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# Establishing the Taxonomy of Building Defects Triggered by Moisture Intrusion and Dampness

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### ABSTRACT

Dampness has long been a major issue in Malaysian public and private buildings. Dampness signifies the presence of undesired moisture in a building's structure, which can occur either due to external infiltration or internal condensation. Moisture within the building can result in a decrease in the structural integrity of the components and potential structural failure, as well as property damage. Moisture within the wall deteriorates the paint, decorations, and overall condition of the wall. Persistent moisture can facilitate the proliferation of harmful disease-causing microorganisms, including tuberculosis and neuralgia. Additionally, it can trigger asthma in individuals residing in the building. Consequently, it is imperative to prevent and address dampness in the building. Identifying the sources of moisture is crucial, as moisture is the primary catalyst for dampness. This study aims to investigate the diagnosis of dampness issues in buildings. It seeks to identify the various types of dampness, locate their causes, and analyze the impacts of dampness on structures. Three methods were used specifically literature survey, visual inspection and case study. The findings reveal that the most common types of dampness that occur in buildings include rising damp, falling damp, penetrating damp, condensation damp, and water leakage. The primary causes of moisture in buildings include faulty waterproofing membranes, improper plumbing configurations, houseplants, substandard building materials, rainwater infiltration via windows and walls, and inadequate airflow. The results of this study can offer valuable information to Building Surveyors when conducting comprehensive building condition evaluations, particularly for issues related to dampness.

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## 1. Introduction

The term dampness refers to any observable, quantifiable, or perceived consequence resulting from an excessive presence of moisture, which can indicate issues with indoor climate or durability difficulties in building structures caused by water leakage of various types [1]. Nevertheless, moisture can be carried in both vapor and liquid forms through processes such as transmission, convection, capillary force, wind force, and gravity [2]. Moisture issues are a frequent occurrence in all buildings [3]. Moisture is responsible for 76% of building flaws. Moisture as well causes 75-80% of flaws in building membranes. There has been a significant expenditure of billions of ringgits in Malaysia to fix defects caused by moisture problems in properties [4]. It should be pointed out that moisture was the primary cause of severe microbiological development in 65% of the structures [5]. Water is usually the primary cause of microbial proliferation, which in turn leads to sick building syndrome.

Furthermore, moisture is recognized as a primary contributor to substandard indoor air quality, unhealthy structures, and the proliferation of mold. Moisture can infiltrate buildings through several means, including rainfall seeping through cracks in walls, floors, roofs, windows, and doors. Malaysia is situated in a tropical region. The mean temperature of Malaysia is consistently high at approximately 26°C throughout the year, accompanied by an average humidity level of roughly 80% and a significant rate of evaporation [6]. Furthermore, the precipitation is substantial, exceeding 2.5 meter [7]. Malaysia is more susceptible to moisture-related issues compared to other Western countries. This increased exposure has negative effects on health, accelerates building deterioration, and impairs functionality [8-10]. The aim of this article is to ascertain the moisture issues that arose in the hospital building, the underlying reasons of these difficulties, and the structural faults present in the facility [11].

There are ten prevalent moisture issues in structures. These sources encompass rainwater or groundwater infiltrating the roof, walls, windows, and foundation. Additional issues encompass plumbing leaks, spills, water infiltration through permeable construction materials such as concrete or wood, rainfall, condensation, and plumbing water [12-16]. In addition, during warm and humid weather, cracks and holes in the building can allow warm or moist outside air to enter, while during cold weather, cracks and holes can allow warm or wet internal air to escape [17]. Unvented or inadequately ventilated sources, such as swimming pools, can potentially exacerbate moisture issues. Insufficient dehumidification caused by heating, ventilation, and air conditioning systems, inadequate condensate drainage due to system flaws, and the containment of wet materials during construction are other variables that can contribute to moisture issues in buildings [18].

The main building experiences moisture problems mostly due to water infiltration through various construction elements, such as the roof, walls, and ceiling [19]. The most common defect observed in walls and floors is water infiltration [20]. The issue of waterproofing is widely acknowledged as the main factor leading to building collapse, causing problems related to moisture [21]. The flat roof is currently suffering from leaks due to the contractor's insufficient application of waterproofing. The primary objective of waterproofing is to safeguard a building structure from the detrimental influence of natural forces and their long-term consequences.

