IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 13, Issue 3, March 2023, ||Series -I|| PP 72-86

Causes, Prevention and Treatment of Dampness in Buildings

Haj Nado
Dr R.L. Sharma
School of Civil Engineering
Lovely Professional University,
Phagwara
Received 13 March 2023; Accepted 28 March 2023

ABSTRACT
In this paper I have done the research on various causes of dampness in the buildings and prevention and treatment methods for the same. This dampness problem has been a concern since the ancient times and still it's a problem in the present date. There are various causes, prevention and treatment methods mentioned in this paper. The main objective of the paper is to find out the source which causes dampness and to find a solution to prevent it or treat the dampness. The major cause of the dampness is moisture and it can occur due to different reasons which are mentioned in the paper and there are also prevention and treatment methods mentioned. Dampness in the building can also cause some serious health related problems to the occupant of the building and it already gives different problems like bad odour, corrosion, failure of structure etc.

I. INTRODUCTION

Dampness is the presence of unwanted moisture in the building structure it is either the result of intrusion from outside or condensation from within the structure. A high proportion of damp problems in buildings are caused by the surrounding climate dependent factors of condensation and rain penetration.

Dampness problem has been a concern since ancient times especially the rising damps which causes because of the water above the ground level so the roman architect and engineer Vitruvius referred to the problem of dampness rising up walls and advised on how to construct buildings to avoid the problem. Dampness in the building leads to weakening in the strength of the materials and can cause the structure to fail and damage to the property as well, it also create unhealthy environment for the users in the building because it gives rise to breeding of mosquitoes. Damp in the building occurs mostly on the floors and the walls of the building because the floors are close to the ground and the walls are directly exposed to the outside weather. Dampness in the wall ruins the paint and also the decorations and quality of the wall, it can also results in rotting of timber especially timber fitting doors and windows. If there is dampness near electrical appliances then one should be careful as electrical fittings get deteriorated and can rise the risk of leakage of electricity and consequent danger of short circuiting. Continuous dampness can cause breeding of germs of dangerous diseases such as tuberculosis, neuralgia etc, it can also cause asthma to the people staying in the building, therefore prevention and treatment of dampness in the building is necessary and to do this finding the sources of the moisture is important ,since moisture is the main cause of the dampness.
There are some various causes of dampness in buildings and its prevention and treatment methods.

Causes of dampness in buildings
1. Dampness because of capillary action. It occurs when the moisture on the wet ground rises above the ground level due to the capillary action.
2. When the rain water splashes and rebound back to the wall can also cause dampness.
3. When the roof slabs, walls, parapets walls etc are not protected properly then the rainwater penetrates and cause dampness.
4. In the case of slope roof , rainwater may enter through the crack coverings and cause dampness.
5. In case of flat roofs, inadequate roof slopes, improper rainwater pipe connections, and defective junction between roof slab and parapet wall may prove to be the source of dampness.

Defects caused by dampness in the buildings
1. Dampness in building causes efflorescence which may ultimately result in disintegration of bricks, stones, tiles etc.
2. Dampness may result in softening and crumbling of plaster in the building.

3. Dampness may cause bleaching and ruin the paint with the formation of coloured patches.
4. Dampness may result in the warping, buckling and rotting of timber especially timber fitting doors and windows.
5. Dampness may lead to the corrosion of metals because of the condensation within.
6. Dampness may cause deterioration to electrical fittings and can cause leakage of electricity and short circuiting.
7. Dampness promotes growth of termites especially in the wooden objects like cub boards, shelves etc.
8. Dampness creates unhealthy living conditions for the occupants because it gives rise to breeding of mosquitoes and germs of dangerous diseases .

Prevention methods

1. Membrane damp proofing

Membrane damp proofing is providing layers of membrane of water repellant material between the source of dampness and the part of the structure adjacent to it. This layer is commonly known as damp proof course (DPC) and it may consists of materials like bituminous felts, asphalt, mastic, polythene sheets or plastic, cement concrete, etc. Depending upon the source of dampness, DPC may be provided horizontally or vertically in floors, walls, etc. Provision of DPC in basement is normally termed as tanking.

2. Integral damp proofing

Integral damp proofing consists in adding certain water proofing compounds with the concrete mixture to reduce the size of the pores so it is impermeable. Such compounds can be found in the market in powdered as well as in liquid forms. The compounds made from clay, sand or lime (chalk, fuller's earth, etc) help to fill the voids in concrete and make it waterproof. Compounds like alkaline silicates, aluminium sulphate, calcium chlorides, etc can also be used but it reacts chemically when mixed with concrete to produce water proof concrete. The quantity of water proofing compounds to be added to cement depends upon manufacturers' recommendations. In general, one kg of water proofing compound is added with one bag of cement to render the mortar or concrete waterproof.

