

# **SUSTAINABLE CONSTRUCTION: THE DILEMMA OF THE HIGH-RISE BUILDING IN A DEVELOPING COUNTRY SUCH AS NIGERIA**

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## **ABSTRACT**

From time immemorial, ascent to the high heavens has fascinated humanity. Religion and Philosophy project the theory that the utmost reality or God resides there. Hence, propelled by fright or flight-ability, significantly from the tower of Babel, man continues to demonstrate his prowess, quest and conquest of height to surmount the summit between him and the ultimate reality or God. However, in each step skywards away from the earth, humanity faces risks as he looks backwards towards the earth, which is his home. This paper is of the view that the lofty vision of skyscrapers is only "a necessary evil" which at its best amounts to building castles in the air. The paper is of the considered opinion that the technology, economy, and culture of poor developing countries cannot support the tall pipe dreams of the high-rise buildings in the near future.

## **INTRODUCTION**

By general definition, Skyscrapers are a very tall, slender multi-storey building that singly or in groups, dominate either the urban skyline, or towers above other buildings. Skyscrapers differ structurally from other buildings: whereas conventional buildings have load-bearing walls, skyscrapers consist of an iron or steel frame, to which they attached non-load-bearing thin, light walls. According to Awotona (1987), the term high-rise normally refer to any residential structure higher than a three-story walk-up as a high-rise. He also uses the term, high-rise, synonymously with tall buildings irrespective of number of floors. In this paper, we regard buildings, which are 10 to 12 storeys high as skyscrapers. These definitions show that there is significant variation in the concept of the high-rise from place to place. The developed countries have a higher upper limit than the developing countries, while the developing countries have a lower limit of what they consider as a high-rise building.

Historically High-rise Flat buildings first occurred in Rome in about 455 BC as a device for exploiting land in congested areas. The advent and subsequent adoption of a new adventurous technology made the true skyscraper possible. The architects of Chicago, the birthplace of the skyscraper, were designing buildings that were exceptionally high for their time. Burnham & Root's Monadnock Building (1889-1892), for example, reached 16 storeys, with a conventional load-bearing brick structure. Nevertheless, the great fire of 1871, in Chicago, was what cleared the ground for a radical rebuilding, and "a city of skyscrapers," generally of 10 to 12 storeys high, was the result.

By 1923, therefore, Le Corbusier had formulated the principles, which were to determine the course of the high-rise flat dwelling accommodation. The challenge to modern architects, he claimed, was to construct buildings according to the industrial standards of the motor car. Le Corbusier's 'Housing and Homes' theme for the 1937 international exhibition, made the main exhibit a completely furnished living unit, which could be let at the end of the exhibition. This was how, after the war, the Unites d'Habitation at Marseilles (1947-52), Nantes-Reze (1952-57), Berlin (1957) and Briey-la-foret (1960) came into existence.

Le Corbusier, essentially a functionalist, broke with the forms and design of historic styles, and sought a new 20th-century style based on engineering achievements: in bridge building and steamship construction; on modern materials such as Ferro-concrete, sheet glass, and synthetics; and on contemporary needs such as town planning and housing projects.

Le Corbusier considered the separation of traffic from living and work areas. The belief was that if a metropolis is to be prevented from spreading out indefinitely, however, it must be built high for residential areas multi-story villas set in open parkland, instead of space consuming, street-extending private houses; super skyscrapers 1,300 feet apart surrounded by gardens, for business districts. Le Corbusier's philosophy of domestic architecture: vertical garden cities,

which afforded every family maximum privacy and independence, (including communal services) combined with utmost exploitation of space. These monumental structures subtly proportioned according to le Corbusier's Modulor System functioned impeccably as machines for living in and belonged without doubt to the grandest architectural creations of the century. That they have found no imitators so far, we can only explain, apart from the prejudice that continues by the unadmitted feeling that only Le Corbusier can play with such vast masses without (350 flats in eight double-stories) the buildings crushing him.

Europe felt the towering influence of American skyscrapers strongly, when Mies van der Rohe produced a spectacular scheme for an all-glass skyscraper in 1920. Having subsequently migrated to the United States, Mies produced a new model for the skyscraper, which his Seagram Building (1954-1958) in New York epitomizes; Seagram Building is an elegant, beautifully detailed rectangular slab of curtain-walled offices that designers copied throughout the world, often with depressing results. Architects, such as Philip Johnson, Michael Graves, Cesar Pelli, Norman Foster, and Helmut Jahn, have extended the vocabulary of skyscraper architecture. While, in more recent years, Johnson's AT&T building (1979) in New York is the classic Postmodernist skyscraper Michael Graves' Portland Building (1983), in Portland, Oregon, shows a more spirited attitude to modernism. The Millennium Tower proposed by Norman Foster for Tokyo Bay would be over 790 m (2,600 ft) high and would contain hotels, shops, and apartments as well as offices in its 170 storeys.