Water infiltration occurred due to the choice of unsuitable tiles and the failure to follow the standard roof slope. The issue of building leakage in Malaysia is a persistent problem that arises due to the tropical temperature, insufficient design, and poor craftsmanship [22]. The Parliament building is experiencing roof leakage, and there have been other occurrences of pipe leakage and ceiling collapse at government buildings. Moisture may also transfer from the saturated area to the dry area. Moisture and vapor can penetrate from the exterior wall to the inner wall, causing the internal finishes to deteriorate because there is no air or vapor barrier present [23]. Furthermore, the

fractures and gaps in the walls and ceilings might allow moisture from the external environment or internal air to penetrate, resulting in condensation. Here are two recommendations for effectively addressing moisture problems that impede water penetration and cause condensation, as well as limit the areas that commonly experience dampness, such as bathrooms and kitchens [24]. Furthermore, it is recommended to expeditiously dry these places when they become moist. In order to efficiently address the moisture problem, it is crucial to guarantee that vulnerable materials remain free from moisture. In the event that these components become moist, it is important to expeditiously dehydrate the construction materials to avert the development of moisture or other related imperfections [25].

From a human standpoint, the perception of whether a wall, ceiling, or floor is damp is somewhat subjective. Oftentimes, dampness is only detected once it has already resulted in evident internal harm to surfaces, such as discoloration, peeling paint, and the formation of mold. The majority of construction materials exhibit porosity, with the degree of porosity typically being correlated with the material's density. A completely desiccated permeable substance would typically only be encountered in a controlled testing environment, following the process of dehydrating it in an oven [26]. However, in practical applications, materials generally perform adequately as long as the moisture content remains under specific thresholds. Nevertheless, increased moisture levels can result in complications. If not addressed swiftly, increased moisture levels can have severe repercussions for the building finishes, and potentially even the structure itself. Finishes can sustain damage or be completely ruined, lumber is susceptible to rot and decay, and metal can undergo corrosion and ultimately malfunction.

A failure in the damp-proof membrane of an exterior wall or the damp-proof course of a floor can lead to various issues, such as the degeneration of carpets and floor coverings, as well as rot in skirting boards and door frames. Nevertheless, the occurrence of a failed damp-proof course is quite uncommon. In the past, some builders and specialists have mistakenly installed a new damp-proof membrane, resulting in a needless expenditure for their clients. Besides, pipework in building services is prone to leaking, which is a frequent cause of indoor moisture. At times, a leaking pipe may remain undetected for a long period of time, and what first appeared to be a small problem might suddenly escalate into an expensive endeavour to repair. Here is an instance of a scenario where an internal pipe had been steadily leaking for a duration exceeding four years, and the proprietor was on the verge of embarking on expensive damp-proofing repairs, as advised by a certified plumber [27].

It is crucial to detect and address these defective agents to guarantee the quality and dependability of the product or system. Through the identification and comprehension of these agents and their impacts, the party accountable or a group of specialists can enforce proactive actions and quality assurance protocols to reduce the occurrence of flaws in the structure. Water is a corrosive substance that presents a major obstacle in the upkeep and structural soundness of buildings. The presence of moisture can infiltrate many areas such as basements, attics, and foundations, as well as through plumbing, roofing, and windows that have leaks. This issue will deteriorate gradually without any means of regulating the inflow of water. The consequences will include damage such as mold growth, wood and building material degradation, corrosion of metal parts, and various other forms of deterioration [28]. The robustness and security of a building's infrastructure are intrinsically linked to the effective management of water and moisture. It is essential to swiftly identify, assess, and rectify any anomalous problems related to these issues.

This study investigated the structural issues arising from dampness and condensation in buildings. It aimed to identify the precise causes of each fault and their possible vulnerabilities, analyze the origins of these flaws, and propose practical methods to rectify them. Additionally, it will explore the diagnostic instruments that can be employed to detect these flaws, present a systematic approach

for assessing the flaws, and suggest a course of action to avert like flaws in the future. Two case studies are being undertaken for the purpose of observation in the study.

## **2. Methodology**

The procedure for piloting visual observations, case studies, and literature surveys, as well as site visits, employs a systematic approach to gather comprehensive data and get significant insights into condensation and moisture difficulties. The observational component involves conducting in-person visits to various instances of condensation and moisture issues, carefully documenting their situations, and categorizing the problems based on their distinct characteristics, such as dimensions, location, and patterns. The observational phase is crucial for acquiring a fundamental understanding of the real incidents of moisture and condensation problems.