3. Surface treatment

Moisture will always try to find its way through the pores of materials, especially, used in finishing. So in order to counter the entry of the moisture into the pores, these pores must be filled up. Surface treatment consists in filling up the pores of the surfaces subjected to dampness. The use of water repellent metallic soaps such as calcium and aluminium oleates and stearates such as bituminous solution, cement coating, transparent coatings, paints, varnishes are effective in protecting the building against the ravages of heavy rain. There is also cheaper and another way of surface treatment given to walls, the one economically used is lime cement plaster. The walls plastered with cement, lime and sand in proportion of 1:3:6 is found to serve the purpose of preventing dampness in wall due to rain effectively.

4. Cavity wall construction

Cavity walls are basically two walls constructed with a space between the creating a cavity, so that even if the outer wall is penetrated by water it will not let the water travel to the inner wall. The two walls of the cavity walls are called leaf, internal leaf and external leaf. If the cavity wall is of non- load bearing, then the two leaves are of equal thickness or sometimes internal leaf with more thickness is provided. The cavity size between the two leaf walls should be 4 to 10cm. The internal and external leaves should have at least 10 mm thickness. The two leaves are interconnected by metal ties or links

Objective:

- To identify the causes of dampness and preventive measures in buildings
- To propose methods for treatment of dampness in buildings

Outcome:

- Various causes of dampness in buildings
- Methods to damp treatment in buildings
- Defects caused by dampness in buildings

II. LITERATURE REVIEW:

Sl no.	Title & Author	Research Findings
1	Cristina Campian and Maria Pop Methods for elimination of dampness in Building walls	The authors have investigated the methods of eliminating dampness from building walls. The dampness in buildings results due to various reasons such as types of material used and masonry, breakage of drainage piping or defective, poorly made roofing etc. Various treatment methods have been

		explained in this paper like ventilation, using disinfectant products, chemical, electro osmotic system and physical method. According to this review the best method to be considered is the radial method, using the mechanical cutting system and the insertion of special plastic sheeting with injection of anti-shrinking mortar.
2	Makoko, Lagos state An Analysis of the causes, prevention and treatment of dampness in buildings	According to this review the ultimate objective of any dampness study is to identify the lead source of moisture in order to recommend actions to remedy the problem. According to Hollis (2000), sources of dampness can be classified as rising dampness, penetrating dampness, condensation dampness and dampness through pipe leakages. According to Burkinshaw and Parrett (2004), dampness can be classified as air moisture condensation, penetrating dampness, internal plumbing leaks, below ground moisture or building specific sources.
3	Lee How Son, George C. S. Yuen Eliminating dampness caused by ground water	According to the research done by the author rising damp is concerned with the movement of water from the ground to the porous material of the walls. It commonly occurs in walls near ground level as well as in solid ground floor slabs, particularly at junctions with the walls basically at the corners of the wall. The mechanism of moisture movement through the porous material takes place in both saturated and unsaturated soils. It is caused mainly due to absence of damp-proof course and can be treated by physical insertion of damp-proof course.
4	Nur Liyana Othman, Mastura Jaafar, Wan Mariah Wan Harun and Fuziah Ibrahim A Case Study on Moisture Problems and Building Defects	According to the author hospital buildings are one of the complicated buildings that normally associate with a moisture problem because it tends to produce more moisture and its very important to maintain the temperature in the hospitals. Besides environment factor, the different operation hour, poor workmanship and improper waterproofing installation also contributes to the moisture problems. Controlling the moisture problems seem to be vital in ensuring the building functionality. This study identifies the moisture problems and it's causes. Based on various records obtained, this study discusses the defects according to four major building elements that are ceiling, wall, floor and roof.
5	J.M.P.Q.Delgado, A.S.Guimarães, V.P.deFreitas, IñigoAntepara, VáclavKolí and Robert Herný Salt Damage and Rising Damp Treatment in Building Structures	According to the authors salt damage can affect the service life of numerous building structures, both historical and contemporary, in a significant way. In this review, various damage mechanisms to porous building materials induced by salt action are analyzed. The importance of pre treatment investigations is discussed as well in the paper; in combination with the knowledge of salt and moisture transport mechanisms. This pre investigation can give useful indications regarding treatment options. The methods of salt damage treatment are assessed then, including both passive techniques based on environmental control, reduction of water transport, or conversion to less soluble salts and active procedures resulting in the removal of salts from deterioration zones. According to the paper it is concluded that cellulose can still be considered as the favourite material presently used in desalination poultices but hydrophilic mineral wool can serve as its prospective alternative in future applications.
6	V. Apih and M. Makarovic Development of a method for drying out the damp walls of buildings	According to the research done by the authors a method, including both materials and equipment, has been developed for the reduction of dampness in the walls of buildings. The effectiveness of this method has been proved by measurements of changes in moisture distribution over a four-year period. Using this method, the penetration of sea-water into the walls was prevented, and the capillary transport of moisture up the walls was reduced, resulting in the drying out of the walls. This method is damp proofing the walls.
7	Kofi Agyekum, Karen Blay and Alex Opoku MECHANISMS FOR PREVENTING RISING DAMP IN NEW BUILDING INFRASTRUCTURE	According to the authors capillary rise of water in buildings has been an issue of concern among past and present researchers. Despite the research efforts done devoted to the proper elimination of the problem in masonry construction, it still remains a challenging problem that needs to be addressed. This study explores treatment mechanisms that can be used to prevent rising damp in new building infrastructure. According to authors it is recommended that the walls to which the epoxy coatings have been applied should be monitored for longer periods against blistering one, and effective measures must be put in order to prevent such. The study further recommends a future study to look at the economic and commercial impacts of the proposed preventive mechanisms.
8	Ugochukwu Kenechi Elinwa, Cemil Atakara and Abiola Ayopo Abiodun	According to the researchers dampness can be defined as water penetration through the walls and individual elements of a building and it contributes to more than 50% of all known building failures. Therefore, the ultimate

