



PROTECTION OF STRUCTURES AND OCCUPANTS AGAINST HAZARDS IN NIGERIA

Dr. ENGR. GANA A.J

COREN Regd, MNSE, MNICE

Istructe London (uk), ICE London (u.k)

Civil Engineering Department, College of science and Engineering
Landmark University, Omu-Aran, Kwara State.

Emails: doctorgana@yahoo.com, Phildebo123@gmail.com



Dr. ENGR. GANA A.J

ABSTRACT

Structures, especially Buildings are usually Build or Constructed to provide comfort and services to the users throughout their service periods. The situation whereby structures are being attacked by hazards of different types is an indication that such structures are not provided protective measures during their service Time. This paper examines protection of structures, majorly with emphasy on Buildings against Hazards. This paper also discussed different types of Hazards and preventive Measures against Buildings and also occupants in Nigeria.

Keywords: Protection, structures, occupants, hazards.

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INTRODUCTION

The Daily Occurrences of Hazards against structures, e.g. Buildings in Nigeria is increasing at an alarming rate in every parts of the country, especially in cities and in towns. Most of the Hazards that had occurred in the past were called "Mistakes" or "errors" either caused by the users of those structures. Some of the Hazards either occurred naturally or as a result of out-life service that led to the occurrences of those Hazards. Records also shows that many of the hazards that took place in the past ended up with great loss of lives and properties.

Professionals [e.g. Architects, Engineers, etc] have introduced many measures to avert and control most of the Hazards against Buildings in the past, but the rate of occurrences still persist in the country. The government Efforts on several occasions to tackle hazards against structures [e.g. Buildings, Bridges, etc] is also a collaborative effort with different professionals which has yielded

tremendous results, but more is still expected because of the daily increase or expansion in the Housing sector of the country.

DISCUSSION

Hazards against structures and occupants in Nigeria

Hazards are of different types, and their occurrences are worldwide. The damages usually cause by different hazards depends on their magnitudes. The common hazards that are of note in Nigeria are the following discussed below:

Requirements for fire outbreak

(1). **Fire-outbreak:** The three essentials requirements before any fire can start in a Building are fuel, (i.e. something to burn), Air (i.e. oxygen to sustain combustion) and heat. The process of combustion or burning requires all the three to be present. Removal of any one of the three will result in extinguishment of the fire and this is the principle on which all forms of fire operate.

Fire is something burning. Flames, light and heat, and often smoke are produced when

something burns. Flames can be out of control and thus, destroy buildings, trees, forests etc. for example, a pile of burning fuel, such as wood, or coal is used for cooking food or heating a room. Another example is a gas or electric fire which is a piece of equipment for heating a room, e.g. heater which is used to make air or water warmer. This is called gas heater or water heater. Immersion heater is a device that provides hot water for a house by heating water, while storage heater is an electric heater that stores heat when electricity is cheaper, e.g. at night.

Definitions

- a. **Fire break** is a thing that stops fire from spreading e.g. a special door or a strip of land in a forest that has been cleared of trees and gasses.
- b. **Fire door** is a heavy door that is used to prevent a fire from spreading into another building.
- c. **Fire drill** is a practice of what people must do in order to escape safely from a fire in a building
- d. **Fire fighter/Fire man** is a person whose duty is to put out fire.
- e. **Fire guard** is a metal frame that is put in front a fire in a room to prevent people from burning themselves
- f. **Fire escape** is a metal staircase or ladder on the outside of a building which people can use to escape from a fire.
- g. **Fire extinguisher** is a metal container with water or chemicals inside for putting out fires.
- h. **Fire hose** is a long tube that is used to direct water on to fires.
- i. **Fire wood** is a stem of a tree that has been cut into pieces to be used for burning in fires.
- j. **Fire retardant** makes a fire to burn more slowly e.g. a chair can have a fire retardant cover
- k. **Fire hydrant** is a pipe in the street that water can be pumped
- l. **Fire storm** is a very large fire, usually started by bombs or bush burning that is

not under control and is made worse by the winds.

