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# AN INVESTIGATION IN TO DAMPNESS IN STRUCTURES (A CASE STUDY OF HIGH RISE BUILDINGS)

**Dr. Engr. Gana A. J**[*1]
[1*] COREN Redg, MNSE, MNICE Instructe Lond (U.K) ICE Lond (U.K) Civil Engineering Department College of Science and Engineering Landmark University Omu-Aran, Kwara state.
*Correspondence Author: **Dr. Engr. Gana A. J**

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## Abstract
The persistence damage being done in Buildings as a result of dampness has become a daily occurrence in many parts of Nigeria, especially in cities and towns where these Buildings are constructed. This havoc is common in Buildings that are already completed, and the occupants are living inside as owners or as tenants. This paper fully examined Dampness in structures, especially in High rise Buildings in Nigeria the causes of Dampness, its effects, and Remedies for dampness in Buildings.

## Introduction
The primary purpose of a structure (Building) that is satisfactorily build is to provide comfort for occupants during its service life period. The moment this primary purpose is not achieved or abuse, such a building becomes "unfit" for human's services. According to F. Olabosipo and O. Ademola (2010), such a Building can be described as one which is inadequate to perform what are normally expected or required of that Building. Dampness will generally occur Buildings during its life use, if some basic precautions are not taking during the construction of such Buildings from the beginning. Therefore, it becomes very imperative for Design Civil and structure Engineers, supervising Engineers on construction sites, and contractors executing Building projects to take proper precaution against the occurrence of Dampness in buildings from foundation to Roof levels.

## Methodology
To really ascertain the occurrences of this menace in both public and private Buildings, a visit was conducted to many completed Buildings already in use in Kwara state. Some of the Buildings inspected are Government owned like Office in ministries, and also private Residential Buildings in use by tenants. The outcome of the visits provided the basic fact on the occurrences of Dampness in High Rise Buildings, especially on external and internal walls, And floor Slabs which demarcated the Buildings into different apartments.

## Discussion
Water is the most essential element required in construction of a Building. In addition, water or moisture is the most harmful element causing damage by inviting dampness in walls of any Building. The causes of dampness in a Building are numerous, but a few of them are discussed below:-

1. Moisture rising up the wells from ground
   All the structures are founded on soil, and the sub-structure it embedded into it. If the soil is pervious, moisture constantly travels through it. Even in the case if impervious soils, lot of soil moisture may be present. This moisture may rise up into the wall and the floor though capillary action. Ground water rise will also result in moisture entry into the building through walls and floor
2. Rain travel from wall tops
   If the wall tops are not properly protected from rainwater penetration, the rain water will enter the wall and will travel down.
   Leaking roof will also permit water to enter
3. Rain beating against external walls
   Heavy showers of rain may against the external face of walls and if the walls are not proper outward slope, water will accumulate on these and could ultimately enter the walls through their junction. This moisture travel would completely deface interior decoration of the wall.
4. Condensation: Due to condensation of atmospheric moisture, water is deposited on the wall, floor and ceilings. This, moisture may cause dampness.
5. Defective roof-leakage is a major source of water entering the wall and making it damp.
6. A porous brick used in construction is a permanent source of dampness in wall as they attract moisture.
7. Bad materials used in construction are also a source of damp wall.
8. Vegetation- Growth of vegetation in the wall indicates presence of moisture or water without which it could not grow. Vegetation develops further cracks in a wall already having crack and cause soakage in the wall.