### **The construction of high-rise buildings**

A Minneapolis architect, Leroy S. Buffington, patented a system of iron framing for tall buildings in 1888. The first steel-framed building was the Manhattan Building in Chicago, designed by William Le Baron Jenney (1890-1899). Thus the use of steel and glass, in buildings serviced by lifts, electric light, and even air conditioning, implied lightness and, in effect, a new architecture, but decorative conventions died hard. Louis Sullivan, whose famous paper "The Tall Building Artistically Considered" appeared in 1896, argued that form ever follows function and was influential in the development of a specific style of rational design in Chicago. The skyscrapers formed the characteristic skyline of Manhattan decisively during the building boom of the late 1920s. The Art Deco Chrysler Building, opened in 1930, was over 300 m (1,000 ft) tall and was briefly the tallest building in the world until the Empire State Building, rising over 380 m (1,250 ft), with 102 floors of office space, was completed a year later. The Manhattan style, with its characteristic "set backs", owed a good deal to the zoning laws introduced by the city in 1916 to prevent the exclusion of daylight from the densely developed streets. They intended The Rockefeller Centre (1931-1940) to be a model of environmentally responsible high-rise building.

Many countries have made improvements in heating, cooling, ventilation, lighting, and sound control. In most large buildings in the United States, for example, complete, year-round air conditioning is now standard. Some areas in a building are cooled even in winter, depending on the distance from exterior walls and the heat generated by lighting, electrical equipment, or human occupancy. Because the level and quality of lighting have improved, the cost of the mechanical and electrical systems in buildings has increased at a greater rate than other individual building costs; such costs currently account for a quarter to a third of total construction expenditure. In the United States, computers that they programmed to maximize efficiency and minimize waste and energy consumption automatically operate and control these systems.

We can now reach an agreement that the high-rise building has long existed in Europe and America with a marked degree of success in spite of protestations. We deduce that the building came into being as a combination of many exigent factors: mass housing in reaction to population explosions, rapid reconstruction as an aftermath of destruction resulting from wars, inferno and natural disasters. The success has invariably depended on technology, particularly on the availability of iron, steel, electricity, related services and technical expertise. The main objective of this paper, therefore, is to examine the practicability of universalising these experiences in the developing countries, where there is pervasive poverty and severe shortages of the indispensable enabling conditions.

## A CRITIQUE OF THE HIGH-RISE BUILDING

The high-rise flat dwelling makes possible a more compact town with saving in agricultural land saving in services and saving in travelling time; there is far greater freedom in composing the building on the site and in obtaining contrast in scale; it causes the least disturbance to the natural landscape, making possible far greater integration between landscape and building. Moreover, being more compact and 'more labour saving' it is a more logical form of building for small families and for families wanting a higher degree of communal services.

Although they are increasingly criticized on ecological and other grounds, tall buildings are seen as symbols of civic and even national pride and continue to fascinate architects, developers, and politicians. The race for the skies now involves such cities as Shanghai, Seoul, and Kuala Lumpur—currently the possessor of the world's tallest building (the 88-storey Petronas Towers, designed by Cesar Pelli)—as well as the great American cities. In 1998, Australia gave approval for the construction of the 574-m (1,837-ft) Grollo Tower in Melbourne, projected for completion in 2005 (Microsoft Encarta Encyclopaedia 2003). As the race skywards continues, we can only ponder: what are the implications of high-buildings for developing countries?

The three main disadvantages of the high-rise buildings are: first, it is usually more expensive in building cost; second, in a tall building some of the dwellings tend to get cut off from communal gardens; and third, its greatest objection, it is an impossible building form for those who wish their dwellings to extend into a private garden. These may also include the inability of the occupant to express their personal identity and archetypal social symbols.

The high-rise flat building is a most unpopular type of dwelling in many countries, for instance, many local authorities in Britain, even in the fifties, went as far as to forbid their erection. The Town and Country-Planning Associations carried on active propaganda against them.

