific types of constructions. Gyula S and Chris P (2003), a more recent innovation is the twin application of FRP reinforcement and fibre optical sensing, which produces 'smart structures' automatically monitoring structures. Among the new technologies, concrete with exposed surfaces has developed and these surfaces have an influence on architecture. One of the most common trends of industrialization in building is the development of 'systems', i.e. 'system building'. Such systems were developed in housing, educational constructions and in industrial and other buildings. Systems are characterized by some kind of load-bearing structure (in steel or concrete) and a façade system with either large panel manufactured from reinforced concrete or a lightweight system (with a timber or steel frame) and of recent researchers are still finding answers to some questions on this approach.

Plate 6: Showing an Apartment building constructed with a lightweight concrete
Source: Robyn.G (2008)

4.7 Plastics, Fabrics And Foils

According to Gyula S & Chris P (2003), structural and space-enclosing purposes, synthetic materials, mostly polymers and polymer composites, are also used to produce building components. Their properties are so different from those of traditional materials that their design calls for specialized knowledge and care. Their fabrication processes usually favour curved surfaces, which in themselves results in new forms, unfamiliar in former construction. There are different types of polymers. They are: the thermoplastics (polyvinyl – PVC, polyethylene – PE, polypropylene – PP, polystyrene – PS,), the thermosets (polyurethane – PU, epoxies) and the elastomers (synthetic rubbers). Plastics and the composites manufactured from them have low modulus of elasticity. The required rigidity of a structure must therefore be derived from the shape rather than from the material. Shapes with high rigidity are three-dimensional surface structures such as domes, shells, or folded plates and are constructed better with polymers. Plastics are applied in construction for many purposes: glazing, skylights, roofs, heat, sound and water insulation, enclosures and claddings, windows and doors, lighting.

Ceilings can now be covered with plastics, suspended roofs (membranes) are made from coated fabrics or foils: PVC or Teflon-coated glass fibre, polyester fabrics, or ETFE foils. PVC-coated polyester fabrics were mostly used in Europe. Various experiments were undertaken in the production of whole buildings to be assembled from components made from plastics. In many cases these were successful for small buildings (kiosks, one-family houses) but not so for larger buildings. Larger buildings invariably require a frame or other load-bearing structure made of concrete, steel, or other non-plastic structural material. A great number of buildings with a combination of different materials, including plastics, have been assembled. Gyula S and Chris P (2003).

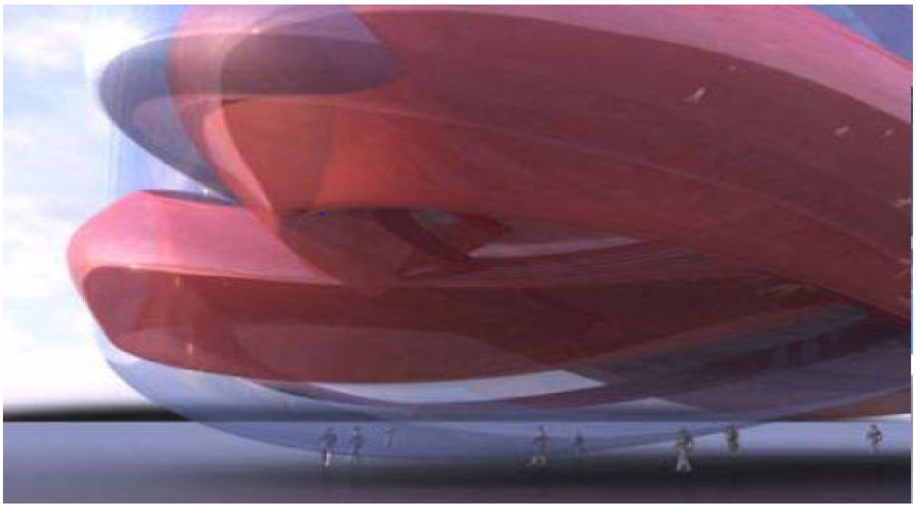


Plate 7: showing the use of PVC as internal material in the Dubai cultural Hub.
Source: Robyn.G (2008)

5. Identified Traditional Building Materials

The locally sourced materials include:

- stones
- mud
- grass
- sticks
- Ropes

5.1 *Mud (Tubali)*

In the early days, mud (tubali) was used in its raw, unmolded form, as opposed to the present-day trend of making it first into bricks.. This was normally done during the rainy season, when there would be plenty of water available for the treading process, which would follow the digging. The mud (tubali) was then well-moistened with water and trodden under dozens of unshod feet. This treatment was repeated about thrice, mud (tubali) till it was soft and fine in texture. It was then finally moulded into balls and allowed to gradually dry. In recent times, mud has been modified using technology into bricks. This is the combination of laterite earth with an appropriate percentage of cement or a stabilizer.

