Industrial Engineering Letters
ISSN 2224-6096 (Paper) ISSN 2225-0581 (online)
Vol.5, No.10, 2015

The Devastating Effects of Rising Damp in the Construction Industry

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ABSTRACT
The unacceptable access and penetration of moisture into building through its structural component such as column's, walls, floors, roofs etc. is called dampness. This study seeks to provide sound up to date information about the various causes of dampness in buildings, the effect of dampness in buildings, method of preventing dampness in buildings or remedies of dampness and diagnosis of dampness.
Causes of Dampness in building are a great concern in the construction industry as it often leads to deterioration of structural component such as columns, walls, floors, roofs, and encourage rapid growth of molds and bacteria which causes related health problems. The foundations of all structures are embedded into the soil, blocks and bricks being porous or masonry below ground level can absorb moisture from adjacent ground or by capillary action.
Causes of dampness are numerous and most of them are not completely solvable later, this is why this research work seeks to provide all the necessary precaution and preventive measures in order to avoid it because prevention is always better than cure.
While water molecules are present in the air and adsorbed by materials within all buildings, when the materials become sufficiently damp to cause material damage or visible mould growth we often say that the building has excess dampness or has dampness problem or we characterize the building as a damp building. The dampness and mould growth may occur on visible interior and exterior surfaces in the building, including within basements or crawl spaces, or hidden inside walls and air conditioning plants and ducting.
The study entails a careful and intensive library research interspersed with a well organize program case study in the Greater Accra Region in Ghana.
It is also recommended that further, researches must be carried out on the above issues in the similar newly developing areas in the Greater Accra Region in order to avoid this problem of rising dampness in the Ghanaian Construction Induction Industry.
Keywords: Penetration, structural component, dampness, capillary action chlorides, nitrates and sulphates.

Introduction

Rising damp is a nationwide phenomenon in the Ghanaian Construction Industry and is the number one major cause of decay to block works and mortar works even sometimes concrete works and reinforce rods in it. This also cause unsightly crumbling of exterior and interior wall finishes of the building bad stain on the wall surface. In poorly ventilated buildings, it may also cause bad musty smells with its health related issues.

What is rising damp?

Rising damp always occurs as a result of capillary action which is suction of moisture from the ground surrounding the structure into the vulnerable and porous building materials such as block work, brick, concrete and mortar works. The moisture travel upwards through capillary action and evaporates from the internal and external surface of the walls and this process allow more water to be drawn from the ground.
In Ghana the rate and the height to which the moisture travel upwards or rise is mostly determined by nature of the wall and the type of surface treatment or protection given to it. In most cases the normal limit ranges from 1m to 3 meters well above ground level.

What causes rising damp?

The followings are the main causes of rising damp.

1. Failure to provide damp proof course
2. Failure to provide damp proof membrane
3. Failure of an existing damp proof course
4. High external ground bridging an existing d.p.c.
5. Internal plaster works bridging an existing d.p.c
6. Bridging of damp proof course due to a buildup of mortar works inside a cavity wall.
7. Leaking water pipes at the base of a wall.

These seven points listed above can be very complex for that matter an expect and specialist trained professionally will be needed to carry out the investigation and survey works before solution can be provided.

Dampness in General

Arora and Bindra (1996) sees damp prevention as the chief requirement to ensure safety of buildings against dampness, since failure to provide preventive measures will cause a lot of defect to the building. (Seeley 1986) also described damp penetration as one of the most serious defect in buildings, according to him, apart from causing deterioration of the structure, it can also result in damage to finishing's and in severe cases adversely affect the occupants. Therefore it is of relevant

importance to share the view expressed by Arora and Bindra (1996) that to ensure the safety of buildings and occupants, there is the need to prevent it against dampness.
Dampness in general can be divided into four major areas or causes, (1) seeping (2) penetrating damp (3) condensation (4) rising damp.
The first three are easy to solve by technically inclined person but the last being rising damp demands expert and detailed scientific explanation will be needed before a solution can be provided.

