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WIND EFFECTS ON STRUCTURES [A CASE STUDY OF BUILDINGS IN IREPODUN LOCAL GOVERNMENT AREA OF KWARA STATE]

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ABSTRACT

Buildings are designed and constructed to provide services such as shelter and comfort for the occupants. Building are also designed and constructed with a provision to the able to withstand natural and environmental hazards during their life time. Some of the environmental hazards are snow, earth quakes, and wind. The wind effects on buildings stand out to be the most common effect in Nigeria, especially in the northern part of the country. This paper examines the effects of winds on structures, majorly on buildings in Irepodun Local Government Area of Kwara State. The paper also proffers suitable recommendation and conclusion for this hazard on buildings, especially the residential ones that are mostly affected.

KEYWORDS: wind, buildings, effects.

INTRODUCTION

Wind is a phenomenon with great complexity, because of the many flow situations arising from the interaction of wind in respect to structures (e.g buildings). wind is composed of a multitude of eddies of varying since and rotational characteristics carried along in a general stream of air moving relative to the earth's surface. The eddies usually give the wind its gusty or turbulent character. The gustiness of strong winds in the lower levels of the atmosphere arises from interaction with surface features. The average wind speed over a time period of the order of ten minutes or more tends to increase with heights, while the gustiness tends to decrease with height.

Air flows from high pressure zones to low pressure zones. The air on earths surface is heated more than over the large surface of water during day time due to solar radiation. The warmer rises upwards, while the colder air flows in wards from the surface of water bodies. Such wind is the one called, "breeze" the flow of breeze is maximum during the periods of high temperature on earth's surface during the nights, the above process is reversed. It is very important for the architects and engineers to have the knowledge of prevailing directions of winds, their intensity, and durations when carrying the designs of structures especially buildings under consideration.

Wind speed:- At great heights above the surface of the earth, where frictional effects are negligible, Air usually movements are driven by pressure gradients in the atmosphere, which in turn are the thermodynamic consequences of variable solar heating of the earth. This upper level wind speed is generally known as the gradient wind velocity.

MATERIALS AND METHODS

The study was conducted in Irepodun Local Government Area of Kwara State, with an emphasy on buildings in Omu-Aran Town, being the local government headquarters. The study involves a critical assessment of buildings whose roofs members have been affected during strong wind and were finally destroyed completely. The map of Nigeria showing basic wind velocities was well study in order to ascertain the wind condition for the Local Government. Photographs of some affected buildings were taken during the visits to such buildings where they are located. The wind speed values from map of Nigeria shows that Irepodun Local Government Area possess a high velocity of speed value across the Local Government.

- The study also reveals that the Local Government Area is physically endowed with warm Humidity, Vegetation, Climatic zones in terms of hot and cool climates, hot and humid regions, and also many water sources purposes