	Preventing dampness using Computational Fluid Mechanism	objective of any humidity study is to identify the lead source of moisture and to recommend steps to remedy the problem. Based on their review, the members of the National Academy of Sciences Committee on Damp Indoor Spaces and Health concluded that the scientifically proven evidence shows that there is direct link between exposure to damp indoor environments and its connected health effects, including upper respiratory (nasal and throat) symptoms, cough, wheeze, asthma symptoms in sensitized persons with asthma. So to prevent dampness Computational Fluid Dynamics (CFD) Analysis technique is used in this research. CFD connected to test proposed natural ventilation, blended mode ventilation, and HVAC systems in structures, which for the most part includes the prediction of air temperature, speed, and relative humidity among different parameters.
9	Nur Liyana Othman, Mastura Jaafar and Fuziah Ibrahim Dampness in major areas of buildings	This study identifies the moisture problems and the causes of moisture for the buildings. Based on various records obtained, this study discusses the defects in the buildings according to four major building elements that are ceiling, wall, floor and roof. This paper concludes that the identified defects in the major elements of the buildings have great potential to affect the building function. WHO had identified that transfer of moisture can happen in both vapour and the liquid phase by diffusion, convection, capillary suction, wind pressure and gravity and also identified that moisture is the cause of 75-80 per cent of building envelopes defects. There are various ways of containing moisture and different moisture problems in building.
10	Divya K Different causes and prevention method of dampness	According to the author absorption of moisture by the building materials is one of the chief causes of dampness. The shape of the materials are granular in nature, so moisture finds an easy access through the voids and the capillary action helps the moisture to travel in different directions. Thus, either on account of faulty design of structure or bad workmanship or by use of defective structures or by use of defective materials, moisture may find its way on the interior of the building either through the wall, floor or roof. The treatment given to prevent leakage of water from roof is generally termed as water proofing whereas the treatment given to keep the walls, floors and basement dry is termed as damp proofing.
11	Olli Seppanen and Jarek Kurnitski Moisture control and ventilation	According to the author moisture is one of the major causes of the dampness in the building. With increasing scientific understanding of the problems represented by moisture and dampness and recognition of the widespread nature of these problems, one must pay proper attention to how the quality of construction affects these problems. Nevertheless, many problems have the same origin and their solutions are thus similar in principle. This paper discusses about the role of ventilation in controlling moisture and providing a healthy indoor environment. Ventilation is intended to remove or dilute pollutants and to control the thermal environment and humidity in buildings. It must be sufficient either to remove pollutants and humidity generated indoors or to dilute their concentrations to acceptable levels for the health and comfort of the occupants and must be sufficient to maintain the building's integrity. It is evident that a sufficient flow of outdoor air for ventilation is necessary: to remove indoor-generated pollutants and moisture from indoor air or to dilute their concentrations to acceptable levels for occupants' health and comfort; and to maintain building integrity. Ventilation can be provided by either natural or mechanical means, but both need careful implementation to avoid malfunctioning. Failures in ventilation may lead to serious health problems and damage to building construction.
12	Folke Bjork, Bror Sederholm, Jan Tragardh and Bo Olofsson Electro osmosis – a method applied for handling of moisture in foundations	Electro osmosis is an electro kinetic phenomena which is applied in some technical fields. It is also applied large scale for transport of moisture out of basements. We see the method of electro osmosis as an opportunity for solving moisture problems in basements. However, there is a need to develop both the technology for the method and the understanding about what to expect out of it. Electro osmosis requires high levels of moisture to function. To go down to moisture levels below those critical for mould and rot other supplementary drying methods are required.

Methodology:
Step1: Literature survey
Step2: Finding out causes of dampness in buildings from literature review
Step3: Effect of dampness in health
Step4: Critical review of various treatment methods for preventing dampness in buildings

CHAPTER:-1
Causes of dampness in buildings

These are some of the causes of dampness in the buildings

1. Types of material used

When constructing a building one should be cautious in selecting the building materials because poor quality materials will lead to dampness in the building. Most of the construction materials such as concrete brick and plaster possess interconnected void within them, when these materials come in contact with water, water finds a way to penetrate into these voids. Again this water when aided by capillary action then water moves in different direction causing dampness in the building.

2. Defective drainage and piping

This can occur through various reasons like old pipes with damaged seals, corroded water pipes inside the walls, holes in the pipes and leaking of water from the pipe joints because of bad workmanship. This drainage water gets absorbed and spread to the wall causing dampness and wet rot, risking the health of the habitants living there. This leakage is often visible at first but the water slowly infiltrate walls and roofs, if its left unattended then can lead to long term damage.