1. Seeping: - This is controlled by good roofing
2. Penetrating damp:- This is controlled by good surface treatment
3. Condensation:- This is controlled by adequate ventilation
4. Rising damp:- This is the most difficult of absorption by capillary action. Which is water soaked up from the ground and is only a problem if the damp proof course and the damp proof membrane's are not there to take care of it or either damaged or bridged.

Rising Damp should be thing of the past
Since 1875 DPCs have been compulsory, although occasionally they are omitted (Dr John Hinks and Dr Geoff Cook). The traditional DPC and DPM must be an effective barriers and the last bus stop for rising damp in buildings although these two materials may not resist movement of moisture or water percolating beneath or below the building.
Modern DPM materials such as polythene sheets are flexible and very reliable to take care of cracks and even vulnerable regions like joints.

Source of rising damp
Rising dampness could happen anywhere in Ghana even on top of the highest mountain in the country, even to mention one of the highest points in Accra (McCarthy hill) Rising Damp is present. So it is not only associated with low land areas.
Buildings without a d.p.c and d.p.m on lands situated on very wet sites are always subject to some degree of rising damp problems. Buildings faced with very wet conditions, from seasonal flooding, are also vulnerable if they do not have an effective d.p.c and d.p.m beneath and in Ghana most of the "remedies" trying to solve the problem only end up to exacerbate the problem.
The following points are considered as the sources of rising dampness in buildings.

1. The height of the water table
2. Surface and subsoil drainage system
3. The rate of evaporation
4. The presence of a damp-proof course (d.p.c)
5. The presence of a damp-proof membrane (d.p.m)
6. DPC bridging
7. Improper lapping of (DPM)
8. The wall finishes in particular, if dense renders are used
9. Thickness of the wall
10. The amount of foundation wall surface area underground
11. Contaminated land (presence of salt)
12. Amount of moisture entering the wall above ground level.
13. Air moisture condensation
14. Internal plumbing leaks
15. Natural flooding

Although it is not a common practice but a good surveyor should consider excavating trial holes in a dampness investigation (Ralph Burkinshares, Mike Parrett 2004)

- To confirm the existence of a d.p.c that has been concealed by raised ground levels externally.
- To verify the construction of walls below ground.
- To establish the height of the water table.

Purpose of Damp-proof courses
The purpose of damp-proof courses is to provide a barrier to the passage of water from the ground into the structure. (William George Nash 1988). They may be horizontal or vertical and placed either below ground level or just above ground level to prevent water rising up the wall.
(Siobhan Vernon, Rachel Tennant, Nicola Germong 2013) defines the purpose of a damp proof courses as a strip of impervious material the same with width as a brickwork or block work wall, to keep out moisture. Now the million dollar question facing the Ghanaian Construction industry is very simple (What would happen if you did not install a damp-proof course?).
The rarest of all forms of damp rises from the ground when a damp-proof course and membrane do not exist or have become damaged. We started building damp-proof courses into our new homes in 1870, but there is no guarantee that a property built after that year will have one, or indeed that it will be an effective one. (Paul Hymers 2007).
Christopher Gorse, David Johnston, Martin Pritchard, 2012) defined damp-proof course (DPC) As a horizontal strip of impervious material that is build into a wall and is design to prevent moisture penetration by capillary action. DPCs should be laid a minimum of 150mm above ground level. A variety of material can be used for a DPC including state, lead, bitumen-

polymer, and polymer, and polyethylene. The most commonly used materials are those that are flexible and care must be taken when installing flexible damp-proof course to avoid puncturing the material. DPCs can also be retrofitted into existing walls by injecting a suitable chemical, such as silicon into the wall at regular intervals.
Rising Damp, together with salt is very common in the Greater Accra Region of Ghana. This could be clearly seen as moisture migration with salt in both old and even new buildings in the Region. This is considered as the number one major causes of deterioration in both new and old buildings. Water can come into contact with the foundation berried underground as groundwater or provided water or even as water use for watering flowers around the building and due to porous and absorbent nature of the foundation concrete and the footing block wall, moisture will tend to rise some distance upwards by capillary action unless there is an active and effective DPC and DPM to serve as a barrier.
In Ghana especially in the Greater Accra Region problem of rising damp is so common in even old and new building where there are no DPC's and DPM due to lack of knowledge about them. The problem is also very common in building constructed in claying land or soil without DPC's and DPM's.