The high-rise building destroys the individuality and identity of its occupants. Ardrey, (1974) asserts that without identity in an architectural composition and setting, its distinctive characteristic uniqueness is lost. He gave the example of what happened in Chicago to the effect that without identity, the perceptions, the quick communications of gossiping neighbours, the reaches of unofficial authority were lost in the mathematical anonymity and isolation of tall concrete honeycombs. So drastic were Hall's conclusions; that the city of Chicago considered abandoning the anonymous high-rise buildings as an answer to the problem of the Slum. As we must seek identity as we seek the sun, so we must dread anonymity as we dread the dark night (Ardrey 1974), since being lost and confused in an ambiguous architectural environment or form is not fun.

For the reason that high-rise housing requires lift services, they tend to impose greater constraint than walk-ups to the more stringent demands for lining up structural and mechanical elements in the vertical plane. These constraints often result in buildings, which are perceived as institutional more prone, to crime, vandalism, and quiet unsatisfactory for the social activities of children and teenagers (Newman 1971; Calway 1963; Morville 1961; Cooper et al. 1972; Reynold and Nicholson 1972). On the issue of cost, studies show that the new multi-story flats with lifts, cost up to 75% more to build a square metre than building a square metre in a separate two-story house (Osborn 1975). This point is particularly important since houses are more desirable than high-rise flats and can accommodate densities of up to about 250 persons per hectare.

Doxiadis (1971) advanced six gravest crimes, which architects have committed:

The construction of the high-rise buildings; the construction of the dispersed buildings; the construction of the unconnected building; the construction of the monumental building; the loss of human scale; and the construction of the anti-human city. Doxiadis (1971) advanced five reasons to explain why the construction of the high-rise building is a very great crime:

Such buildings work against nature by producing a lack of scale both in terms of human need and in terms of natural environment. They spoil the landscape. The high-rise buildings work against man himself. They imprison the elderly, mothers and young family members and impoverish the imaginative life of young children who lose their direct contact with nature. Even where children maintain the contact, they remain subjected to parental control. As a result, the children and parents suffer. These high-rise buildings work against society because they do not help the units of social units—the family, the extended family, and the neighbourhood etc. to function as naturally and as normally as before.

The high-rise buildings work against the networks since they increase the densities, overload the roads make servicing with water more difficult and expensive and create vertical networks. High-rise buildings work against the elements of human settlement from the economic point of view (the city is over loaded with people and costs), from the socio-political point of view. (The few, who are the owners of these lands and buildings, benefit against the interest of the many, who are tenants); and from the technological, cultural and aesthetic points of view. More importantly, they are unduly costly compared with alternative public policies of land settlement, site preparations and self-help in housing provision.

## **EXPLOITATION OF HIGH-RISE BUILDINGS**

### **Communications and Power Systems**

The electrical power required in buildings has increased with the number and complexity of environmental systems in operation. An increasing number of buildings, particularly in remote locations need to be equipped with their own primary electrical generating systems through the installation of emergency power generators to offset the inconveniences of regular power failures as it often occurs in Nigeria and other developing countries.

Robert Stock (Microsoft Encarta Encyclopaedia, 1999), states that petroleum, natural gas, and hydroelectricity are Nigeria's major sources of commercial energy; however, the largely non-commercial consumption of fuelwood and charcoal slightly outpaces them. Despite major programs to extend electricity to homes, only a small portion of rural households is electrified. Demand for electricity outstrips supply, in part because the government agency overseeing energy production is inefficient. Nigeria has only developed 5 percent of the country's potential hydroelectric capacity (Stock 1999). With electricity production at 18.700 billion kilowatt/hour, to serve a population of 126,635,626, (National Census 1999) spread over an area of 923,768 sq km (356,669 sq mi) (Stock 1999) and a low per capita income of \$970, (Anonymous 2002). The general opinion is that Nigeria is not yet ready for the high hopes of ready-energy requirement of the high-rise dwelling accommodation.

### **Vertical Transport**

Multi-storey buildings are taller than the maximum height people are willing to walk up, thus they require vertical mechanical transportation. High-speed, automatically controlled, cable-operated lifts are the major form of vertical transport in high-rise structures. Low-rise buildings and the lower floors of commercial buildings may also need escalators. The cost of procurement, installation and maintenance are presently prohibitive. Certainly, these are not for the poor countries that technologically advanced countries compel to pay even higher for procurement and importation of goods and services owing to the poverty of their technology.