3. Poorly made roofing

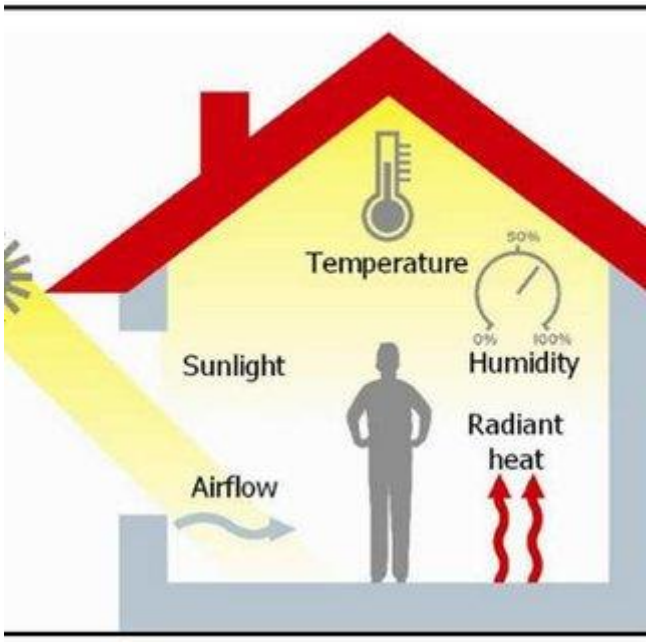
Poor roof causes penetration of rain water through unprotected tops of walls, parapet, compound walls etc. In case of flat roofs, if there is inadequate roof slopes, improper rain water connection to wash away the water and defective junction between roof slab and parapet wall may prove to be the source of dampness. Rain water falling on external walls, parapets also causes dampness. In case of sloped roof rain water may percolate through defective roof covering. Rain water then descend through the top supporting wall because of faulty eaves course and eave or valley gutters and cause dampness.

4. Penetration of moisture, rain, water etc

Penetration of moisture in the building is either the result of intrusion from outside or condensation from within the structure. Condensation occurs when warm moisture laden air comes into direct contact with a cold surface such as a wall, window or windowsill. Moisture penetration also occurs when there is wet weather and voids present in the walls or roof. Penetrating damp in the properties is usually the result of defect in the building such as external damage from roof tiles, cracks in the wall, faulty guttering or internal damage from leaking or burst pipes, porous walls and bad workmanship.

5. Environmental factor

Dampness in the building can also be caused by bad weather, humidity of the air, rain etc. The unwanted moisture present in the air enables the growth of various fungi in wood, causing rot or mould health issues and may eventually leads to unhygienic environment for the habitants in the building. This occurs when there is wet weather, heavy rainfall etc, basically its due to the climate change. Most of the construction materials such as concrete, brick, or plaster possess interconnected voids within them and when these materials come in contact with moisture or water, it tries to find a way to penetrate the materials and with capillary reaction action it leads to dampness in the building.



6. Salt action

Salt damp happens when moisture passes through the soil ground and reaches the masonry wall. It occurs because there is no damp proof membrane or damp proof membrane has been ruptured. The heat prompts the moisture to evaporate out of the wall surface, which is why the deterioration of the mortar in the wall occurs. The salt that rises in the moisture crystallises after evaporating thus causing the mortar to crumble and wall to structurally fail. A portion of the salt residue also creates a chemical reaction that destroys the internal frame of the house. Salt is formed when water reacts with the natural salts contained within the construction material and mortar. The water dissolves the salts which are then carried out and deposited into the surface by the natural evaporation that occurs when air comes into contact with the surface of the wall or floor. This process is also called Efflorescence.

7. Capillary reaction

Capillary action is the process of a liquid flowing in a narrow space without the assistance of, or even in opposition to, any external forces like gravity. Capillary action occurs because water is viscous, thanks to the forces of cohesion (water molecules like to stay close together) and adhesion (water molecules are attracted and stick to other substances). Adhesion of water to the walls of a vessel will cause an upward force on the liquid at the edge and result in a menisans which turns upwards. This action takes place when the walls or roof of the building come in contact with water and the water find its way through the voids present in the construction materials and eventually leads to dampness in the building.

8. Faulty design and bad workmanship

This case occurs mainly because of lack of supervision. Suppose a designer has specified that the thickness of damp proof course must be 15mm, but due to lack of adequate supervision, the thickness of completed damp proof course become 10mm, then this will not serve the purpose for which it is constructed and consequently it will lead to dampness in building.

CHAPTER:-2
Effect of dampness in health

It has been proven by Academy of Sciences Committee on Damp Indoor Spaces and Health that if you have damp in your home you're more likely to have respiratory problems, respiratory infections, allergies or asthma. Damp can also affect the immune system.

People who are affected by it are the sensitive people including:

- Babies and children because they have weaker immune system.
- Elderly people
- People with existing skin disease like eczema
- People who have respiratory problems such as respiratory allergies or asthma
- People who have weak immune system like people having chemotherapy

These people should be careful and stay away from damp places.