Rising damp with salt crystallization
The moisture that moves up the wall invariably contains dissolved salts, often chlorides or sulphates, and they are deposited near or at the wall surfaces where evaporation takes place (M. Lielt, Heing R. Trechesl 1982).
In most cases the height of the capillary rise is been influenced by the size of the capillary spaces in the footing course and the block wall. The smaller the capillaries, the higher the capillary rise. The rate of evaporation from the wall could also be a contributing factor. An increase or decrease in the rate of evaporation will be accompanied by a fall or rise.
The sources of dampness which involve movement of water in liquid form can be classified as follows:
1. Direct rain penetration through the structure.
2. Faulty rainwater disposal (gutters and down pipes).
3. Faulty plumbing (water supply or disposal).
4. Rising damp by capillary action.
5. Dampness in solid floors.
   (EG Godbert, TA oxley 2013)

Damp-proof causes and floor membranes
Most properties, in the UK built after 1877 will possess a wall, damp-proof course (dpc) traditionally located at least 150mm above ground level. The wall dpc has two functions. It helps prevent moisture soaking up post it from below the ground; and it acts as a barrier to water entering the wall between the ground or the dpc externally.
Evidence of this second role can be clearly seen if porous brickwork appears to be frost-damaged between the ground and the dpc where rain splash has soaked porous masonry. Bricks just above the dpc are protected from undue soaking and remain in better condition. Cement rendered plinths can help shield the wall base, but they may also trap moisture behind.
It is also important to note that ground level means finished ground level, because, sometimes contractors lay paths and pavings that compromise this necessary minimum height of dpc even before the building has been completed. (Ralph Burkinshow, Mike Parrelt 2003).

Effects of dampness in buildings
1. Causes routing of doors and window frames.
2. Causes corrosion of reinforce bars and metallic fixtures.
3. Causes bleaching and blistering of paints on above the internal and external surfaces.
4. Causes petting off and removal of plaster tiles even terrazzo works.
5. Causes sports and stain on the floors and walls.
6. Deteriorate carpets, skirting boards, dado rails and furniture.
7. Deteriorate electrical installations.
8. Causes efflorescence.
9. Causes health related problems to occupants.
10. Reduce the life span of the structure.

Causes of dampness in buildings
1. Rain penetration
2. Level of site
3. Drain ability of soil
4. Climate condition
5. Defective orientation of building
6. Moisture entrapped during construction
7. Defective construction for example Joints

Preventive Method
1. By providing DPC (Damp proof course).
2. By surface treatment, by providing damp proof paint (emulsion asphalt).
3. By integral water proofing method.
4. By providing damp proof membrane.

5. By avoiding leakage of water pipes.
6. By avoiding condensation in the building.
7. By providing good roofing.

Materials used for damp proofing

1. Lead sheet
2. Polythene sheet
3. Copper sheet
4. Slates
5. Hot bitumen
6. Mastic asphalt
7. Engineering bricks
8. Bituminous felts
9. Combination of sheets and felts

Property or requirement of damp proofing material

1. It must be completely impermeable or impervious.
2. It must be rigid, flexible to support the loads place upon it without excluding or from the wall.
3. Be in comparatively thin sheet so as to prevent disfigurement of the building.
4. Durable to have a longer life span.
5. It should be dimensionally stable.
6. Be flexible enough to give any settlement of the building without fracturing.
7. The material should be reasonably cheap.
8. It must be easy to obtain.
9. The material should be such that it is possible to carry out leak proof joining works.
10. It should be free from deliquescent salt like sulphate, chlorides and nitrates.