Global Journal of Engineering Science and Research Management

9. Earth backing against wall- Dumping of earth against wall causes dampness in it.
10. Cavities, holes left in the wall due to negligence and dab-holes kept for erection of scaffolding and latter not filled properly with concrete are a prospective source of attracting and storing moisture.
11. Mortar joints not laid properly and uniformly are source of attracting moisture.
12. The worst source of moisture ingress in building wall is the defective damp proof course. Decayed, dilapidated or defectively laud damp proof course, i.e., failure of the dampness wall.
13. Earth banks- Construction of earthen bank by the side of a building, side slope covering some height of the wall above damp proof course would cause dampness in wall.
14. Splashing of rain off the ground on the wall above the damp proof course which happens when the plinth height is low or these be ground nearby with higher level.
15. Defective window sills allowing stagnation of water on it.
16. Sloping ground- This generally happens in hill areas, where building area constructed on the slopes of the hills.
17. Dampness in hollow walls is caused due to deposit of mortar droppings during construction and lack of ventilation.
18. Leaking pipes- soil, waste water, rain water supply pipes allowing water to enter the walls.
19. Salt in the plaster – presence of salt in the plaster or precisely in sand used for plaster will render the wall damp.

## Miscellaneous causes

**Moisture may also enter due to the following miscellaneous cause**

i. poor drainage at the building site
ii. Imperfect orientation walls getting less sunlight and heavy showers may remain damp.
iii. Imperfect roof slope: specially in the case of fat roofs
iv. Defective construction: imperfect wall jointing joints in roofs defective throttling etc.
v. Absorption of water from defective rain water pipes.

**Effect of dampness in wall of buildings**

There are May injurious effect which are a direct result of dampness in walls of building
The most common ones are started of mosquitoes and creates unhealthy

1. Dampness gives rise to breeding mosquitoes and creates unhealthy living condition.
2. Travel of moisture through wall and ceiling may cause ugly patches.
3. Moisture travel may cause softening and crumbling of plaster especially lime plaster.
4. the wall decoration is damaged, which is very difficult and costly to repair
5. Continuous presence of moisture in the walls may cause efflorescence resulting in disintegration of brick, lilts, etc., and consequent deduction in strength.
6. The flooring gets loosened because of reduction in the adhesion when moisture enters through the floor.
7. Timber fittings, such as doors, windows, Admires, wardrobes etc, coming in contact with damp walls, damp floors etc., get deteriorated because of Warping, Bucking, dry-rotting etc of timber.
8. Electrical fittings get deteriorated, giving rise to leakage of electricity and consequent danger of short circuiting.
9. Floor covering are damages. Or damp floor, one cannot use floor covering
10. Dampness promotes and accelerates growth of termites.
11. Dampness along with warmth and darkness breeds germs of dangerous diseases such as tuberculosis; neuralgia etc. occupant may even be asthmatic
12. Moisture cause rusting and corrosion of metal fittings attached to walls, floor and ceilings
13. Unhygienic condition inside the building- inviting various diseases to the inmates
14. Decay- the action of moisture on the different portion of the structure induce decay and disintegration of materials like Bricks, stone, steel, timber, etc. as continuous presence of moisture in the portion cause growth of moss, fungus and corrosion.
15. Dry rot- the presence of moisture in timber cause the disease in the timber, termed dry rot. Dry rot is effective due to presence of a virulent type of fungus allied to mushroom type.
16. Disintegration- Continued presence of moisture in brick may cause mechanical injury to the wall. If there are crack in the wall or porosity which may retain water; in freezing temperature, the water will freeze, increase in volume and cause severe damage.
17. Efflorescence – It is produced by the entrance of moisture in the brickwork which usually contains various soluble salts. These salts are dissolved by the water and issuing from the pores of the bricks, they crystallize and cause disintegration of bricks.
18. Furniture- They are damaged due to continuous damp environment.
19. Decoration of timber, bamboo, papering, etc, get damaged.

Global Journal of Engineering Science and Research Management

20. Warping and decay of timber
21. Plaster getting soft and subsequently crumbling
22. Corrosion of metal
23. Damage to electrical installations and short circuiting
24. Deterioration of floor covering
25. Infestation of termite
26. Blistering, flaking and bleaching of paint

**Remedies for Dampness of walls in buildings**

Remedies to damp wall may be temporary or permanent according to the exigency of occurrences. The treatment to remove dampness would be different for internal and external walls:-

***Temporary remedies for internal walls***

i. Application of bituminous painting – The affected wall is to be cleaned, allowed to be dried and then a coat of hot bitumen, bituminous compound – emulsions- are available in the market which may be applied cold with brush.
ii. Painting with water proofing solution – Either commercially available such solutions or prepared solution as described later may be applied as prescribed after cleaning the surface.
iii. Applying cements wash – this is an easy method. Cement and water mixed in thin consistency with admixture of adhesive gum may be applied one or more coats after cleaning the surface.
iv. Applying bitumen paint as mentioned above. Application of bitumen or bituminous paint on walls internal or external though may be effective, will render the wall surface unpleasant.