Causes of Fire Outbreak

- a. Fuel
- b. Oxygen
- c. Ignitions
- d. Flames
- e. Dry materials
- f. Matches
- g. Candles
- h. Carpets and rugs, because they aid fire outbreak
- i. Directional signs by wind
- j. Excess power supply

Extinguishments are based. In a Building, the most probable source of the outbreak of fire is:-

- (a) **Electrical Installations:** Electrical wiring when exposed and laid over wooden battens is usually the most vulnerable source of fire. There may be Joints in the wire which may not be protected properly. The wire itself may be of inferior quality. When these are laid, they should be thoroughly checked. The Joints should be protected otherwise there would be electric sparks that will initiate fire in buildings wiring can be installed with fire-proof cables. The wiring on wooden battens should always be painted with fireproof paint.

The distribution boxes and any other exposed portion of the wiring should be painted with fire proof paint circuit breakers should be installed for breaking electric circuit when a certain level of temperature has reached in any section. Electrical wires used in Buildings should have colour marks indicating their proper use as live wires or neutral the colour system should be followed and noted on a display board. Preventive and routine maintenance escalators, Ventilators, air conditioners, transformers, switch gears; etc should be afforded constant maintenance during their uses.

Fire prevention and fire fighting

Fire prevention and fire fighting arrangement should always be kept in the Buildings to prevent disastrous fire, any time fire breaks out. Arrangement for fighting fire against spreading and ultimately extinguishing it within the shortest possible time should always be kept. Fire fighting

installations are very important in Buildings and should always be kept. Tall buildings of height exceeding above Eighteen (18) metres should have dry or wet riser installed solely for use by the fire service personnel's that are approved by the government

Timber works: Timber is generally used in Buildings in various ways and in good quantity of the timber fire-proof would reduce a substantial sources of fire in Building materials would always help in resisting fire. The timbers used for doors, window frames, and shutters can be replaced by metal frames, glass and glass Reinforced Gypsum boards.

Smoke detector: Smoke detectors should always be installed at intervals, especially at the corners where papers may be dumped in Buildings. The smoke detectors usually send an alarm to the control office of the building when the density of the smoke exceeds a specified limit

Fire Exit: In additions to stair cases, lifts or escalators provided in Buildings for climbing upstairs or going down, there should be emergency stairs for quick exit of the frightened persons or occupants in different floors of multy-storied buildings. The emergency exit should lead ground directly outside to the ground from each floor, with a travel distance not exceeding zometres.

Safety during construction of Buildings: Most building design codes provide specific measures that must be taking for fire protection during the construction of buildings. Where provisions are not available, fundamental fire-safety precautions are necessary and should be taking into consideration

(2). Intruders into Buildings: Prevention of illegal entry into buildings by professional criminals that always determined to break into house in Nigeria is common in every part of the country. Hence, the prime objective of security measures is to make illegal entry difficult. If this is done, it will always take an intruder longer time to gain entry or will compel the intruder to make Noise, thus increasing the chance of detection and apprehension other objectives of security measures has to do with detection of break-in attempts and alarming intruders so that they have to live the premise before they cause a loss or injury, and alerting building occupants and the police of the

break – in attempt. Of recent, many communities in Nigeria have established ordinances and setting up minimum requirements for security in their communities. This has yielded a tangible result to an extent. An improvement on this is expected because of the high level of strategies by intruders, and sophisticated communication Technologies in the country every day.

(3). Flood: The Meaning of Flood According to Oxford Dictionary, flood is a large amount of water covering an area that is usually dry, but Dictionary of Geological terms says, flood is any relatively high stream flow which overtops the natural or artificial banks in any reach of a stream (or river/sea). Flood is caused by rising global temperature which results in heavy downpour, thermal expansion of the ocean/sea and glacier melt, which in turn result in rise of sea level.

In Nigeria the pattern is similar with the rest of the world. Precisely, from ending of September to first two weeks, of October 2012, Nigeria witnessed terrible flooding across the nation. Flooding in various parts of Nigeria forced millions of people away from their homes, posed tremendous danger to people's lives and properties, destroyed business, polluted water resources and increased the risk of diseases (Baiye), flooding occurs within rivers in the inland areas of developed cities, especially where sudden heavy rainfalls change within a very short period of time into destruction and uncontrollable torrents.