### *2.1 Literature Review*

The literature review component involves conducting a comprehensive examination of academic journals, research papers, industry reports, and relevant publications pertaining to building cracking, structural engineering, materials science, and construction processes. The main goal is to locate and examine well-established theories, models, case studies, and best practices related to the issues of dampness and condensation. This includes studying the processes by which these problems develop, assessing the associated hazards, and identifying strategies to reduce or eliminate these risks. Through the process of conducting keyword searches, tracking citations, and querying databases, anyone can obtain a comprehensive understanding of the theoretical principles and practical implications of constructing fractures. By integrating the knowledge obtained from the literature review with the observational data, a more comprehensive comprehension of the observed phenomena can be attained. This enables the formulation of dampness and condensation repair strategies that are based on reliable evidence.

### *2.2 Visual Examination*

Visual inspection of water is visually examining it for any abnormal coloration and qualitative attributes, such as the water's moisture content and the presence of sediments. It is a method, but it is not precise. Nevertheless, this is the initial stage in the pursuit of enhanced water quality management. Regarding specimens exhibiting atypical characteristics such as a blurred appearance, sporadic unpleasant odour, or visible particles, more investigation or a more comprehensive analysis is required to determine the nature and amount of contamination.

### *2.3 Case Study*

A case study is a specialized research methodology that enables the investigator to conduct a thorough analysis of a specific issue, typically involving an individual, group, organization, event, or trend. This case is categorized as a qualitative research approach, which entails the collection and examination of diverse sources, including field work, literature, interviews, and historical records. The primary objective of a case study is to acquire a comprehensive comprehension of the current and frequently the subject under investigation, typically in real-life situations.

### 3. Types of Dampness

#### 3.1 Rising Dampness

Rising dampness is an infrequent type of moisture that specifically impacts the walls of structures. It happens when moisture from the ground ascends through the walls via capillary action. This indicates that groundwater is efficiently drawn up by minuscule capillaries in the bricks, resembling a sequence of drinking straws. The water in question contains soluble minerals that are also transported upwards along the wall. Near the impacted wall, there are further permeable construction elements such as plasterwork and wooden components present in the floorboards, joists, and skirtings. These materials have a high capacity for absorbing groundwater, which can lead to the development of damp rot in the lumber. Typically, the presence of rising damp becomes apparent by the visible harm it inflicts on the inside walls of a structure [29]. Plaster and paint may degrade, while wallpaper tends to become loose.

Groundwater infiltration often leaves a conspicuous stain on the wall, taking the shape of a tide mark. Additionally, you could observe the formation of salts on the inner surface. Moisture infiltration, commonly known as rising damp, is frequently linked to the detachment of paint and plaster. Externally, the mortar may deteriorate, and white salt streaks may become visible on the walls. Rising dampness exclusively occurs at lower levels, as the dampness that ascends the wall originates from the soil beneath it in the ground as shown in Figure 1. Decomposing skirting boards, deteriorating plaster, and water stains on sidewalls all indicate a potential issue with increasing moisture. Figure 2 demonstrates a profound dampness issue appeared at the internal wall.



**Fig. 1.** Indications of rising dampness appear at the ground level



**Fig. 2.** A serious dampness problem occurred at the internal wall

The majority of individuals typically become aware of the presence of growing wet on interior walls as the initial sign of a problem. Rising damp frequently causes water stains on your interior walls, reaching up to the level where the water has penetrated. Typically, these tide mark stains manifest themselves at a height of up to one meter above the skirting board. In extremely exceptional instances, water has the potential to surpass this location. The elevation that the water reaches is contingent upon various important aspects [30]. These factors encompass the porosity of the bricks and mortar as well as the speed at which evaporation occurs. Brickwork with a larger concentration of tiny pores will facilitate more water absorption compared to brickwork with less openings. Rising dampness can appear at elevations of up to 1.5 meters, and in extremely uncommon situations, much higher.

Groundwater frequently contains dissolved salts, which are then left behind as deposits on walls as the water evaporates. The presence of these salts might result in the formation of bubbles in the paint and leave behind a white, powdery residue on the outermost layer. There are two primary categories of salt namely sulphates, which cause the formation of crusted white spots, and hydrophilic salts called nitrates and chlorides, which are not apparent. The water-soluble salts persistently absorb water and so require treatment. As shown in Figure 3, rising dampness occurred at the external wall was due to accumulation of excessive water on the wall which can result in the proliferation of molds, fungal organisms, and microbes. Contact to these microorganisms has been clinically linked to breathing issues, sensitivities, and asthma.