Plate 8: Mud used for building up walls
Author's fieldwork.2011

5.2 *Palm Frond*

Palm fronds were used together with broad *gbodogi (sarcophrynium)* leaves, for cladding purposes, and the stem was cut up and used as trusses and purlins on the roof framework Moukhtar, (2006). The joists were usually gotten from the coconut palm (which had been fired for extra strength), or of the branches of other trees chosen for their hardness and termite-resistance. A more durable material has replaced palm frond as building material used for roof framework.

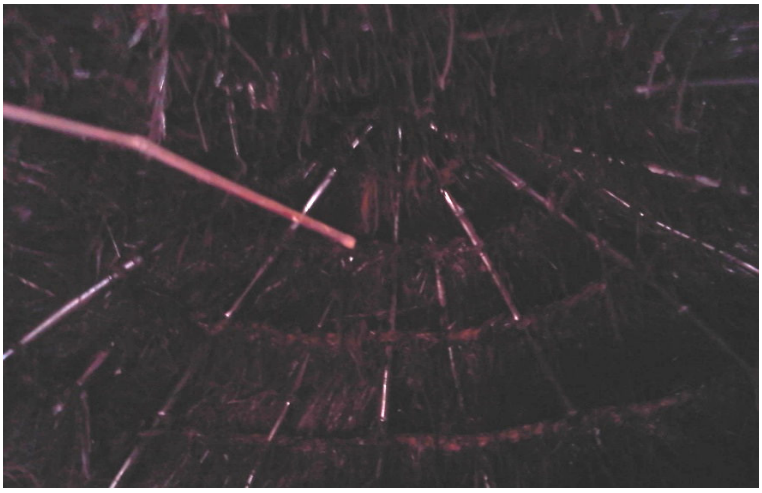


Plate 9 : Palm frond used as roof joist.
Author's fieldwork.2011

5.3 *Timber*

Wood is locally sourced in the neighbouring forest, the application of timber is a vital component of the building. From the roof to the foundation of the building and are used in the constructing the window frames. Wood also provides support for the roof as truss. Wood is been used as a post for fencing of the compounds., however the door frame and the lintel are made of treated timber as well. The structural defects on timber have limited it use thus subjected to specific areas to be applied in the building construction.

Plate 10: A window made up of wood and Zinc.
Author's fieldwork.2011

5.4 *Grass*

Grasses used for fencing of the compound include gamba and jinhi woven with kalgoo to form the covering for the fence, Grasses are also used for roofing. They are tied with palm leaves Kwakwa to the branches of giyayya gotten from corn stalk. It serves as an additive when preparing the mix the mud, it is also used to weave floor mats. Fence and interior decorated items are produced with special grass.

Plate 11: Grass used a material for Roofing
Author's fieldwork.2011

Plate 12: Grass used a material for fencing.
Author's fieldwork.2011

6.0 Sampling:

The sampling method adopted was the selected sampling which was based on some developed criteria for the research such as population of the area, Occupation, Infrastructures and Economic activities. Three settlements were selected based on these criteria's

The sampled settlement are:

- *Tunga Settlement*
- *Bosso Low cost Settlement*
- *Kpakungu Settlement*

6.1. Data Collection:

Data was collected by using both the primary and secondary sources of data collection. The Primary source involves the use of relevant literatures that deals with the subject matter and the secondary source involves the use of interview and observation to collate information needed for the study. The responses were frank and rational. One of the major instruments used for the study was observation carried out on both Public and Commercial buildings within the identified settlement.

The impact of technology on building materials observed in the identified buildings and materials used was also identified.