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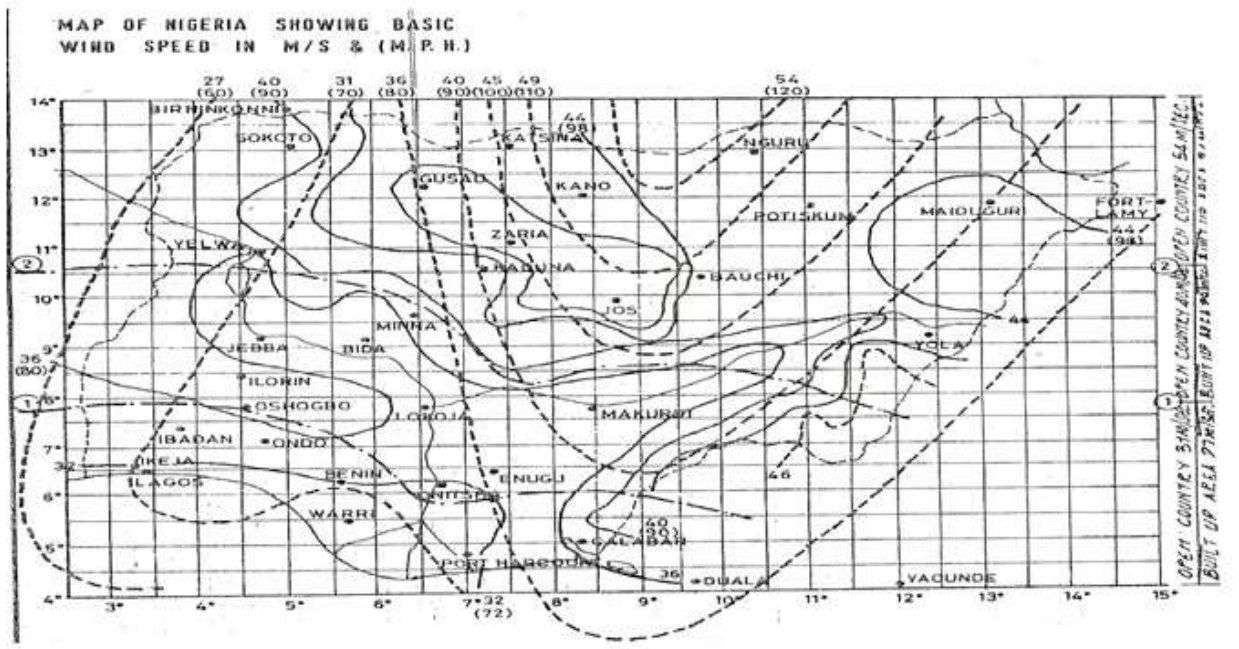