When dampness is found in the building it should be treated immediately or the continuous dampness will lead to become mould and moulds produce allergens (substances that can cause an allergic reaction), irritants and, sometimes, toxic substances. Inhaling or touching mould spores may cause an allergic reaction, such as sneezing, a runny nose, red eyes and skin rash. Moulds can also cause asthma attacks.

Causes of damp and mould

Damp and mould in the building are caused because of excess moisture and the moisture in buildings can be caused by leaking pipes, rising damp in basements or ground floors, or rain water seeping in through the damaged part of the roof or from around the window frames.

A newly built home can also have damp if the building is not given time to dry properly during the construction time and water is used when building it is still drying out – for example, in the plaster on the walls. Excess moisture indoors can also be caused by condensation.

If you have mould or damp in home it's important to find out why you have excess moisture in your home and to find that you should know what's causing the damp, after that make sure your home is repaired or take steps to atleast limit the moisture in the air like let there be some air circulation. You may also need to get a professional to remove mould for you, but if it's only a small amount you may be able to remove it yourself.

CHAPTER:-3
Methods of Treatment of Dampness in Building

These are some of the prevention and treatment methods of dampness in the buildings

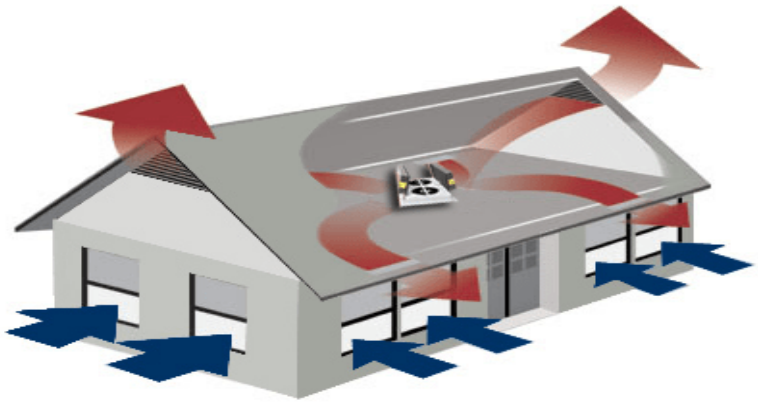
1 Proper ventilation

The proper purpose of ventilation is to control moisture and provide healthy indoor environment. Ventilation is intended to remove or dilute pollutants and to control the thermal environment and humidity in buildings. It must be properly built so that it either remove pollutants and humidity generated in indoor areas or to dilute their concentrations to acceptable levels for the health and comfort of the occupants. Ventilation can be provided by various natural and mechanical methods. These usually improve health but may also have adverse effects if not properly designed, installed, maintained and operated, as ventilation can then allow the entry of harmful substances that degrades the indoor environment. Although ventilation is used to control humidity, under certain circumstances it can result in very high or very low humidity. In non-residential buildings and in hot climates, ventilation is often integrated with air-conditioning, which complicates the operation of these systems. The addition of humidifiers to ventilation systems or as stand-alone units can introduce excess humidity, chemicals (used to treat the water in humidification systems) or microorganisms that grow on components in humid locations, such as drip pans in air-conditioning units or humidifiers. Ventilation (outdoor airflow into a building) must be adequate to remove and dilute pollutants and humidity generated indoors, although the first alternative for improving indoor air quality should be control of pollutant sources. Ventilation should be energy efficient and arranged so that it does not degrade indoor air quality or climate and does not cause any harm to the occupants or to the building.

There are two methods that may be used to ventilate a building:

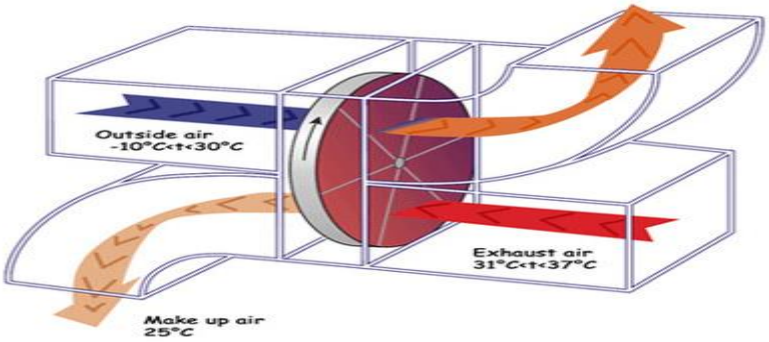
1.1 Natural Ventilation

Natural forces (eg winds and thermal buoyancy force due to indoor and outdoor air density differences) drive outdoor air through windows, doors, solar chimneys, wind towers and trickle ventilators, which are the natural ventilators. This natural ventilation of buildings depends on climate, building design and human behaviour. In cold and hot climates, the configuration and size of openings are a significant aspect of ventilation design. As the weather fluctuates constantly, the challenge of designing natural ventilation is to harness forces determining air movement, so that the flow into a space is maintained at the desired rate. The advantages of having natural ventilation is its suitable for many types of buildings in mild or moderate climate, it has less maintenance cost and makes less noise but it has inadequate control over the ventilation rate, which can lead to poor indoor air quality and excessive heat loss and it is unsuitability for noisy and polluted locations.