The table below explains the common building material found in Minna which will be used to or extract result from the data collected

6.1 Modern Building Material was used to Measure the Impact of Technology on Building Material in Minna

Table 1: *A table showing the percentage used to bench mark the level of modern material used in building construction in Minna*

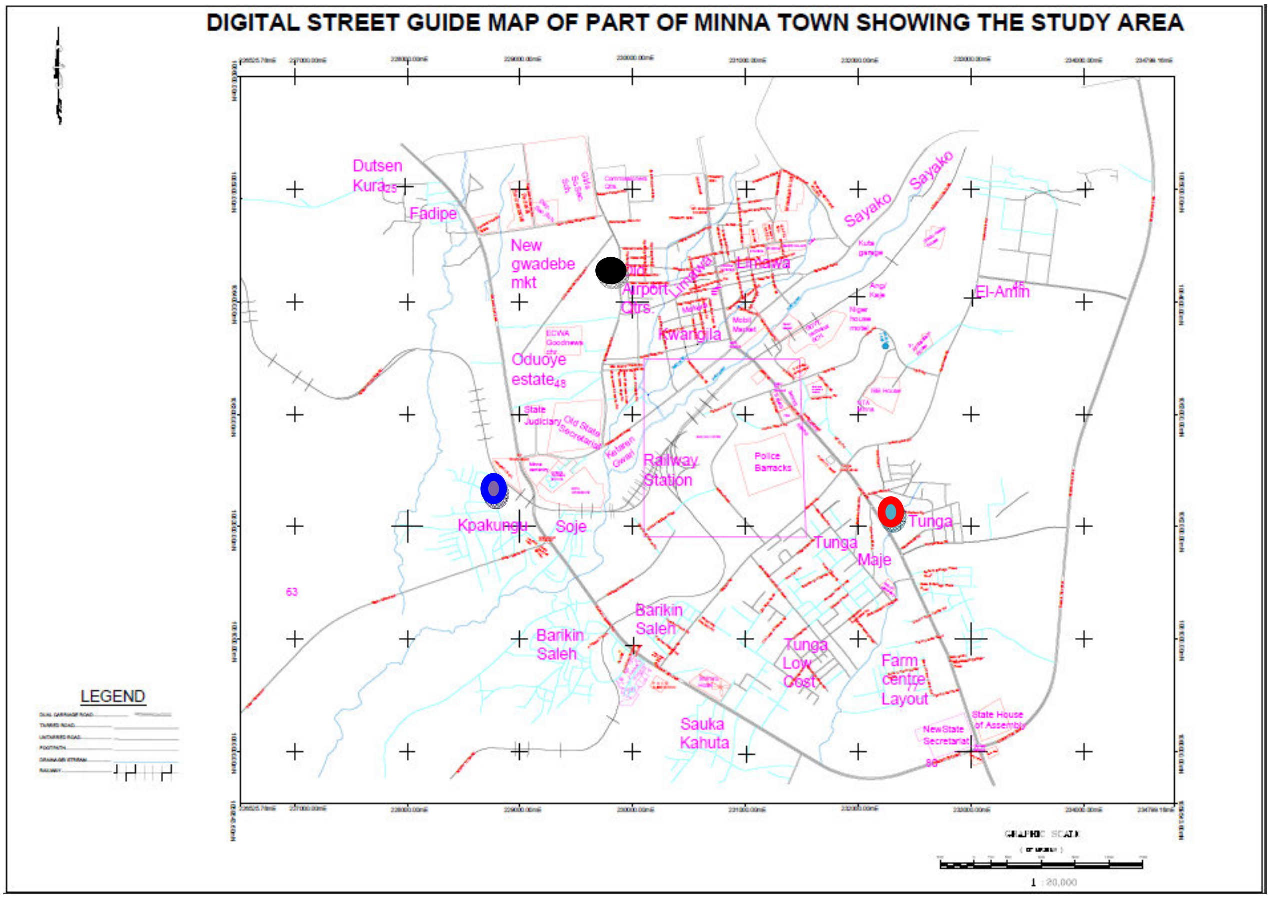
Source: Researcher's field work.

Percentage	Remark
60-100%	Totally is built up with Modern Material
30-59%	Still apply the Modern material of the 1990s but the Material has undergone local transformation using appropriate technology.
0-29%	Traditional material building still at the crude stage without modification most of these buildings are found in farmlands and villages.

6.2 *Sampled Settlements*

- *Tunga Settlement*

This is a settlement area characterized by modern buildings. The residents were subjected to various questions, and observation was made in order to establish the construction building materials used in the erection of residential buildings. The buildings commonly found are residential buildings, government official structures and commercial buildings which justify the impact of technology on the use of modern building materials in new and old buildings in other regions thus data analysis was focused on two settlements; Bosso Low cost and Kpakungu



Kpakungu Settlement

Bosso Low Cost Settlement

Tunga Settlement

Figure 3: Map of showing the study area showing the sampled settlements.