**Fig. 3.** Rising dampness occurred at external wall

### *3.2 Falling Dampness*

Falling dampness occurs when water infiltrates permeable brick structures from above, causing horizontal infiltration. This may be due to insufficient waterproofing of the topmost layer of a barrier (coping), malfunctioning flashings, clogged or leaky gutters, deteriorated plaster joints, and the accumulation of dust and vegetation on the top layer of masonry. Decomposed leaves, bird excrement, lichen, and soil contain mild salts and acids that, if transported by water into masonry, can accelerate deterioration [31, 32]. When it comes to flat roofs, improper rainwater pipe connections, insufficient roof slopes, and faulty roof slab-parapet wall couplings can all be the cause of moisture buildup and lead to falling dampness as shown in Figure 4.

Rainfall that falls on the outside walls and parapets might lead to the occurrence of falling dampness as illustrated in Figure 5. If a sloped roof has a poor roof covering, rainwater may seep underneath. Moreover, defective gutters slope and eave or valley gutters might permit rainwater to seep down the upper load-bearing wall, resulting in moisture and dampness. Many building products, such as concrete, stones, or cement, include connected voids. When these elements make interaction with water, the water seeks a pathway to enter these empty spaces. Once again, the water is able to travel in many directions due to the action of capillary, resulting in the presence of falling dampness [33]. One should exercise caution when there is moisture in the area of electrical appliances, as it can cause the deterioration of electrical fittings and increase the likelihood of electrical leakage and the subsequent danger of short circuits [34]. Persistent moisture can facilitate the proliferation of harmful disease-causing microorganisms, including tuberculosis and neuralgia. Additionally, it can induce asthma in individuals residing in the building. Consequently, it is imperative to prevent and address dampness within the structure. To achieve this, it is crucial to identify the origins of the moisture, as it serves as the main trigger for falling dampness.



**Fig. 4.** Falling dampness occurred due to improper rainwater pipe connections



**Fig. 5.** Rainfall that hits the exterior walls and parapets caused falling dampness to occur

### 3.3 Penetrating Dampness

Penetrating dampness refers to the accumulation of moisture that moves horizontally from the external walls of a structure into the interior of the building itself. Penetrating dampness, frequently mistaken for rising damp, can result in additional, more severe problems such as wood decay, heightened heat dissipation, frost-induced harm to brickwork, and unattractive water damage on both the outside and interior of a building. Penetrating dampness can impact all types of structures; nevertheless, older buildings that have received minimal or no upkeep are more susceptible to water infiltration. Contemporary buildings may also experience issues with penetrating dampness if there are flaws in the design and construction of the structure. In such cases, the walls of these buildings can get damp.

Penetrating dampness (Figure 6) pertains to the infiltration of water into a building's structure, typically due to an external flaw. Defects manifest in different forms, including degraded gutters, flawed pointing, permeable brickwork, poor roof textiles, or fractured and shattered plaster. During rainfall, the moisture often escapes off the masonry or concrete surfaces [35]. Nevertheless, under specific conditions, such as during instances of intense precipitation or when the building has an exterior flaw (as previously described), the moisture is unable to go away and instead seeps through to the interior surfaces.

If the issue of penetrating dampness is promptly resolved, there is no need for concern regarding the health consequences associated with it. The primary indicators of penetrating dampness as previously mentioned include a musty aroma and ugly marks on wall surfaces. It is important to note that while these stains may be visually unappealing, they do not pose any health hazards. Residing in humid environments is suboptimal, and it is imperative to promptly address any issues related to dampness [36]. Extremely penetrating dampness can result in the occurrence of humidity difficulties, with the presence of black mold being one of the signs (Figure 7). Penetrating dampness, when considered as a standalone challenge, will not necessarily lead to illnesses. Nevertheless, it can promote the proliferation of mold. As a result, the release of spores into the air can trigger allergic responses, skin irritations, difficulty breathing, inflammation of the eyes, choking, and worsening of asthma. Mold germs provide a significant risk to youngsters, elderly people, and others with weakened immunity.