The urban flooding is very common in most towns in Nigeria, especially where most unguided road and building constructions distort a damage existing natural earth surface flow and drainage patterns of overland flows. Other causes of urban flooding include where existing surface water drainage patterns have been blocked with all kinds of solid wastes from domestic, municipal and industrial sources. Large urban flooding occurs mainly in towns and cities located on the flat or low lying terrains where either little or no provision has been provided for adequate and proper surface drainage.

Thus, urban flooding is now a yearly phenomenon in most states in Nigeria like Kogi, Oyo, Bayelsa, Delta, Anambra, Crossriver, Akwa Ibom,

Benue, Rivers, Lagos Ogun, Ondo Taraba, Kano, Enugu, Ebonyi, Niger, Edo, Kwara, Sokoto, etc. In late September and early October 2012, most of these states witnessed dangerous flooding from tropical storms that claimed and destroyed lives and properties worth billions of naira. Farmlands and industries were equally submerged and destroyed.

Effects of Flooding

The detailed records and statistics of the losses and damages sustained by the people and urban dwellers and various flood victims are not easily obtained it had been observed that various visible degrees of irreparable havocs have been sustained by the people of Nigeria due to various perennial natural disasters in many states and cities. Houses, buildings, churches, industries and bridges collapsed. Markets and farmlands submerged completely. Schools and various residential houses were submerged and washed away. The challenges from these environmental problems includes environmental problems include environmental pollution, poverty, diseases, flooding, droughts, biodiversity and desertification. Etc.

Benefits of Flooding

Most of the flooding in Lagos and Ogun states is caused by the release of water from Oyan Dam Ogun State (Etuonovbe, 2011). However, hunters, fishermen and hawkers cashed in on the disaster to make money. The fishermen do not paddle their canoes to the far end of the river before catching fishes. This is because, when the water level of a river increases more fishes swim ashore. Thus, this makes fishes available and more abundant during rainy season than dry seasons. And thereby creates a boom for fishes hawking business. Other water reptiles like snakes, crabs, turtles, etc, and readily available even in people's bedrooms.

Due to flooding, animals are chased to dry land. This creates chances for the traps of the hunters to catch more animals than usual. This is because, as flood surges forward, animals run away from it and thus were caught by the hunter's traps.

Prevention of Flooding Short term and Long term Measures

In order to prevent flooding short term and long term measures need to be carried out. Short term measures includes rescue of people whose

residential house/homes, farmlands, and industries had been ravaged by flooding. Here, relief materials and money were sent immediately to the people affected. This preventive short term measures. This short term proper planning of long term measures give room for proper planning of long term measures. This short term measure gave opportunity for Senators and government agents at all levels to donate money and relief materials including clothing, sleeping materials and food stuffs to victims, who are camped in churches, schools etc.

On 9th October, 2012, the President of the Federal Republic of Nigeria Dr. Goodluck Ebele Jonathan in a National Broadcast on flood disaster in Nigeria announced that the Federal Government earmarked over Seventeen Billion Naira (₦17,000,000,000.00) to assist flood victims and flood disaster areas in Nigeria. He categorized it into groups as follows:

Group A – Oyo, Kogi, Plateau, Bayelsa, Delta, Benue, Anambra, and Adamawa. Each state in this category will receive ₦500,000.00 (Five hundred million naira).

Group B – Jigawa, Kano, Kaduna, Bauchi, Niger, Taraba, Cross River, Nasarawa, Imo, Lagos and Edo. Each state will receive ₦400,000,00 (Four hundred million naira)

Group C – Kwara, Ogun, Ondo, Gombe, Rivers, Katsina, Ebonyi and Abia. Each state will receive ₦300,000,000.00 (Three hundred million naira).

Group D – Sokoto, Kebbi, Ekiti, Osun, Yobe, Enugu, Zamfara and Akwa Ibom. Each state will receive ₦250,000,000.00 (Two hundred and fifty million naira)

Beside actions taken by NGOs, churches, individuals and NEMA (National Emergency Management Agency). NEMA had already spent not less than one trillion naira to assist and reduce problems of flood disasters in Nigeria.