6.3 Identified Modern Building Material Commonly used in Building construction in Minna

***Table 2**: A table showing the identified modern material*

***Source:** Researcher's field work.*

Building Component.	Modern Building Materials (MBM)
1. Foundation	Sandcrete Block
2. Wall	Brick and Sandcrete Block
3. Floor	Monolithic Concrete Floor Slab
4. Roof Members	Treated Timber.
5. Roof Covering	Corrugated Al Zinc
6. Doors	Well polished Hardwood Doors
7.Windows openings	Large Glass Windows
8. Fence	Sandcrete Block
9. Finishing.	Cement mortar

***Table 3**: A table showing the Settlement, Building Type and Number of Building*
***Source:** Researcher's field work.*

No	Settlement	Building Type	Number
1	Bosso Low Cost	Residential	2
		Commercial	1
2	Kpakungu	Residential	2
		Commercial	1

- **Bosso Low Cost Area**

Bosso Low Cost is a government layout where there is a combination of government owned buildings and privately owned ones. The use of new building materials is evident on the buildings but the question is, How much of these modern material are applied in these buildings? For this area, two residential buildings and one commercial building were selected randomly to observe the recent technological level of modern building materials used in building construction.

ISSN 2224-6061 (Paper) ISSN 2225-059X (Online)
Vol.7, 2013

***Table 3**: A Table showing the makeup of identified building materials in Bosso Low Cost*

***Source:** Researcher's field work.*

Bosso Low cost: Building Residence No 1

BUILDING COMPONENT.	**LESS MODERN OR MODIFIED BUILDING MATERIAL**	**MODERN BUILDING MATERIALS**	**REMARKS**
1.Foundation	______	Sandcrete Block	MODERN BUILDING MATERIAL
2.Wall	Bricks	______	LMM
3.Floor	______	Concrete Floor Slab	MBM
4.Roof Members	______	Treated Timber.	✓
5.Roof Covering	______	Corrugated Aluminium	✓
6.Doors	Wooden Doors	______	LESS MODERN MATERIAL
7.Windows openings	______	Wooden Frame & Al panels	✓
8.Fence	______	______	
9. Finishing.	______	Mortar plastering for walls	✓

Table 4: *Table showing the makeup of identified building materials in Bosso Low Cost*

Source: *Researcher's field work*

Bosso Low cost: Building Residence No 2.

BUILDING COMPONENT.	LESS MODERN OR MODIFIED BUILDING MATERIAL	MODERN BUILDING MATERIALS	REMARKS
1.Foundation		Sandcrete Block	MODERN BUILDING MATERIAL
2.Wall	Mud Bricks	_____	LESS MODERN MATERIAL
3.Floor	_____	Concrete Floor Slab.	MBM
4.Roof Members	_____	Timber	✓
5.Roof Covering		_____	LESS MODERN MATERIAL
6.Doors	Wooden frame and Aluminium panels	_____	L MM
7.Windows openings	_____	Wooden Frame & Al panels	✓
8.Fence	_____	_____	_____
9. Finishing.	_____	_____	_____

***Table 5**: A table showing the makeup of identified building materials in Bosso Low cost*

***Source:** Researcher's field work.*

Bosso Low cost : Commercial Building No 3.

Building Component.	Less Modern or Modified Building Material	Modern Building materials	Remarks
1.Foundation	_____	Concrete and Sandcrete Blocks	MBM
2.Wall		Sandcrete Block	MBM
3.Floor	_____	_____	✓
4.Roof Members	_____	Treated Timber.	MBM
5.Roof Covering	_____	Corrugated Zinc	LESS MODERN MATERIAL
6.Doors	Wooden frame	_____	✓
7.Windows openings	Wooden Frame & Al panels	_____	✓
8.Fence	_____	Sandcrete block	MBM
9. Finishing.	_____	Plaster mortar	✓

- **Kpakungu Settlement**

This is a fast growing settlement characterized by various building types in a cluster linear settlement. Most of the residents of kpakungu are civil servants, business owners, petty traders and farmers. For this area two residential buildings and a commercial building were also selected randomly to observe the recent technological level of modern building materials used in building construction.

Table 6: A table showing the makeup of identified building materials in Kpakungu

***Source:** Researcher's field work*

.

Kpakungu: Building Residence No 1.