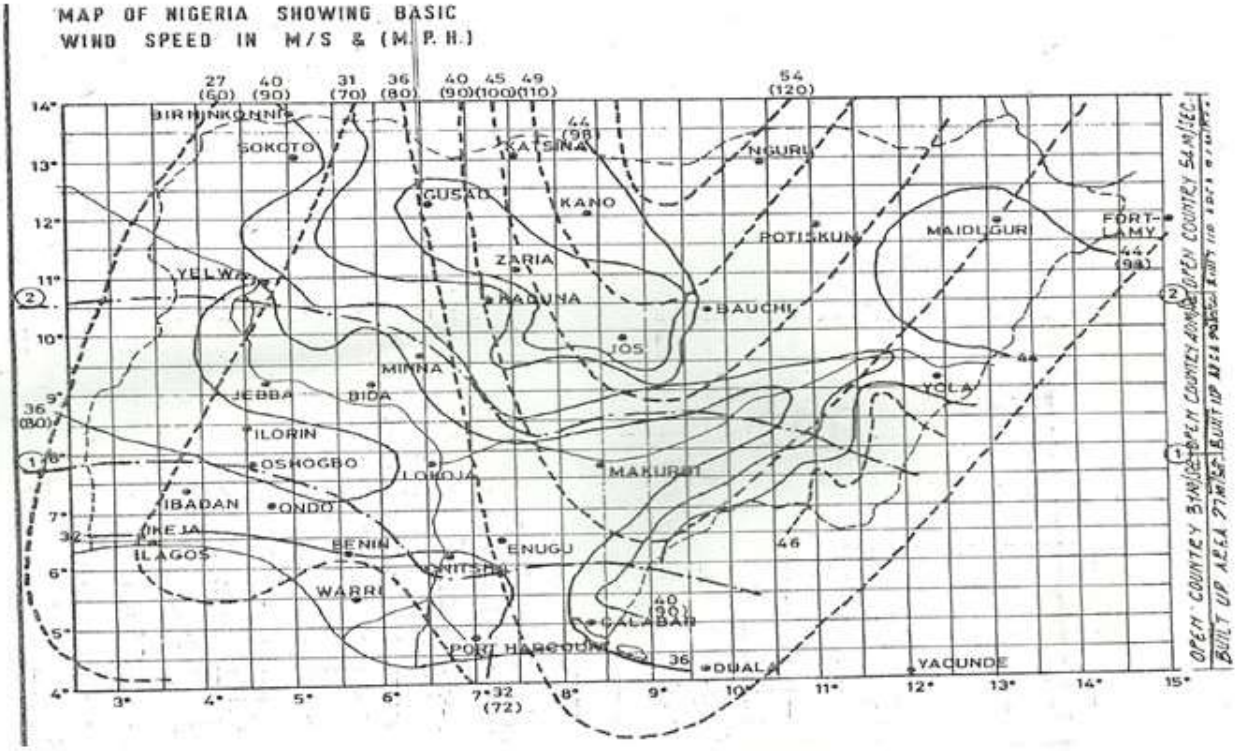

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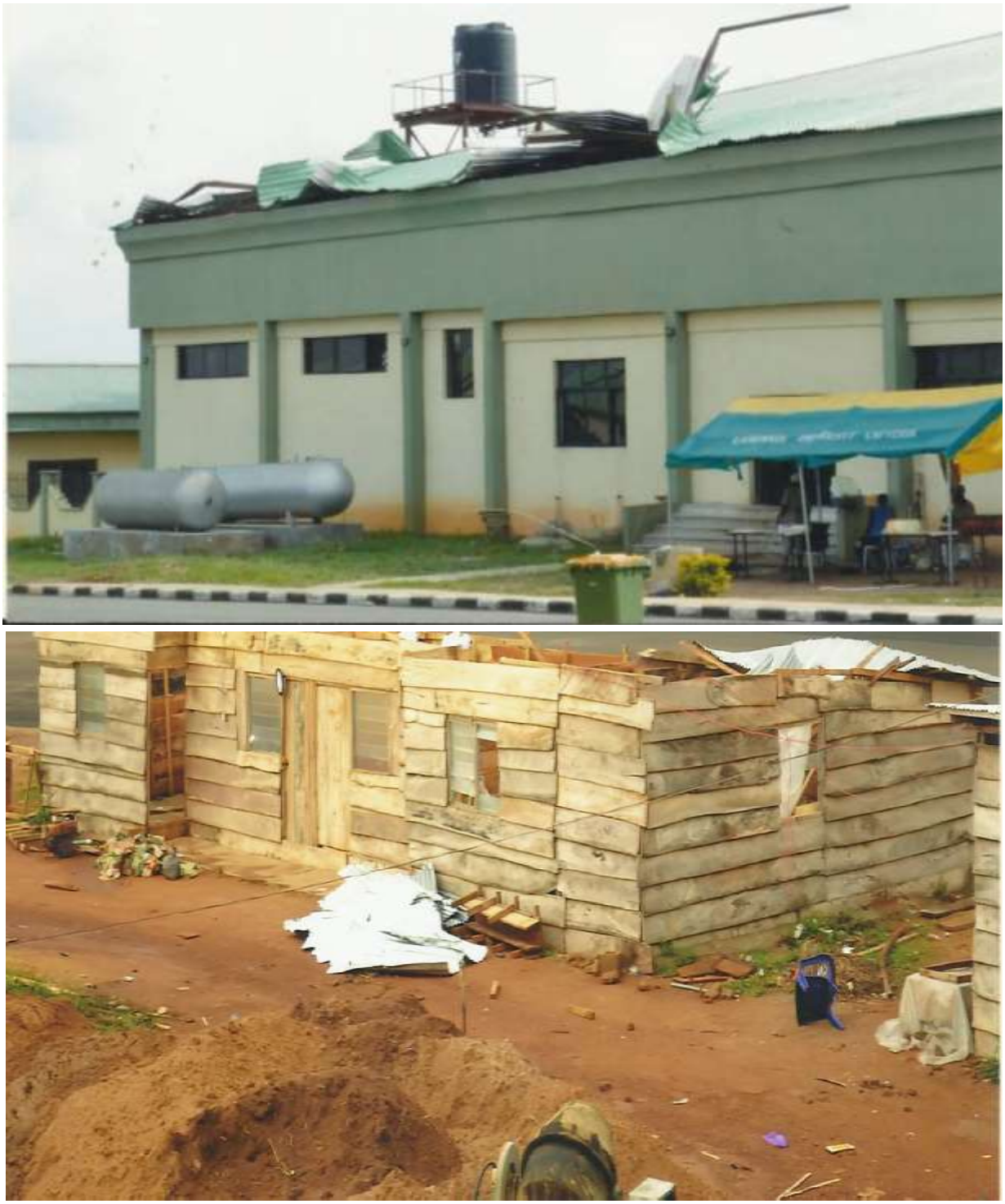
MAPS OF NIGERIA SHOWING VARIOUS BASIC WIND SPEED VELOCITIES