Long Term Measures

There should be adequate geological, environmental, scientific and engineering investigations before any building construction takes place. In order words, there should be multi professional approaches to avoid any construction either on or across natural drainage systems on the

earth surface. The investigations must find out if the area suffers from floods, and how serious was the previous floods. Dams must not be close to buildings.

Expert advice and appropriate building materials must be used to construct structures on approved way and areas. We must not dump solid wastes on water drainage to avoid obstructing drainage. Water drainage ways must be cleared of solid wastes more regularly. Trees must not be cut either indiscriminately or without regulation by forests authorities, and when trees are cut, they must be replanted immediately. Farmers must not cultivate on or across natural erosion ways. Laws and regulations must be enforced to make people not to build and reside in flood prone areas. Natural drainage systems that are blocked by structures and building =s must be allowed to regain original shape by or else be demolished to allow free overland flow.

Therefore, detailed studies could be geared towards flood control measures in low-lying zones or areas. The results of the studies and investigations must be adhered to strictly by stakeholders, especially before commencement of construction works in low-lying and flood prone areas. Town planning authority must be readily available, up and doing in their very important duties to reduce and possibly avoid/stop flooding and its long term consequences. There must be very wide education, awareness and enlightenment to Nigerians on the dangerous consequences of flooding and how to prevent the flooding in Nigeria. We must protect our own environment.

In his recent visits to flood affected states across the nation, the president, Dr. Goodluck Jonathan promised the victims the assistance of Government and also to seek the assistance of International bodies like European Union and World Bank etc. The president also inaugurated a National Committee on Flood Relief and Rehabilitation that will assist government in raising funds to mitigate the pains and ensure the effective post-impact rehabilitation of victims. The Committee will be co-chaired by Alhaji Aliko Dangote and Mr. Olisa Agbakoba, while Dr. Mike Adenuga Jnr. will serve as the Chief Funds Mobiliser.

(4). Wind: 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 size 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 earth's surface is heated more than over the large surface of water during day time due to solar radiation. The warmer air rises upwards, while the colder air flows inwards 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.

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 sandcrete 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 V_i = local basic wind speed
- ii V_s = $V_{s1} S_2 S_3$, m/s
- iii W_i = $0.613 V_s^2 N/m^2$

Where V_s = design wind speed in m/s

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

There S_2 = multiplying factor relating to height above ground and wind braking obtainable from literature and ranges between 0.55 and 1.27

Where S_3 = multiplying factor related to the life of the building which can be taken as 1.0, and correspond to an excessive speed occurring once in fifty years

There W_1 = 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 Codes of practice. For residential buildings of not more than 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.

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.

Table 1.0: Load partial factor of safety for various Load combinations

	Load combination	Load Type					
		Dead Adverse	Beneficial	Imposed Adverse	Beneficial	Earth And water pressure	Wind
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

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 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.

(5). Earthquakes

Earthquakes occurrences are not common in Nigeria like in the other countries of the world, they are real and they occur like other mentioned Hazards. Structures in those countries are usually attacked just like other Hazards as well. An understanding of what earthquake is and Hazards against structures and human lives is analyzed below:-

- I. An earthquake is a phenomenon that manifests itself through strong vibrations occurring on the ground surface, due to release of large amount of energy within a short period of time through a sudden disturbance in the earth's crust or in the upper part of the mantle.
 - II. Earthquakes are natural hazards that cause loss of live and damage to construction facilities. They are a global phenomenon and a global problem.
 - III. Earthquakes usually result from sudden tremors in the movement or break in the earth crust. They are often associated with volcanic activities. Certain processes which can generate tremors includes:
 - 1) Faulting
 - 2) Detonation of high power explosives
 - 3) Passage of heavy traffic in detonation and faulting, there is a break of rapture or fracture within the rock which is translated into seismic or vibrational pressure seismic = vibrational wavesEnergy called earthquake. There are three types of seismic or vibrational waves
 - 1) Primary waves which usually move back and forward
 - 2) Secondary waves (shears waves). They move up and down.
 - 3) Long waves (vice chart- pal ash waves) these are outside waves which move outside.
- (i). Primary waves are the faster and they go through different types of materials either gas, solid, or liquid.
 - (ii). Secondary waves they travel through solids and sometime gases, but they cannot travel

through liquids. Primary and secondary waves are called body waves because they travel through the earth. Body waves can be refracted and reflected at inter face. They increase in velocity when they travel from rocks of lower density into those rocks of higher densities. Instruments for recording earthquake shocks are called seismography. Instruction in the seismography are

- i. The one that measures morth and fauth
- ii. The one that measures east and west.