Classification of damp proof materials

Four major categories of materials are used to prevent and stop dampness in buildings these are

1. Flexible materials: - such as bituminous felts which may be Hessian based or fibre/glass fibre based, plastic sheeting, polythene sheet etc.
2. Semi rigid materials: -such as mastic asphalt or combination of materials or layers.
3. Rigid materials: - such as engineering bricks, stones, slates, cement concrete with additive.
4. Grout materials: - Grout consists of cement sherry and acrylic based chemical or polymers.

Function of Damp Proofing Course

- To prevent entry of moisture in walls below ground level.
- Prevent entry of moisture in walls just above ground level.
- Prevent rainwater coming directly into the fabric of the building.

The function of a damp-proof courses (dpc) is to act as a barrier to the passage of moisture or water between the parts separated by the dpc. The movement of moisture or water may be upwards in the foundation of walls and ground floors, downwards in parapets and chimneys or horizontal where a cavity wall closed at the jambs of openings (Stephen, Christopher 2013).

Fig. 1

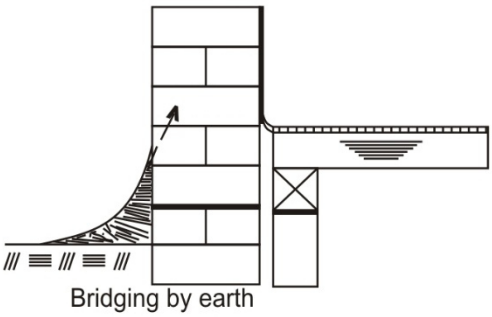


Fig. 2

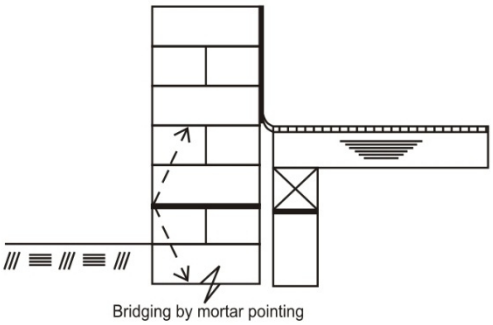
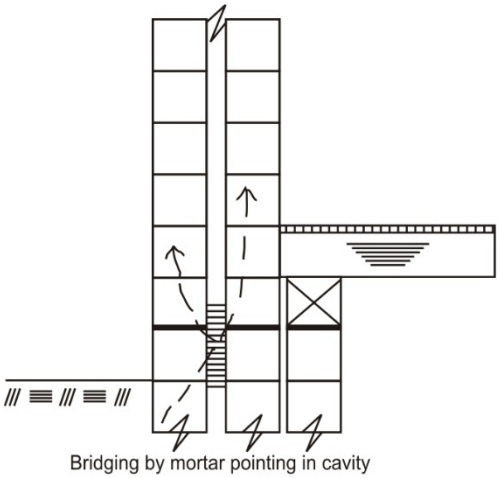


Fig. 3



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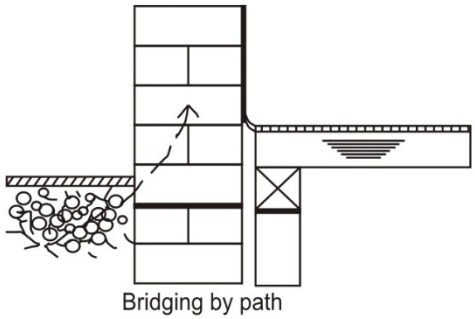