BUILDING COMPONENT.	LESS MODERN OR MODIFIED BUILDING MATERIAL	MODERN BUILDING MATERIALS	REMARKS
1.Foundation	_____	Bricks and Sandcrete Blocks	LMM
2.Wall		Sandcrete Block	MBM
3.Floor	_____	_____	✓
4.Roof Members	_____	Treated Timber.	MBM
5.Roof Covering	_____	Corrugated Zinc	LESS MODERN MATERIAL
6.Doors	_____	Wooden frame	✓
7.Windows openings	_____	Wooden Frame & Al panels	✓
8.Fence	_____	_____	_____
9. Finishing.	_____	_____	✓

ISSN 2224-6061 (Paper) ISSN 2225-059X (Online)
Vol.7, 2013

***Table** 7: A table showing the makeup of identified building materials in Kpakungu*

***Source:** Researcher's field work.*

Kpakungu: Building Residence No 2.

BUILDING COMPONENT.	LESS MODERN OR MODIFIED BUILDING MATERIAL	MODERN BUILDING MATERIALS	REMARKS
1.Foundation	_____	Sandcrete Blocks	MBM
2.Wall	Plastered Mud	_____	LMM
3.Floor	Cemented floor	_____	LESS MODERN MATERIAL
4.Roof Members	Timber	_____	LMM
5.Roof Covering	Corrugated Zinc	_____	✓
6.Doors	Wooden Doors	_____	✓
7.Windows openings	Wooden Frame & Zinc panels	_____	✓
8.Fence	_____	_____	_____
9. Finishing.	Mud Mortar	_____	✓

***Table 8**: A table showing the makeup of identified building materials in Kpakungu*

***Source:** Researcher's field work.*

Kpakungu: Commercial Building No 3.

BUILDING COMPONENT.	LESS MODERN OR MODIFIED BUILDING MATERIAL	MODERN BUILDING MATERIALS	REMARKS
1.Foundation	_____	Reinforced concrete and Sandcrete Blocks	MBM
2.Wall	_____	Sandcrete Block	MBM
3.Floor	_____	Concrete Floor Slab	MBM
4.Roof Members	_____	Treated Timber	MBM
5.Roof Covering	Corrugated Al-Zinc	_____	LMM
6.Doors	_____	Wooden and Glass Doors	MBM
7.Windows openings	_____	Al Frame & Glass panels	✓
8.Fence	_____	Sandcrete Block	✓
9. Finishing.	_____	Cement Mortar	✓

7 .Data Analysis

Analysis of the study shall be deduced from the tables above. Each table represents the sample size of each neighborhood identified by the researcher.

***Table 9**: A Table showing the % Frequency of qualitative data in Bosso low cost.*
***Source:** Researcher's Field work.*

7.1 Bosso Low Cost Settlement: % Frequency Of Qualitative Data Collected.

SAMPLE SIZE	% FREQUENCY OF LESS MODERN OR MODIFIED BUILDING MATERIAL	% FREQUENCY OF MODERN BUILDING MATERIALS
Sample 1	44.4%	44.4%
Sample 2	50%	44.4%
Sample 3	33.3%	66.7%
AVG	127.7/3 = 42.5%	155.4 = 51.8%

***Table 10**: A table showing the % Frequency of qualitative data in Gidan Mangoro*
***Source:** Researcher's Field work.*

7.2 Kpakungu Settlement: % Frequency Of Qualitative Data Collected.

SAMPLE SIZE	% FREQUENCY OF LESS MODERN OR MODIFIED BUILDING MATERIAL	% FREQUENCY OF MODERN BUILDING MATERIALS.
SAMPLE 1	55.5%	33.3%
SAMPLE 2	77.7%	11.1%
SAMPLE 3	88.8%	11.1%
AVG	222.0/3 = 74%	55.5/3 =18.5%

8. Discussions of Result

8.1 Bosso Settlement Area

From the data obtained, the percentage frequency was calculated to show that the level of technology affects the change and use of modern building materials. According to the percentage above, it can be deduced that the sample size represents the entire population of Tunga settlement therefore the result will be a generalization of the settlement. The information extracted from the data obtained shows that a high percentage of above 51.8% have refined their buildings with modern materials and techniques, thus have been influenced by the technological innovation in building materials resulting in a brand of architecture referred to as "Modern Architecture".

Table 8 above also shows that 42.5% of buildings still use less modern building materials. The use of less modern building materials can be attributed to factors such as low income, occupation and level of technology in the communities.

8.2 *Kpakungu Settlement*

Table 10 above gives the average percentage of the samples used to collate data, the information extracted from the data shows that the level of impact of technological change on building materials is 74%. This indicates that most buildings located in the settlement have been influenced by the impact of technology.