***Permanent remedies***

Before selecting a method for permanent remedy against dampness in walls, the cause of dampness, should be investigated. Once the cause is established, the action to be taken for remedial measure would not be difficult. The main object would to be remove the cause. In most of the cause, removal would not be difficult. As for example:

1. Dampness due to leakage from the root-stop the roof leakage.
2. Vegetation- removal of the vegetation including uprooting and applying chemical solution so that growth may not recur and sealing if there be any crack.
3. Earth backing, bank, sloping ground, etc. – the space around the building need be dressed to avoid splashing of water on the wall.
4. Cavities, holes, etc. – detect the exact spot, open the space and fill the cavity with concrete.
5. Defective window sills – these are to be corrected.
6. Dampness in hollow walls – the main purpose of constructing hollow walls is defeated. Utmost care must be taken during construction to avoid dropping of mortar. The outer leaf of the wall which is a non-load bearing, may be opened partially for removing the dropped mortar and cleaning. Further weep holes may be provided below horizontal damp proof course and air bricks may be provided at suitable places for ventilation.
7. Salt in plaster – this is due to using bad quality sand during construction. In such case, there is no other alternative than to remove the plaster and apply new rendering with salt free sand.
8. Leaking pipes – the location need to be traced correctly. These mainly happen in cases of soil and waste water pipes, when the pipes from inside the building pass through the wall for coming out. In most cases, these are joints at these locations. These joints need be opened up from outside and the joints or leaks repaired. As the pipe is in horizontal position, the joints must be lead caulked. In cases, the location need to be opened carefully and the joint repaired with sand and cement mortar. In case of water supply pipes, if the pipes laid are exposed, locating the leakage is not difficult. In cases of concealed pipes, the identification of the location is not much difficult as the dampness in the wall would indicate the position. The spot need to be opened and leak repaired.
9. In case of dampness due to use of porous brick and bad materials, the solution would be to demolish the portion and reconstruct those portion with better bricks and materials. If this is not possible due economics reasons, the remedy would be remove the plaster from either side and then replaster with new mortar of richer proportion with admixture of water – proofing compound. The external plaster should be in two layer should be laid over the bricks surface after cleaning and raking the joins. 20 mm thick cement sand plaster, 1:4 over which the second layer of plaster 10mm thick, 1:3 to be laid admixture of water proofing compound. The internal plaster should be single layer 20 mm thick cement sand 1:4.
10. In case of mortar joints not laid properly- this is a construction defect. The plaster on both faces should be removed. The mortar joints should be opened up to 20 mm deep and raked properly and then replasterted
11. Damp proof course – damp proofing of a building is achieved by using suitable damp proofing material which should satisfy the condition to be impervious to the moisture. new, due to absence of damp proof curse or due to bad construction

Global Journal of Engineering Science and Research Management

if damp proof course provided does not satisfy condition above the moisture rises through the damp proof course and the walls get damp and consequently other ills appear, the commonest method is dealing with the wet rising from the soil by the capillary action is insertion of a new damp proof course of replacing the old one.

The simple method is to remove two layers to bricks right through the thickness equal to the thickness of the proposed damp proof course to provide room for insertion of the damp proof course.

When the lower course has been replaced, it should be covered with a bed mortar 12mm thick so as to get a uniform bearing all over. Over this, the damp proof course maid of cement concrete 1:1½ :3 with admixture of the water proofing compound is to be laid. Then the remaining course of brick is replaced. They most be well buttered with cement mortar, and after being pushed into the opening, they can be wedged down into intimate contact with the damp proof course tightly into the top bed joint.