Seismology

The study of earthquake is called "seismology" the word "seism" means Earthquakes. The study includes seismic waves, their origin, propagation, recording and analysis.

Causes of Earthquakes

Earthquakes are primarily caused due to two reason:-

- (1) **Natural Disturbance** – They are:
 - (a) **Natural Disturbances**- these usually takes place in several part of the world. It usually produces sudden out-burst or explosions. The impact is usually strong enough to produce vibrations in the nearby areas. People living in places like Japan and Italy have experienced this type of earthquake. These types of earthquakes are not very deep, and they confined within a few kilometers.
 - (b) **Tectonic Causes** – Tectonic causes are those which occur inside the earth. According to the theory of plate tectonics, the crust (outermost layer of earth) is made up of rocks and is divided into many plates. These plates are constantly in motion in different directions and with different speeds
- (2) **Artificial Disturbances or causes**
Artificial disturbance are all men made like. They are as follows:-
 - i. Nuclear tests
 - ii. Explosions
 - iii. Deforestation leading to massive landslide. These earthquakes are of

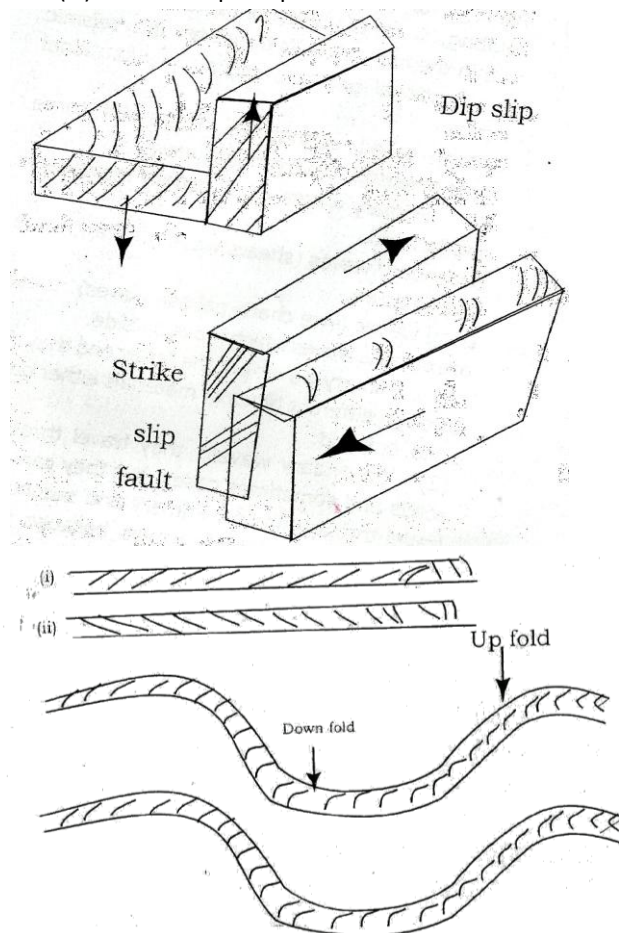
very low intensity and usually affect the surrounding areas only.

Chief causes of Earthquakes

Fault is the chief cause of earthquake. The sudden slide of fault produces vibrations in the earth's crust, thereby causing earthquakes.