9**.**Conclusion

The paper discussed that Architecture began to experience change as a result technological innovation and highlighted some identified building materials which have undergone technological change. It further identifies some of the traditional building materials. From the analysis above it was deduced that 58.25% represents the level of technology in the use of modern building materials while 35.15% represents the frequency level of technology in the application of building materials to buildings. This shows that there is a gradual transformation of the entire building material in Minna; this is because of the impact of new and innovative building materials due to the advancement in technology. From the data analysis discussed earlier, it was deduced that the impact of technology on Architecture has affected the use of building materials in building construction.

The paper shows that enough effort has not been made in the use of advanced indigenous building materials in building construction, progress has been recorded in the aspects of research but there is little attempt to implement the findings of these research by the agencies responsible to promote and develop modern indigenous materials.

The rapid development of urban cities in Minna will open an opportunity to developers to adopt appropriate building materials that are economical and environmental friendly as these can be achieved with the use of some modified indigenous building materials and technology.

Finally, the advancement in technology has enabled Architecture and allied professionals to experiment on the wide range of building materials. Nevertheless, it has also affected our mode of life and the environment.

References

Beall, Christine (2000) New Masonry Products and Materials, Structural Engineering and Materials, Vol. 2, No. 3, July–September, pp. 296–303

Gyula.S and Chris P (2003):Architecture and Technology, Architectural press: Oxford,pp 31-49

Idris,M. (2000) The Use of Marble Veneer in Building Façade in Riyadh: Materials, Adapt ability and Construction, Architectural Science

Isaac.O and Manasseh, J (2008).Use of Cement - Sand Admixture in Laterite Brick Production for Low Cost Housing : *Leonardo Electronic Journal of Practice and Technologies*. Issue 12, Jan-June , Pp 163-174. Retrieved February.2013.from http:// lejpt.academicdirect.org/A12/163_174.pdf

Moukhtar, M.(2006). Transformation of Vernacular Housing Pattern In Peri-urban Abuja-Nigeria Due To Informal Urbanism,1976-2006.Retrieved April.2010.from http:// www.fab.utm.my/download/.../cStudents_student2Seminar200702.pdf

Meyer Sternberg and Menno (2001). Aluminium verbindungen: Berechnung nach Eurocode 9,Stahlbau, Vol. 70, No.2, February, pp. 121–5

Nawy and Edward G. (1996) .Fundamentals of High -Strength High Performance Concrete, Longman

Sadegzadeh, Massud, Kettle, Roger and Vassou, Vas- soulla (2001). The Influence of Glass, Polypropy- lene and Steel Fibres on the Physical Properties of Concrete, Concrete, Vol. 35, No. 4, April, pp. 14–18

Wigginton, Michael (1997). Glas in der Architektur,Deutsche Verlags-Anstalt Concrete and reinforced concrete CEB-FIP (May 2000) Lightweight Aggregate Concrete. Part 1:Recommended Extensions to Model Code 90. Guide

Zahner, L. (1995). Architectural Metals: A Guide to Selection, Specification and Performance, John Wiley & Sons, Inc

Biography:

Mustapha. A.Raji was born in Okene, Kogi state, Nigeria on 30th March, He is a graduate Architecture from Abubakar Tafawa Balewa University, Bauchi (2008) where he obtained a B.Tech Architecture, after the mandatory One year of National Youth Service, he proceeded to Federal University of Technology, Minna where he obtained Masters.Tech Degree in Architecture (2011).A Current member of the Congress of New Urbanism ;a prestigious organization base in Chicago, US. with a membership status an 'Urbanist'. My Interest are reading, writing, research and Sport.

Acknowledgement

I give gratitude to Almighty ALLAH for the; guidance, protection and for giving me the hope to actualize this academic research paper.

I sincerely express my appreciation to My Parents; Engr A.S Raji and Hajarat Raji and Siblings; Dr Rashidat, Mahdi and Muzzammill for their unequivocal support and prayers for my success.

My appreciation goes to Dr. Mohammed Oumar A.A who under his guidance I understudied the skills of research writing.

My special thanks goes to Arc Edidiong, who contributed her experience in making this research paper well structured.

My appreciation goes to Arc Nnamdi.O, Arc Azeez ,Arc Femi ,Arc Gideon .O, Umar.G, Arc Lambert, Arc Moses ,Hassan, Constance, Hawa Buba, and Mr Gideon for their Moral and emotional support during the preparation of this research paper

Finally, My appreciation goes to My (FUT,Minna) colleagues for their wonderful encouragement and contribution throughout the research process.