1.2 Mechanical Ventilation

Mechanical ventilation is based on the requirement that the ventilation rate is maintained in all weather conditions without involving the occupants of the building. When ventilation is provided by a mechanical supply and exhaust system, the outside of the building can be made airtight because of the force of fan, and energy losses due to infiltration and exfiltration can therefore be reduced. Heating and cooling can easily be combined with mechanical ventilation systems. Moreover, mechanical ventilation systems may also control pressure differences over the building envelope and prevent moisture damage in building structures. It can be used in any type of building and it is very convenient in architectural design, which may be the major reason for its regular demand in modern building practice. Mechanical fans are the main component driving mechanical ventilators. Fans can either be installed directly in windows or walls, or installed in air ducts for supplying air into, or exhausting air from a room. There are three types of mechanical ventilation.



1.2.1 Exhaust only ventilation

This type of ventilation uses a fan to move indoor air out of your home, while outdoor air is drawn in through leaks. In apartment buildings, exhaust from the different floors can be connected to the same duct if the pressure drop in the exhaust grille is high enough to prevent airflow from floor to floor. A central fan serves all the apartments. Room airflow can be controlled by adjustable grilles, according to humidity or the concentration of carbon dioxide or other pollutants, or by occupancy sensors. The advantages of mechanical exhaust ventilation are a constant ventilation rate and the small negative pressure in the building, which prevents moisture migration into external walls and prevents condensation and (consequently) mould growth.

1.2.2 Supply only ventilation

It is the opposite of exhaust only, as instead of pushing indoor air out, it draws outdoor air in using fans. The indoor air escapes through a system of exhaust fan ducts as well as the building enclosure. Exhaust air may flow through a heat exchanger before it is discharged outdoors. In the heat exchanger, a major part of the heat is recovered and used to heat the outdoor air for ventilation. This is usually the most economical use of recovered heat, as the need for heating is met by the available heat. Another use of recovered heat is for domestic hot water.

1.2.3 Balanced ventilation

This is mixed type ventilation using fans to draw air both into and out of a building. This system has all the benefits of exhaust only and supply only without many of the drawbacks like humidity in the wall, but its cost is higher than the others.

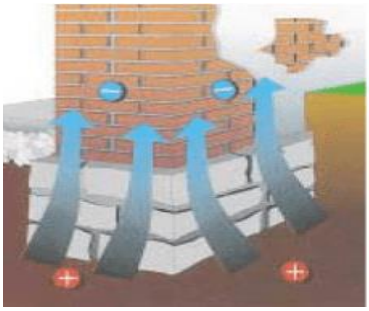
2 Electro osmotic system

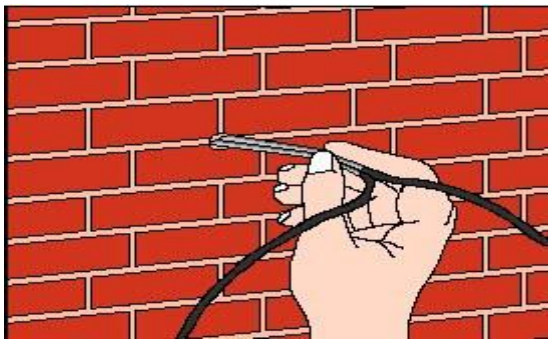
Some prior condition had to be met for the electro osmotic process to work. A closed electrical circuit is required. The resistance between the electrodes should be low enough that it should allow enough current output to occur. There must be moisture in the capillaries all through the material. Electro osmosis damp proofing systems generate sufficient osmotic flow to overcome the capillary forces that cause rising damp. Such damp proofing course utilises a series of platinum coated anodes, commercially pure titanium connecting wire, a copper coated cathode and a regulated power supply to drive excess moisture down the wall and back into the ground. The anodes are inserted into brick, concrete or stone walls at regular intervals. The copper cathode is buried into the ground at a lower level and at least a meter or two from the walls. The power regulator imparts a small, but perfectly safe electrical current through the wall. Free moisture molecules are repelled from the positively charged anode zone and attracted to the buried cathode. The flow is initiated by the movement of positively charged ions that are present in the pore fluid of damp masonry. The water surrounding the positive ions moves with them as the dampness is driven from the wall and harmlessly back into the ground, the osmosis damp proof course working like poles of a magnet to repel or attract. An electric damp proof course is particularly useful in buildings having:

2.1 Rubble filled walls – Osmosis damp proofing is the only effective way to damp proof walls having a cavity filled with rubble.

2.2 Random stone walls – Damp proofing creams require mortar bed continuity whereas an electric system does not.

2.3 Low level timber floors – electro osmosis damp proofing system is the only rising damp treatment that can be installed in masonry walls above timber floor joists to drive excess moisture down to a level beneath them, fulfilling a vital purpose of an effective damp proof course.