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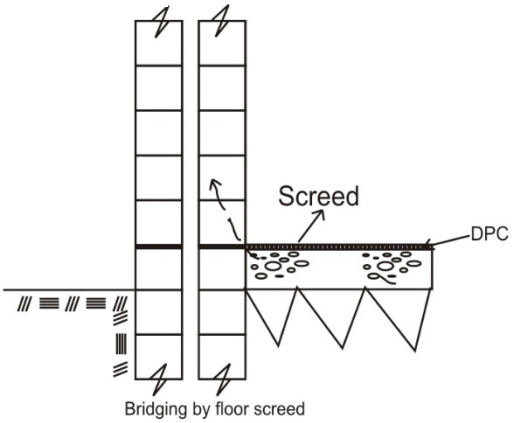

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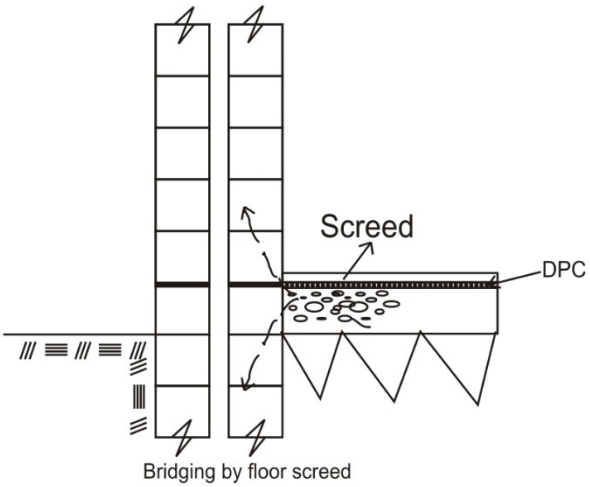