**Fig. 6.** Penetrating dampness connected to water intrusion into a wall element



**Fig. 7.** Presence of black mold on internal wall surface

### 3.4 Condensation Dampness

Condensation dampness is the process that happens when moist air makes interaction with cold substrates, including wall and windows. As the temperature declines, the air's capacity to hold moisture declines, resulting in the formation of minute drops of water on surfaces. The air in the house will consistently have a certain amount of relative humidity, but the generation of water vapor from activities such as cooking, bathing, showering, and breathing contributes to its presence. Prolonged presence of condensation on walls can permeate the paint and seep into the plasterwork, leading to dampness and providing an ideal breeding ground for rapid mold growth. Condensation dampness can result in the formation of mold in the house, which may contribute to the discoloration and damage of the wallpaper, wall surfaces, window frames, furnishings, and apparel.

The mold and its spores emit an unpleasant smell commonly linked to a moist dwelling. The presence of salt deposits inhibits the growth of black mold, such as in cases of rising dampness. Consequently, the occurrence of black mold indicates the presence of condensation dampness. Condensation dampness can strike due to the existence of air conditioning water and rainy weather in the building [37]. Permitting the proliferation of fungus and moss under damp conditions would gradually cause erosion as proved in Figure 8. The presence of moisture on the building walls is produced by the lack of proper drainage for the air conditioning water. This leads to the growth of organisms such as fungi and moss, resulting in wall dampness as exhibited in Figure 9.



**Fig. 8.** The presence of fungus and moss in moist environment would gradually lead to erosion



**Fig. 9.** Growth of organisms including moss and fungi



### 3.5 Water Leakage

Numerous instances of water leakage have been reported, encompassing both leaks from ceilings (Figure 10) and breaches from floors (Figure 11). These might arise from the walls or ceiling of residential or commercial buildings, resulting in unsightly molds and persistent stains developing on the surfaces. This leakage could perhaps originate from your upstairs neighbor or even within your own unit. Water has the ability to seep through minuscule, imperceptible fissures that you may not have considered to be present in the walls and ceilings within the house, as well as in unforeseen areas such as the electrical conduit. Frequently observe a substantial expanse of discoloration and fungus on your ceiling or bathroom walls, this is a distinct sign of the gradual buildup of wastewater due to water leakage. Figure 12 shows the water leaking through the floor. Water leakage issues might arise, particularly during heavy rainfall, when there is a roof directly above or when there is a balcony with a break on the side, allowing rainwater to infiltrate.



**Fig. 10.** Water seeping through the ceiling



**Fig. 11.** Seepage resulting from breaches in the flooring



**Fig. 12.** Water seeping through the floor

### 4. Sources of Dampness

The most prevalent issue in housing remains the presence of excessive water or moisture in various states, including vapor, liquid, and flooding. The implications encompass evident saturation of walls, ceilings, and floors, formation of blisters in paint, swelling of plaster, degradation of masonry owing to sulfate attack, and proliferation of mold on surfaces and fabrics. These effects are typically

accompanied by a musty odor. Additionally, it might result in less apparent issues, such as a decrease in the efficacy of thermal insulation or the development of fractures in brickwork due to the corrosion of embedded metal components. Multiple factors contribute to the occurrence of moisture in structures.

#### *4.1 Defective Waterproofing Membranes*

Waterproof membranes offer a convenient and economical solution when a building exhibits indications of damage caused by water. Waterproofing involves various factors and procedures to guarantee optimal durability and longevity for both the building and its occupants. Regrettably, malfunctions in the waterproof membrane can have a catastrophic impact on the structural soundness of the building, pose health hazards to inhabitants, and escalate the overall cost of maintenance [38]. Inadequate overlapping of the waterproofing membranes might result in the infiltration of rainfall via the gaps. In addition, incorrect incline, faulty connections between the roof slab, terrace, and wall parapet, and obstructed drainage systems can also cause water accumulation, leading to moisture problems. Figure 13 displays a defective waterproofing membrane



**Fig. 13.** Defective waterproofing membrane

#### *4.2 Inappropriate Plumbing Arrangement*

Inadequate plumbing arrangement in buildings can result in the occurrence of leaks and moisture issues over time as shown in Figure 14. If the threaded adapter of a plumbing fitting is positioned within the tiles, the installation necessitates the use of an extension piece. This introduces an additional connection in the pipeline, which has the potential to result in the escape of fluid. In addition, the usage of UPVC piping in a hot water pipeline is an instance of an inappropriate selection of material based on its qualities. Under such circumstances, the material which lacks the ability to endure elevated temperatures will initiate a process of deterioration and disintegration, resulting in the occurrence of leaks [39].