### **Water Supply and Waste Disposal**

High-rise Flat buildings must have a piped-in water supply for a variety of purposes: drinking, washing, cooking, waste disposal, internal fire fighting (either through standpipes and hoses or through automatic sprinklers), and service to air-conditioning systems or boilers. High-rise Flat buildings also need devices that assist waste-pickup and disposal systems. The high-rise building cannot work with inadequate water supply situation, based on the reality that only 20 percent of rural Nigerians and 52 percent of urban Nigerians have access to safe water (Anonymous 1999).

### **Air-conditioning systems**

Heating and cooling have changed dramatically. Modern buildings, with their large heat gains, pose additional heat problems in tropical countries. Those hedged in high-rise accommodations definitely miss the soothing effects of the courtyard and the shade of garden trees.

## **HOUSING CONDITION IN NIGERIA WITHIN THE LAST TWENTY FIVE YEARS (1975-2000)**

The housing condition in Nigeria has worsened considerably within the last twenty-five years due to a combination poor economy and population explosion. The advantages of the high-rise buildings are low while the disadvantages mount higher with time when compared to the advanced countries. The reasons for these discrepancies include poor level of technological advancement, demography and economy.

### **Technological advancement**

As we can see from history, architects and engineers conceptualized high-rise buildings, from the beginning, as machines for living in. While the high-rise building seems feasible in the developed countries, it is the view of this paper that they are not feasible, for now, in developing countries, including Nigeria, due to the low level of the economy, electricity supply, water supply, lifts, escalators, and cranes.

The high-rise buildings depend extremely on constant electricity supply to run electro-mechanical systems. Recent records show that Nigeria has an intractable endemic epileptic electricity supply. Water supply is in critical deficit. Most people have no access to portable water. Some only have access to public water supply away from their homes. It is pertinent to note that most families who live on first floors cannot get running water from the public water system without additional mechanical means. It will be impossible to get water for regular domestic and hygienic purposes, especially for large-size families, to the heights of high-rise dwellings. Vertical transportation systems, lifts and escalators, are imported and costly. Without these facilities, moving young and elderly members through stairs becomes a nightmare.

The construction of high-rise buildings involves mechanical construction equipment and expertise, which are quiet prohibitive in cost. This makes it impossible for individuals and even difficult for the governments to embark upon adequate high-rise housing construction programmes. As is widely known, the backbone of the high-rise accommodation rests on iron and steel. The steel industry in Nigeria is not only expensive but the Aladja and Ajaokuta steel complexes have become strangulating albatrosses on the Nigerian economy. Little wonder that most levels of governments in Nigeria engaged in low low-income housing. For example, the 1991 and 1994 National Housing Policy, respectively, in spite of the severe intractable housing crisis, especially in urban areas of the country where it manifests in: severe overcrowding and its attendant health hazards and crime, shortages of housing stock, infrastructural deficiency and prohibitive land and housing cost; government continues to engage in low low-cost housing (Ali 1998). Though demographic studies do suggest the desirability of high-rise accommodation, it becomes impracticable due to cultural and constructional cost implications of the rather expensive and extensive extended family. The density of youthful dynamic or elderly senile family members occupying limited space in the skyscrapers, away from the sure ground, have undesirable social implications. Culture and religion impose segregations and taboos that may further restrict free movement among inhabitant at the height of the high-rise housing. The poor income level of those who would live in such high-rise accommodations has severe consequences in their exploitation. The people would not be able to pay for gas and allied services, which accompany the high-rise housing. Cooking with firewood and preparing local dishes that require pounding yams, cassava or grains and smoking fish increases the risks of fires, particularly where fire-fighting services scarcely exist. The poor maintenance culture in Nigeria has killed many a laudable projects. The council of registered builders of Nigeria (CARBON 1998) has observed over the years the deplorable conditions of building and associated infrastructures. It has attributed the situation to lack of adequate maintenance of both public and private properties, which has very often resulted into collapse of buildings and loss of lives (Anonymous 1998). The 1004 Housing Project for legislators in Lagos in the eighties is a sad example. The then luxurious flats fell flat in bad times that saw the rapid deterioration and decay of services such as lifts, electricity, and refuse disposal systems. The cost of restoring these derelict facilities has risen beyond redemption.

The Federal Ministry of Works observed that the population explosion coupled with increasing urbanisation has compounded physical planning and infrastructural management problems in Nigeria settlements. These problems are exerting a lot of pressure on planners. The Ministry further noted that since the promulgation of the urban and regional planning Decree 88 of

1992, only three (3) states – Lagos, Sokoto and Nasarawa - have established their urban and regional Planning Boards. The high-rise building is often, more than other building types, susceptible to abuse when it combines in a building form and in the way that developers position the flat-type high-rise building on the site. The object has been to cram as many dwellings on the site as possible irrespective of light, air and amenities of planning. Some terrible examples abound in Nigeria, particularly in Lagos, Aba and Onitsha.