3. Physical method (insertion of damp-proof course)

Damp proofing or a Damp-Proof in construction is a type of moisture control applied to building walls and floors to prevent moisture from passing into the interior spaces. Damp proofing is defined as a material that resists the passage of water under pressure. Generally, damp proofing keeps moisture out of a building, where vapour barriers keep interior moisture from getting into walls. A DPC is a durable, impermeable material such as slate, felt paper, metal, plastic or special engineered bricks bedded into the mortar between two courses of bricks or blocks. It can often be seen as a thin line in the mortar near ground level. To create a continuous barrier, pieces of DPC or DPM may be sealed together. In addition, the DPC may be sealed to the DPM around the outside edges of the ground floor, completely sealing the inside of the building from the damp ground around it. Damp proof course can also be applied after construction, by injection. The effectiveness of liquid injection damp proofing products is dependent on the type of formulation and the skill of the installer. In

practice injection times tend to be lower than those required to provide a damp proof course of optimum effectiveness.

Step 1:
Drill 12mm holes in the mortar joint at 120mm intervals around 75mm-150mm above the external ground level. Drill the holes to within 10mm to 20mm of the opposing face. Clear the holes of dust and debris.

Step 2:
Place the injection lance or nozzle into the back of the bore hole with a low-pressure injection unit or cartridge applicator gun and begin to fill with the Damp Proofing Cream. Pull the lance/nozzle back as the hole fills up to ensure the hole is completely filled. Continue to the next bore hole and continue the injection operation.
The Damp Proofing Cream should revert to a liquid form during the next 7-10 days, penetrating deep into the brick substrate to create the new damp proof course. The bore hole can be sealed with watertight sand and cement or a plastic DPC Plug once the cream has completely dispersed from the hole.

Step 3:
Following the installation of the new Damp Proof Course, it is critical that the re-plastering specification is strictly followed, and that the plasterer performing the work is made aware of the importance of following the re-plastering specification in conjunction with the installation of the Chemical DPC.

4. Radial method (using mechanical cutting system and the insertion of special plastic sheeting with injection of anti shrinking mortar)

This process is generally referred to as the Comer Recon method, after the Romanian business that makes patented cutting machines as well as related items and equipment. Outside walls composed of brick, tinstones, concrete, and expanded clay blocks are employed with this technology. On hard rock or stone walls, diamond-tipped tools are required. The first step should be to remove the wall plaster to a certain height, but if the remaining plastering is also in poor condition, it is a good idea to remove it before cutting the wall to encourage evaporation of water contained in the wall to be treated and the removal of the remaining plastering.

Wall cutting is done in accordance with the existing wall structure, and plastic sheeting is fitted into them. These sheets produce a perfect insulating barrier with outstanding dielectric characteristics, strong chemical inertia, and excellent thermal resistance to compression, acting as a barrier to rising damp. Applying mortar to the insulating substance is the standard process. Then, for each wall segment, a number of innovative plastic anchoring wedges are placed into the gap, compressing the mortar in the cut while also securing the insulating material and ensuring the wall's rigidity as the saturated mortar hardens

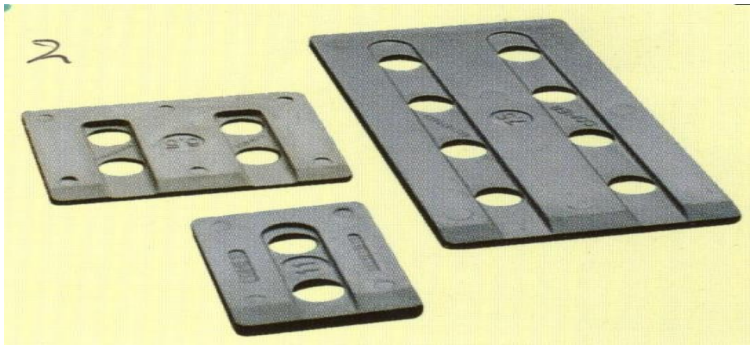


Fig: Anchoring Wedges

The wedges are first pushed into the gap, followed by the injection of pre-mixed anti-shrinking mortar into the cut. The mortar not only fills any existing voids in the wall construction, but also penetrates the wedge grooves and the cut itself, reinforcing it at the base. It is critical to wait until the entire wall has dried completely before replastering. In terms of modalities for this type of work in seismic zones, wall cutting gear is frequently employed in Germany, Austria, Great Britain, France, Thailand, Czech Republic, Slovakia, Hungary, Spain, and Belgium.

5. Water proofing

Water proofing is one of the most essential construction applications since it increases the endurance of a variety of surfaces. Furthermore, waterproofing materials should be employed to ensure the comfort of the house or office that will be used after the construction is completed. The process of making an object or structure waterproof or water resistant is known as waterproofing. Water proofing ensures that an insulated material or structure remains impervious to water or resists water entry under specified conditions. It's a method for reducing the impact of liquid penetration on systems in the construction and design industries. Construction applications are one of the areas where water insulation is frequently encountered. Waterproofing is

achieved by using membranes and coatings to maintain a structure or structure contents and structural integrity. In order to prevent water leakage and accumulation of water, waterproofing is carried out in layers on the top of the structure, while retaining its respiratory characteristics. Internally, it removes the existing water content in the structure and externally forms a protective structure around itself. Typically, the building waterproofing system is constructed by creating a large number of barriers so that water cannot enter into the building. The development of these multiple layers forms a structure around the building with the materials and techniques inside. This structure can be considered as a sustainable property or a green building measure by preventing excessive heat from escaping outside. This can be done by applying a variety of paints, coatings and other materials of coatings that help to create a transition between the external and internal temperature.