Moreover, the utilization of an incorrect solvent-material for connecting pipes might also contribute to plumbing malfunctions. For instance, when pipes are composed of UPVC, it is necessary to use a solvent or adhesive that is compatible with UPVC. The same principle applies to CPVC pipes. Any lack of compatibility in this situation can result in the escape of liquid or moisture due to a less secure connection. Failure to apply sealant at the intersection surrounding the bathroom floor sink outflow pipeline will result in the diffusion of dampness. This could eventually end in unsanitary and unclean circumstances for people and can cause degradation of the surfaces below the ceiling over

time. Leakage or moisture problems can often be attributed to loss of plumbing fittings or inadequate tightening of plumbing fittings, as well as bad labor during placement.



**Fig. 14.** Improper installation of plumbing

### *4.3 Houseplants*

Houseplants may lead to serious dampness problem. Transpiration is the mechanism by which plants transfer moisture into the air through microscopic pores called stomata on their leaves as exhibited in Figure 15. This elevates the level of humidity in the interior atmosphere. However, not all plants have the ability to increase humidity. Furthermore, it is essential to determine the appropriate amount of water to provide to your potted plants in order to prevent them from emitting excessive moisture into the surrounding atmosphere. Gaining some expertise in indoor gardening can enable you to prevent moisture in your dwelling while simultaneously promoting environmental friendliness and sustainability [40].



**Fig. 15.** Indoor plantations

### *4.4 Inferior Building Materials*

Occasionally, inferior supplies for construction are utilized during the building process, resulting in potential problems with the overall quality of the construction as shown in Figure 16. For instance, if substandard materials such as sand with excessive salt content are utilized, efflorescence will

inevitably occur at some point [41]. Inferior bricks will expand as they collect rainwater, resulting in moisture and dampness.



**Fig. 16.** Inferior materials and components can lead to dampness problem

#### 4.5 Infiltration of Rainwater Via Windows and Walls

The primary cause for destruction within dwellings is typically water infiltration resulting from openings within the window frame and the wall on the outside as shown in Figure 17. The opening will serve as a conduit for moisture to enter the house. Inadequate filling of voids can result in the infiltration of moisture, corrosion of paint, and harm to the interior walls. Moisture infiltration may occur in the absence of a fillet or drip mold. If the paint applied to the outer wall lacks water-repellent properties, moisture might accumulate underneath the layer and gradually spread interior. In both instances, the walls on the outside rapidly disintegrate as a result of dampness.



**Fig. 17.** The intrusion of rainwater through window and wall

#### 4.6 Insufficient Airflow

Inadequate ventilation in the residence will inevitably lead to the presence of dampness and mold growth as shown in Figure 18. Various activities such as breathing, cooking, and using the hot water dispenser in the restroom contribute to the humidity levels in the interior air. When the area is sealed

off, the surplus moisture becomes retained. It is essential to have adequate air circulation in the house to keep an optimal humidity level and prevent any decline in the quality of indoor air.



**Fig. 18.** Presence of dampness and mold growth due to inadequate ventilation

## **5. Harmful Effects of Dampness**

### *5.1 Pest and Bug Proliferation*

Damp residences lead to unsanitary living conditions. Moist environments allure microorganisms and insects. Moist environments provide breeding grounds for social insects such as mosquitoes, flies, and termites. Inhabitants residing in damp locations frequently experience respiratory issues, wheezing, skin rashes, and allergies [42].

### *5.2 Structural Deterioration*

As mentioned earlier, penetrating dampness occurs when water infiltrates the interior walls and roof from the exterior, as opposed to rising dampness which ascends vertically. However, penetrating dampness spreads sideways. Penetrating dampness typically arises from structural flaws, such as insufficient roof protection, fractured plaster, leaky rain gutters, and interior intrusion of water due to faulty pipes. Failure to address penetrating dampness can result in significant deterioration of the structural integrity of the residence [43-48]. With respect to the severity of the problem, it can result in consequences such as decay of concrete structures or damage [49-51]. Exposure to heat and elevated temperatures might also lead to severe structural damage [52-54]. Different types of concrete will behave differently as it possesses varying engineering properties [55-57]. In addition, leaks and unpleasant spots on the exterior of the house give it an unappealing appearance. Prioritizing the resolution of damp concerns is crucial to prevent the occurrence of expensive complications. To prevent possible harm from water, it is important to address certain areas. This involves promptly fixing fractures, fixing broken gutters, adding waterproof coating to the outside walls, while decreasing dampness levels in the air through making use of a dehydrator.