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Housing conditions in Selected Nigerian Towns

Town	% of Households occupying one room	Average number of persons per room	% of houses with tap water	% of houses with flush toilet	% of houses with electricity
Lagos	72.5	3.8	71.7	43.5	93.2
Port Harcourt	51.5	2.4	75.0	18.6	81.4
Benin City	48.0	2.2	24.9	4.0	59.3
Warri	59.9	2.6	62.4	10.9	89.7
Kaduna	63.9	2.1	40.3	14.1	53.3
Kano	69.1	2.4	26.1	1.8	69.1
Ilorin	23.9	1.6	30.7	10.3	28.4
Ibadan	47.3	2.1	33.4	25.2	56.1

Source: Central Planning Office, the third National Plan, 1975-1980, Ministry of Economic Planning, Lagos

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Housing Conditions in Selected Areas of Lagos Nigeria

Settlements	Average household size	Persons Per Room	% of houses with tap water	% of Houses With Toilet Amenities			
				Pit Latrine	Bucket Latrine	W.C. System	No Toilet at all
Category A (Unplanned Slums Settlements)							
Isale-Eko	10.8	5.4	50.0	27.3	33.3	22.0	17.4
Mushin	8.0	8.0	42.0	62.0	8.0	20.0	10.0
Ajegunle	5.8	5.8	0.0	18.0	78.0	0.0	4.0
Maroko	5.0	5.0	0.0	0.0	86.0	0.0	14.0
Badia	4.8	3.6	0.0	6.0	53.0	0.0	41.0
Category B (High Income Residential Areas)							
Ikoyi	6.1	2.0	100	0.0	0.0	100	0.0
Victoria Island	4.8	1.6	100	0.0	0.0	100	0.0

Apapa	5.6	1.4	100	0.0	0.0	100	0.0

Source of data: Igwe J., from Fieldwork of the Department of Architecture, University of Lagos, 1984

### Demography in Nigeria

Nigeria ranks as the 10th country with the largest population in the world. With a birth rate of 42.6 per 1000 and a death rate of 12.9 per 1000, Nigeria's population is growing at an average of 3 percent annually—a rapid pace and little changed from the 1970s. The average Nigerian woman gives birth six times in her lifetime, although among women that are more educated, the rate is somewhat lower. Nearly half of Nigerians are younger than 15 years. By 2025, the population, according to projection, could grow to 203 million, or nearly double the current size (Anonymous 1999).

These figures have grave implication in terms of architecture and housing provision, particularly in urban centres where the urban-rural drift is making the greatest explosive impact. Urban areas have doubled their share of the population between 1970 and 1996. Stock (1999) observes that Lagos is one of the world's largest cities, which grew as colonial Nigeria's capital, and despite its loss of the federal capital in 1991 to Abuja; Lagos remains the country's leading port, economic and cultural centre. Ibadan, founded as a 19th-century war camp, became the largest pre-colonial city in sub-Saharan Africa, a fact that testifies to massive rural-to-urban migration.

The figures further show that the Nigerian families are large. The ideal housing would have been the high-rise dwelling house but for some foreboding reasons. The high-rise dwelling house, though reduces distances and transportation time and cost, hardly serves the interest of large families and the needs of the majority who are poor and unable to keep up with the high-tech lifestyle subsumed in high-rise buildings. The multi-ethnic communities in Nigerian urban areas are heterogeneous and naturally antagonistic. These cultural differences do not kowtow to the culture of co-operative coexistence ideally envisaged in communal services, which tenants, generally, regard as no man's business (Okusanya 1987). Therefore, as experience shows, the environment and services remain poorly maintained.

### CONCLUSIONS

The high-rise dwelling accommodation is inevitable in the face of increasing population. However, poor developing countries without a culture of high-rise communal living, inadequate resources such as iron and steel, which form the core of high-rise buildings, reliable electricity and water supply, buoyant economy and adequate technology, cannot really rush into the construction of high-rise buildings.

Like the building itself, the first step is to lay a sound infrastructural foundation, socio-cultural studies and synthesis into the architecture as well as developing an affordable appropriate technology. Any hasty step forward skywards leads to physical and psychological paralysis of the high dreams of high-rise buildings. However, the hope of housing the teeming multitude, in spite of poverty, must compel governments into taking adequate steps before any future inevitable implosions.

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