Fig 7

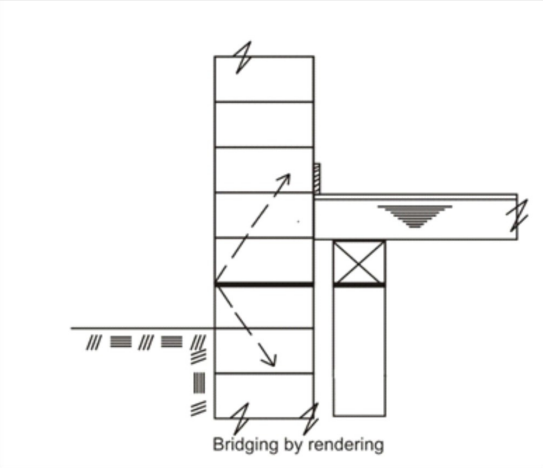

Fig 8

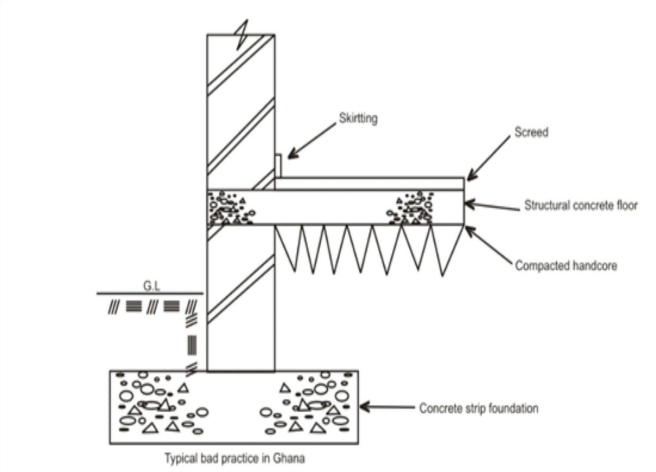

Fig 9

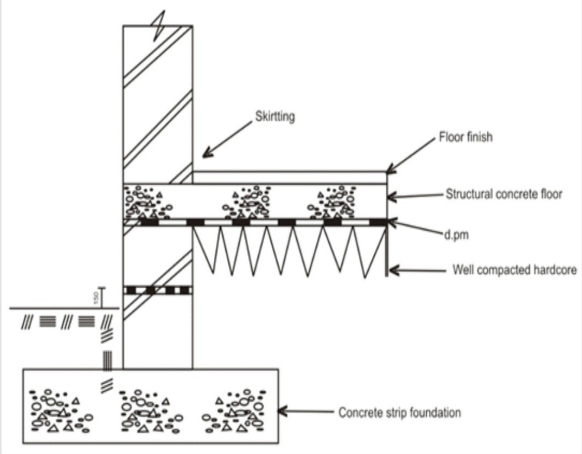

Fig 10

Fig 11

Fig 12

Failure of D.P.C. and D.P.M

Rising damp problems can be caused by the bridging of the D.P.C and D.P.M. which allows water to rise up the wall above the level of the membrane and which sometimes can be rectified without much difficulty or expense. (Lielt and Trechsel 1982).

As illustrated in fly 1 above some common sources of this bridging action are:

1. The heaping of soil or debris against the wall.
2. The location of a concrete path or floor slab directly against the wall.
3. The building up of mortar droppings or other debris inside the cavity.
4. Failure to extend the DPC a sufficient distance across the wall so that moisture can travel up the wall through the render or mortar pointing.
5. Perforation of the DPC by building operations and subsequent bridging according to (Lielt and Trechsel 1982).

Underground drainage leaks are a frequent source of dampness and often go unnoticed as a cause, simple because they are out of sight. Even a camera survey may not detect leaking drains unless there is an obvious cause, such a cracked pipe or a penetrating tree root. (Jonathan 2012).

What need to be done in the Ghanaian construction industry? D.P.C and DPM at different levels.

One of the best practice in Europe DPC at different levels, Damp proof course a minimum of 150mm above ground level, internal dpc may be at a different level, but should still be 150 above ground level (Stephen and Christopher 2005).

Fig 13

Fig 14

Findings / Observation

The following findings were made during the study of the greater Accra region

- Most areas lies in low grounds
- There is no proper layout of most areas
- Non-existence of damp-proof course (d.p.c)
- Non –existence of damp-proof membrane (d.p.m)
- Lack of proper drains
- Claying nature of most areas is a factor to consider
- Defective Construction works
- Stagnant and surface water in almost all areas
- High water table in most areas
- Improper disposal of waste water

Conclusion

Base on the findings, it can be concluded that

The waterlogged conditions in most areas mainly due to the area lying on a low ground

The claying nature of most ground is a contributing factor to consider

Lack of proper drainage system in most areas is due to lack of proper layout of the area

The indiscriminate disposal of waste water on the ground due to lack of proper drains is also a contributing factor to consider.

The major causes of dampness in most areas are the rising damp which is, as a result of the claying nature of most grounds couple with high water table in almost all areas.

The rising damp effect in the region has resulted in the following

(i) Softening and crumbling of block works and plaster works on walls
(ii) Disintegration of block walls
(iii) Disintegration of reinforced concrete works
(iv) Corrosion of iron rods
(v) Disintegration of doors, frames and window frames
(vi) It has caused bleaching and flaking of paints
(vii) The stagnant water in most areas have become a breeding ground for mosquitoes
(viii) The stagnant water also creates unhygienic `conditions in the environment.

Recommendation

Rising damp problems are usually the outcome of a combination of causes and only a very experience and an expert in the field would be needed to do thorough inspection in order to give a correct diagnosis in order to solve the problem once and for all. One reliable method of overcoming rising damp problem is the chemical injunction method.

The following recommendations are therefore very imperative to provide possible remedies to the problem of rising damp and a better approach to the future projects to be undertaken.

(i) Underground drains must be constructed to serve as a dewatering system.
(ii) Most structures constructed on water ways must be pulled down to make way for the construction of storm drains.
(iii) Building inspectors, architects, builders and building owners must insist on installation of d.p.c and d.p.m during the construction stage.
(iv) They should seek advice from competent engineers as to how to install d.p.m and d.p.c properly.
(v) The habit of indiscriminately disposal of waste water on the ground should be discourage with immediate effect.
(vi) Clean-up exercise should be encouraged to ensure a healthy living condition.

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