### *5.3 Electrical Appliance Problem*

Electric appliances can be damaged if they come into touch with moisture existing in a dwelling. This can also result in severe consequences such as the appliance being electrocuted and the person

handling it potentially experiencing an electric shock. It is crucial to ensure that there is no moisture accumulation in the vicinity of the switchboard and wiring.

#### *5.4 Destruction of Doors and Walls*

Doors and walls can sustain significant damage in a damp environment, particularly timber doors and windows. As a result, termites infest the wood and cause it to swell. Doors and windows may become destroyed, rendering them non-functional. Severe instances can result in the impairment of installations [58].

#### *5.5 Damage of Timber-Based Furniture*

Timber-based furniture can be damaged by high humidity levels in indoor environments. Wood has the ability to absorb moisture, causing it to expand. This can have a negative impact on the durability of furniture.

#### *5.6 Efflorescence*

The phenomenon of efflorescence, which refers to the formation of white deposits on the surface of plaster, bricks, and paint, is caused by the presence of dampness. This wetness leads to the deterioration and crumbling of bricks and plaster, as previously mentioned. The rise in porosity of materials leads to a decrease in their strength, which poses a detrimental effect on the building. The paint finish also becomes brittle and tends to detach [59, 60]. This imparts an unpleasant ambiance and appearance to the house. The removal of the paint exposes the walls and ceiling to additional harm.

#### *5.7 Unappealing Residence*

The presence of damp patches on the walls, accompanied by the growth of algal spores, creates an unsightly and inhospitable appearance for the house [61]. The atmosphere is permeated with a musty and oppressive odor [62]. This odor has the potential to trigger allergies and skin conditions in numerous individuals [63].

#### *5.8 Rust of Metal*

Rust of metal occurs when metal appliances, furniture, or other goods are exposed to moisture, leading to their deterioration [64, 65]. Metals have an affinity for dampness and over time, they corrode or lose their luster [66]. Metal installations have the potential to become fragile and fracture [67, 68]. This poses a significant risk, particularly when it comes to railings and grills [69].

### **6. Conclusions**

Each building is encompassed to varying degrees by natural moisture of various types. Also, buildings often have internal moisture generated by regular occupancy, usage, and industrial activities. Effective design measures are crucial for preventing moisture infiltration into buildings. However, if these precautions are insufficient, dampness can penetrate building components and lead to their degradation. Dampness is a major concern in any property due to inadequate insulation,

heating, ventilation, and untreated structural defects. Moisture-related issues in buildings extend beyond physical deterioration. The numerous maintenance approaches raise serious and diverse health problems and environmental challenges. The following conclusions can be withdrawn:

- i. The prevalent forms of moisture that typically manifest in buildings are rising dampness, falling dampness, penetrating dampness, condensation dampness, and water leakage.
- ii. The main sources of dampness in building are Defective waterproofing membranes, inappropriate plumbing arrangement, houseplants, inferior building materials, Infiltration of rainwater via windows and walls as well as Insufficient airflow.
- iii. The main harmful effects of dampness are pest and bug proliferation, electrical appliance problem, destruction of doors and walls, damage of timber-based furniture, efflorescence, unappealing residence and rust of metal.
- iv. It is imperative to identify and rectify these faulty agents in order to ensure the quality and reliability of the product or system. By identifying and understanding these agents and their effects, the responsible party or a team of experts can implement proactive measures and quality assurance methods to minimize structural faults.
- v. Dampness is a destructive fluid that poses a significant challenge in maintaining and ensuring the structural integrity of structures. Dampness can permeate many spaces, including basements, attics, and foundations, as well as enter through plumbing, roofing, and leaky windows. This problem will progressively worsen in the absence of any mechanism to control the influx of water.
- vi. The implications of dampness in buildings will encompass harm such as the propagation of mold, deterioration of wood and building materials, corrosion of metal components, and several other types of decay. The resilience and protection of a building's infrastructure are inherently connected to the efficient control of water and moisture. It is crucial to promptly detect, evaluate, and correct any abnormal abnormalities associated with these concerns.

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