The minimum difference between the indoor and outdoor temperatures of a building results in less wear symptoms and protects the structure. This takes place in such a way that the effect of shrinkage or expansion in the various material composition of the building is reduced by matching or equalizing the room temperature and the outdoor temperature. It reduces the load in the waterproofing system and other processes that the residents tend to use to make room temperature livable. This reduction can be counted in electricity consumption, drinking water consumption and other resource consumption savings. This tends to make the building more green.

6. Damp proofing walls and floors

To prevent mould and moisture, damp proofing is a method of moisture management applied to walls, home floors, or commercial structures. Damp proofing issues are one of the most common difficulties in today's homes, especially in older or poorly designed structures. Vapour barriers restrict internal moisture to the walls, whilst damp proofing devices keep moisture away from the building. Integral damp proofing is a method that involves mixing damp proof materials with the concrete mix ratio to make it water proof. Materials that repel water, such as chalk, fatty acids, petroleum, calcium chloride, and others, can be added to concrete in proper proportions to make the mixture water resistant. The act of adding a partition between the source of moisture and the concrete slabs is known as damp proofing. The partition or membrane employed is usually composed of materials that are both water repellent and flexible, such as plastic, polythene sheets, asphalt, metals, and so on. Both floors and walls can benefit from this membrane.

III. SUMMARY

According to the review papers it is clear that dampness should be treated and to do so it’s causes should be found and there are different causes of dampness in the building and it can be through physical effect, environmental effect or chemical effect like bad workmanship, rain, moisture, capillary reaction etc. There are also various treatment methods mentioned like using damp proof course, CFD and also through natural ways like proper ventilation system. Dampness in buildings can also cause various health related problems for the habitant because gives rise to breeding of mosquitoes and germs of dangerous diseases, dampness can also cause failure of building structure because it weakens the strength of the materials, so it is important to take proper care of the building and prevent it from dampness.

ACKNOWLEDGEMENT

The creation of this dissertation required the combine sincere efforts, hard work, talent and blessings of great people who directly or indirectly contribute to project work. This thesis is no exception and I owe special gratitude to several persons. I express my sincere gratitude to my mentor, Dr R.L. Sharma, Civil Engineering Department, Lovely Professional University, Jalandhar, for his stimulating guidance and for the invaluable and unconditional support he gave me and for many interesting discussions on our topics and theories related to this research. Without his valuable suggestions I would not have been able to complete this study.

REFERENCES

[1]. Asian Conference on Environment-Behaviour Studies Chung-Ang University, Seoul, S. Korea, 25-27 August 2014 " Environmental Settings in the Era of Urban Regeneration" A Case Study on Moisture Problems and Building Defects Nur Liyana Othman* ,Mastura Jaafar, Wan Mariah Wan Harun, Fuziah Ibrahim

[2]. Development of a method for drying out the damp walls of buildings in Venice V. Apih, M. Makarovic Institute for Testing and Research in Materials and Structures (ZRMK), Ljubljana, Slovenia

[3]. ScienceDirect www.sciencedirect.com

[4]. Kofi Agyekum1 , Karen Blay2 , & Alex Opoku3 1 Building Technology Department, Kwame Nkrumah University of Science and Technology, Ghana 2 School of Architecture, Building and Civil Engineering, Loughborough University, Loughborough, UK 3 UCL Bartlett School of Construction and Project Management, University College of London

[5]. Methods for elimination of dampness in Building walls Cristina Campian1 , Maria Pop1 1 Technical University of Cluj Napoca, Faculty of Civil Engineering, Cluj-Napoca, Romania
[6]. Construction Practices Contributing to Rising Damp in Kumasi Metropolitan and Ejisu Municipal Assemblies in Ghana Richard Oduro Asamoah,1 John Solomon Ankrah,2 Philip Bannor,1 and Kofi Ofei-Nyako1
[7]. Hindawi Publishing Corporation Advances in Materials Science and Engineering Volume 2016, Article ID 1280894, 13 pages http://dx.doi.org/10.1155/2016/1280894
[8]. Does electro-osmosis work in moisture damage prevention? Applicability of infrared-based methods to verify water distribution under electric fields Jacopo Melada , Marco Gargano , Ivan Veronese , Nicola Ludwig∗ Department of Physics Aldo Pontremoli, State University of Milano, via Celoria 16, 20133 Milano, Italy
[9]. Development of a method for drying out the damp walls of buildings in Venice V. Apih, M. Makarovic Institute for Testing and Research in Materials and Structures (ZRMK), Ljubljana, Slovenia