Pictures showing the removal of roots on Buildings due to the Effects of wind.

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DISCUSSION

Building and types:

Buildings can generally be categorized as load bearing walls and framed buildings. Load bearing wall buildings are limited to two storey buildings (that is ground floor and one suspended floor). such buildings are supported by the walls which are generally supposed to be 225mm thick and of good quality sand Crete blocks. Buildings on load bearing walls must be built on relatively good soil, since the foundation types are limited to strip and most of time wide strip foundations Framed buildings are buildings consisting of foundations, i.e pad, raft, or piled, columns, floor beams, floor slabs, etc the load from a framed building are transmitted through the roof or slab to the beams and to the columns which finally transmit the loads to the foundation. The procedure of construction

Includes the following:-

i. Foundation construction
ii. Columns up to DPC level
iii. Ground floor slab
iv. Columns up to the next floor
v. Floor – beams and slabs, which are better cast together
vi. Columns up to the next floor
vii. Floor beams and slabs which are better cast together
viii. Columns up to the next floor
ix. Roof beams and gutter slabs, if any. The walls of framed buildings are simply in full panels and can be constructed even after the roof is completed or put in place.

Loadings:

Generally structures (buildings) carry their own weights and in addition to imposed loads. Structures own weight are called dead loads, and the impose loads are called live loads. The third common type of load is called wind load. These three load are usually applicable to building. In tall buildings like factory, wind load and its effect most be giving proper consideration.

Dead Loads

Dead load refers to the specific weight of the actual materials multiplied by the volume or area or length of the material involved.

Imposed loads

These are mobile loads the buildings usually carry. The imposed loads for the buildings includes the weight of the occupants, the furniture, and machines or even goods, such as books and other movable material within the buildings. The values of imposed loads are usually listed in the code of practice. Imposed loads are also called live loads on structures.

Wind loads

The wind loads are generally imposed loads on buildings, but treated with care because of its nature. The effect of wind loads on building is horizontal, while that of live and dead loads are in vertical directions. Wind loads are usually obtained from the local wind speed, particularly where the building is to be located or built. The wind forces on the buildings are usually as follows:-

I Vi= local basic wind speed

ii Vs= Vs1 S2 S3, mls

iii Wi= 0.613 Vs^2 N/m^2

Where Vs = design wind speed in m/s

where Si = multiplying factor relating to topology which can generally be taken as 1.0 on sites where wind acceleration is know to occur, the values of 1.1 should be adopted and 0.99 in completely sheltered area.

There S2 = multiplying factor relating to height above ground and wind braking obtainable from literature and ranges between 0.55 and 1.27

Where S3 = multiplying factor related to the life of the building which can be taken as 1.o, and correspond to an excessive speed occurring once in fifty years

ThereW1 = the wind load in N per square metre. These are usually multiplied by the projected area in order to determine the wind force on the building, and also the wind pressure as assumed uniform over the entire surface,

Load combinations

Every building should be able to carry the loads imposed on it and it is usually a combination of loads plus live, dead, and wind loads. Each of the combination must be accompanied with the appropriate partial load factor as contained in the Cades of practice. For residential buildings of not more then five storeys, load combination is limited to dead plus live load only. Table 1.0 of B.S8110: part 1:1997, Reproduce here as table B; 1 give the various values of the partial factor of safety.