Types of faults

- (i) Dip slip
- (ii) Strike slip fault
- (iii) Oblique slip fault



Differences between fold and fault

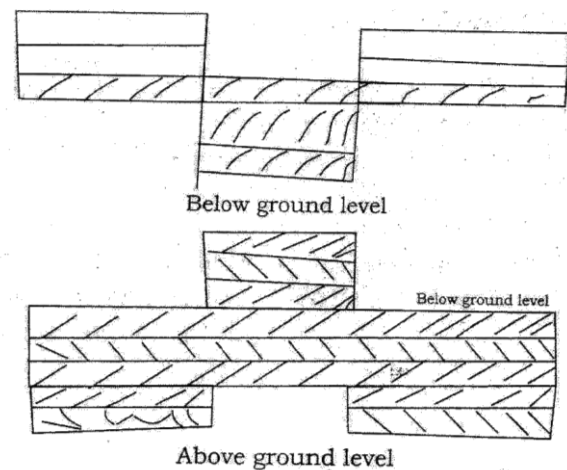
- (1) **Fold:** This is the horizontal movement of the earth crust from either side, so that the middle earth crust will "wrinkle" or fold. The horizontal movement of the earth crust itself is due to the force of compression.
- (2) **Fault:** this is formed by the vertical movement of the earth's crust. The earth crust between

the faults may either sub-side below the general level or rear above

Classification of Earthquakes

Earthquakes are classified according to the various criteria stated below:

- (1) Based on Location the location is explained under the following.
 - a. **Interplate earthquakes** – These are earthquakes that occur along the boundaries of the tectonic plates and are called interplate earthquakes.
 - b. **Intraplate earthquakes** – These are earthquakes that occur within a plate itself away from the plate.



- (2) **Based on Focal Depth** – The focal depth is explained under the following:
 - a. **Shallow Earthquakes** – these are earthquakes whose focal depth, i.e. distance from focus is less than 70km
 - b. **Intermediate Earthquakes** – These are earthquakes with focal depth between 70 to 300km.
 - c. **Deep Earthquakes** – This is the earthquake in which the focal is greater than 300k.

- (3) **Tectonic Earthquakes** – These are as follow:
 - a. **Non – Tectonic Earthquakes**- these are cause due to non – tectonic reasons like volcanic activities and man-made reasons. Man-made reasons are nuclear power testing, blast, construction of large dams and deforestation.

b. Tectonic Earthquakes: these are caused due to sudden slip in the fault of the tectonic plates of the earth.

(4) Based on the magnitude of earthquakes

S/N	Types	Magnitudes
1.	Great Earthquakes	8 and more
2.	Major Earthquakes	7.7 to 9
3.	Strong Earthquakes	6.6 to 9
4.	Moderate Earthquakes	5.5 to 9
5.	Light Earthquakes	4.4 to 9
6.	Minor Earthquakes	3.3 to 9
7.	Micro Earthquakes	< 3.0

(5) Based on Epicentral Distance

A. Local Earthquakes – The affected area is very less within 1^0 of the epicenter of the earthquake.

B. Regional Earthquake: $1^0 - 10^0$

C. Teleseismic Earthquakes

General Effect of Earthquakes

- (i) Loss of life and injury to human body
- (ii) Damage to natural environment
- (iii) Damage and destruction of Economic

Earthquakes Effect on Structures

There are three basics effect of earthquakes on structures:

- (1) **Grand Shaking** – As the earth vibrates, all building on the ground surface will be subjected to vibrations. Earthquake induced accelerations, Velocities and displacement can damage or destroy a building unless it has been design and constructed properly.
- (2) **Ground Failure** – Earthquakes induced ground failure is observational in the form of ground rapture along the fault zone, landslides, settlement and soil liquefaction (i.e. soil behaving like a liquid). The ground rapture cracking of ground.
- (3) **Fire Effect** – when the fire starts after the earthquakes, it is difficult to extinguish it, because earthquakes will result in loss of water supply, breaking of pipes, traffic jams, etc.

Category Damages of Earthquakes on Structures

S/N	Damage category	Extent of damage
1	Slight non-structural damage	Tin cracks in plaster, falling of plaster in bits
2	Slight structural damage	Small cracks in walls, falling of plaster in large bits over areas. The load carrying capacity of the
3	Moderate structural damage	
4	Several structural damage	
5	collapse	

Conclusion

Structures are generally designed to last long and to provide valuable services for the users. The designed life time of any structure can only be maintained if necessary precautions are taking and abide with a daily basis by individuals and the society at large. This is the secret while many structures around the world have been standing for many years now without any defeats. The maintenance principle attached to existing structures is also a key for sustaining long life of structures and occupants against hazards. With all hands join together with the government at federal state and local government in tacking the menace of hazards against structures and occupants, national stability and development of Nigeria will be real.

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