## Materials used for damp proofing of Buildings

The following materials are commonly used for damp-proofing course

1. ***Hot bitumen***
   This is highly flexible material, which can be applied with a minimum thickness of 3 mm. it is place on the bedding concrete or while in hot condition.

2. ***Mastic asphalt***
   Mastic asphalt is semi-rigid material which is quite durable and completely impervious. It obtained by heating asphalt with sand mineral fillers. However, is should be laid very carefully, by experience persons. It can withstand only very slight distortion. It is also liable to squeeze out in very hot climate or under heavy pressure.

3. ***Bituminous or asphalted felts***
   This is a flexible material, which is available in rolls of various thicknesses. It is laid on a leveled flat layer of cement mortar. An overlap of cm is provided at joints and full width overlap is provided at angles, junction and crossings. The laps should be sealed with bitumen. Bituminous felts cannot withstand heavy loads; through they can accommodate slight movements

4. ***Metal sheets***
   Sheet of load, copper, aluminum can be used as D.P.C. these sheets are of flexible type. Lead sheet are quite flexible. Their thickness should be such that its weight is not less than 20kg/ m2. They are laid similar to the bituminous felt. Lead sheet have the advantages of being completely impervious to moisture, resistant to ordinary atmospheric corrosion, and capability of taking complex shapes without fracture and resistant to sliding action. It does not squeeze out under ordinary pressure. However, it may be corroded when in contact with lime or cement. It should, therefore, be protected by a coating of bitumen. Copper sheets, of minimum 3 mm thickness, are embedded in lime or cement mortar. It has high durability, high resistance to dampness, and high resistance to sliding and reasonable resistance to ordinary pressure. Aluminum sheets, if used, should be protected with a layer of bitumen. It is not as good as lead or copper sheets.

5. ***Combination of sheets and bituminous felts***
   Lead foil sand witched between asphalt or bituminous felt can be effectively used as D.P.C. The combination, know as lead core possesses characteristic of easy lying. Durability efficiency, economy and resistance to cracking.

6. ***Bricks***
   Special bricks, having water absorption not less than 4½% of their weight may be used as D.P.C. in locations where damp is not excessive. These bricks are laid in two to four courses in cement mortar: the joints of bricks kept open.

7. ***Stones***
   Dense and sound stones, such as granite, trap, slates etc are laid cement mortar (1:3) in tow course or layers to from effective D.P.C. the stones extend to the full width of the wall.

8. ***Mortar***
   Cement mortar (1:3) is used as bedding layer housing other D.P.C. materials. A small quantity of lime may be added to increase workably of the mortar. This mortar may also be used for plaster work on external walls.

Global Journal of Engineering Science and Research Management

9. ***Cement Concrete***
   Cement Concrete 1:2:4 mix or 1:1½ : 3 mix is general provided at plinth level to work as D.P.C. the thickness may vary from 4cm to 15cm. such a layer can effectively check the water rise due to capillary action. Where dampness is more, two coats of hot bitumen paint may be applied on it.

10. ***Plastic sheets***
    This is relatively a new type of D.P.C. material, made of black polythene 0.5 to 1mm thick in the usual wailing width and roll length of 30m.

## Characteristics of Damp Proofing Materials

Damp proofing materials should possesses the following characteristics before being used in Buildings

1) The material should be perfectly impervious and it should not permit any moisture penetration or travel through it.
2) The material should be durable, and should have the same life as that of the building.
3) The material should be strong, capable of resisting super imposed loads/pressure on it.
4) Material should be flexible, so that it can accommodate the structural movements without any fracture.
5) The material should not be costly.
6) The material should be such that leak-proof jointing is possible
7) The material should remain steady in its position when once applied. It should not allow any movement in itself.

## Conclusion

One of the basic requirements of a structure (building) is that it should remain dry or free from moisture traveling through the internal and external walls, roofs or floors Dampness usually give rise to unhygienic conditions, apart from reduction in strength of structural components of the building. Damp prevention is therefore one of the important items of building design. Every building should be damp proof. Thus is the duty of construction Engineers and supervisors on construction sites.

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