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Table 1.0 Load partial factor of safety for various Load combinations

	Load combination	Load Type					
		Dead		Imposed		Earth And water pressure	Wind
		Adverse	Beneficial	Adverse	Beneficial		
1	Dead and imposed (and earth and water pressure)	1.4	1.0	1.6	1.0	1.4	
2	Dead and imposed (and earth and water pressure)	1.4	1.0	-	-	1.4	1.4
3	Dead and imposed (and earth and water pressure)	1.2	1.2	1.2	1.2	1.2	1.2

EFFECTS OF WIND ON BUILDINGS

- Wind usually produces three different types of effects on buildings. These effects are (1) Static, (2) Dynamic, and (3) Aerodynamic. The response of load depends on type of building. When the buildings deflects in response to wind load, then the dynamic and aerodynamic and Aerodynamic effects should be analyzed in addition to static effect. Flexible slender buildings and structural elements are usually subjected to wind along and across the direction of wind most of the time.
- Buildings Irepodun Local Government areas are equally under the above three effects. These effects are common every where, and they are not enough to cause. Buildings to collapse. Some certain factors are added to the above three effects, that usually result in to destruction of buildings.

ADDED FACTORS TO WIND EFFECTS ON BUILDINGS

There are many factors to be put in consideration during the design and construction of building structures. These factors are:-

i. The dimensions of the building structures:- The taller the buildings during their useful life and services. Generally in Nigeria, any building that is less than four storey, the wind load may not be taking in to consideration during the design stage.
ii. To topography:- Buildings sited on high level elevations or on high level terrain are more easily subject to the attack of wind that those on low level terrain. The topography of the building site determines the effect of the wind on buildings within such environment.
iii. Velocity of wind: - Areas with high velocity of wind affects buildings easily than areas with low velocity. To guide against the effects of wind on buildings, proper consideration should be taken during the design stage by the engineer carrying out the design assignment
iv. Planning of buildings with respect to prevailing climate:- Planning of buildings with respect to prevailing climate involved having a proper knowledge of the climatic conditions of the environment like air temperature, vegetation that the said the environment is made up and hot and dry. Climates. These are to be properly planned for before the design of such buildings commences.
v. Design factors: in the design of special Buildings, such as tall buildings, chimneys, cooling towers, latticed towers, transmission towers, long span bridges, etc. blowing winds usually induce stresses which sometimes become alarming and occasionally lead to collapse. Very strong winds greater than 80km/hour which are generally associated with cyclonic storms, thunder storms, dust storms, or vigorous monsoons, etc must be considered while designing Buildings, because the vertically down ward acting loads such as self weight of the Building does not provide sufficient stability against wind horizontal forces. It is noted that imposed loads called live loads are assumed absent at the time of high wind velocities.
vi. Wind loads: - All types of structures including Buildings are subjected to loads

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pressure due to blowing winds. Wind pressure on a structure depends upon its location, height above ground level, the shape in plan as a whole is determined by the combined action of external and internal air pressure acting upon it. In all cases, the calculated wind loads act normal to the surface. Buildings should be designed with due attention to the effects of wind on the comfort of the people inside.

- Personal assessment has proved that most of the buildings that have undergone wind effects in this local government were as a result of not using correct sizes of Aluminum covering gauges and correct sizing of roof members.

RECOMMENDATION

The added factors to wind effects on buildings are the responsibilities of town planners, architects, and engineers especially those employed in the local government headquarter. Efforts should be put in place to make sure errection of buildings, the actual conditions and standards required by the owner (clients) are follow. The design and construction supervision procedures of buildings. Should be giving adequate attention as it is done professionally.

CONCLUSION

Wind is one of the environmental hazard on buildings that has occurred several times, and it is still occurring in many parts of the world. The effects on structures, especially buildings are numerous. Core effects is on lives and properties account for most of the times when it happens. On buildings, it reduces the life span and services expected. To guide against this menace, both the professionals and interested developers should work hand in hand, in order to reduce the effects of wind on buildings in this local government area.

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