STRATEGIES FOR CONTROLLING DAMPNESS IN AN EXISTING BUILDING IN MINNA (NIGER STATE)

BY

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2018/3/74391TI

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION, SCHOOL OF TECHNOLOGY EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF TECHNOLOGY (B. TECH) DEGREE IN INDUSTRIAL AND TECHNOLOGY EDUCATION.

MARCH, 2023

DECLARATION

I, **Adamu Mustapha** with matriculation number **2018/3/74391TI**, an undergraduate student of the department of Industrial and Technology Education, certify that the work embodied in this project is original and has not been submitted in part or full for any other diploma or degree of this or any other University.

Adamu Mustapha

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Sign and Date

2018/3/74391TI

CERTIFICATION

This project has been read and approved as meeting the requirement for the award of B. Tech degree in Industrial and Technology Education, School of Technology Education, Federal University of Technology, Minna.

Dr. W.B Kareem _____

Project Supervisor Signature and Date

Dr. T. M. Saba

_____

Head of Department Signature and Date

_____

External Examiner Signature and Date

DEDICATION

With profound joy and gratitude in my heart, I dedicate this project to God Almighty for His Unshakable and Unbreakable Faithfulness. His Divine and constant guidance in my life has made this project a reality today. Thank God.

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My appreciation goes to Almighty Allah for preserving and sparing my life in the quest of my academics and keeping me through the thick and thin times. Much appreciation goes to my supervisor, Dr. W. B. Kareem who showed and gave me the essence of living. Much respect sir because only Almighty Allah can repay you for the time and effort towards the completion of my work.

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ABSTRACT

This study examined the strategies for controlling dampness in an existing building in Minna (Niger state). Four research questions were developed to guide the study. The study employed a survey research design. The study used a four-point scale questionnaire, which contains a total of 28-items, as instrument. The total population of the study was 80 respondents comprising 70 residential occupant and 10 building contractors. The findings of the study reveal the Rising damp, Penetrating damp, Excessive condensation on windows, not just during the winter, Rotting woodwork, such as skirting boards. The study recommended among other things, Construction industry professionals must be involved in all the stages of the design and construction processes, Ineffective monitoring as the major barrier to risk management implementation in the construction project therefore effective monitoring has to be adopted in order to enhance proper risk management in the construction industry.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

One of the important functional requirements of a building is that it should be durable. All new buildings must be soundly designed and constructed to make them entirely waterproof. Building regulation (1991) requires that walls, floors, and roofs of new buildings should have built-in-proof measures to stop the passage of moisture to the inside of the building designs should take account of normal sources of moisture such as penetrating, rising, and condensing dampness. But moisture can as well rise in other ways, which may not have been anticipated at the design stage such as leakage from roof, plumbing systems, leaking pipes, and cisterns.

Dampness spoils paint, interior decorating, encourages mold and rot growth, hampers aesthetics, poses a threat to the health of occupant, bacterial and fungal growth. The causes of dampness are however numerous and before the effect can be adequately rectified the source must be located (Jøntvedt Jørgensen *et al.,* 2020). Moisture gets into the building and instead of disappearing, becomes trapped into the structure. Once inside, it remains where it is or finds its way into more vulnerable areas, by which time the damage has been done.

Bamgboye (2017) described damp proofing as the treatment of masonry walls internally and externally to prevent dampness or moisture from penetrating the masonry fabric.

Coppola *et al.,* (2018) reported that the way to reduce dampness problems and the associated health effect is to improve the design, construction, operation, and maintenance of the building.

Berry (2020) explained that all modern buildings have what is known as a damp proof course (DPC) or damp-proof membrane (DPM) and that its purpose is to prevent moisture from the

outdoor environment and the ground rising through the blockwork via capillary action which can render the walls damped.

Alam *et al.,* (2018) also stated that dampness could enter the building through the cracks, movements of a building can result in cracking also, subsequent water penetration causes dampness.

The prevailing dampness problems experienced in the areas are a result of much of the rainfall in the area induced by conventional processes, (flood erosions).

Some residential and office structures in Minna, Niger state have not been subjected to proper maintenance or show little signs of maintenance since they were constructed, some years back. This is serious as there are many cases of building defects in the state. Despite the importance of water to living, water or moisture resulting in dampness poses a great danger because the water is 'no longer in the free state'. Thus issues such as attack on decoration, building fabrics deterioration, loss of paint adhesion/discolouration of paint/blistering of wallpaper, stains on wall surfaces, dark/yellow-brown patches, loss of plaster, wrot/removal of skirting, cracks, attack of reinforcement, mould and algal growth and unpleasant odour inside the home become evident (Sauni *et al*, 2013). Consequently, thermal insulation property of building materials and structural integrity becomes undermined thereby leading to an adverse effect on the environmental microclimatic conditions of the buildings with discomfort to the occupants (Yang, *et al.,* 2019).The absence of maintenance by authorities and dwellers of these structures often lead to reduced lifespan of these structures as stated by Izobo-Martins *et al.,* (2018), which invariably defeat the purpose for which they are put i.e to ensure that the national stock of buildings, both as a factor of production and accommodation, was used effectively as possible.

1.2 Statement of the problem

Most buildings in Minna are faced with maintenance challenges resulting in decreasing and ultimate defects of various levels. While the 1984 version of BS 3811 defined maintenance as the combination of all technical and associated administrative actions aimed at retaining an item and bringing it to a level in which it can perform its expected function, BS 3811(1974) defined maintenance as the combination of all technical and associated administrative actions (including supervision actions) intended to retain an item in or restore it to a state in which it can perform its required function, BS 3811(1974) defined building maintenance as work done to keep a building in or restore it to its initial state or a current acceptable standard. To retain implies that defects are prevented from developing by carrying out work in anticipation of failure. To restore means that minor defects had already occurred before they are corrected.

For facilities to continue to perform their expected functions, some degree of improvement is therefore needed on the longevity of the building as standards of comfort and amenity arise where there are primary requirements for maintenance. The acceptable standard must not be less than that necessary to meet them and the acceptable standard must sustain the utility and value of the facility.

The main problem of this research is the accelerated deterioration of the materials of which the building is constructed and thus reduces the expected life of the building. This study will therefore investigate the strategies for controlling dampness in an existing building in Minna Niger State.

1.3 Purpose of the study

The aim of this study is to investigate the strategies for controlling dampness in an existing building in Minna (Niger state). The specific objectives of this study is to:-

1. Identify the prevalence of dampness in an existing building in the Minna metropolis

2. Survey the effects of dampness in an existing building in the Minna metropolis

3. To inquire the reasons for dampness in an existing building in Minna metropolis

4. Determine the remedies to dampness in existing residential buildings?

1.4 Significance of the study

The study would be of immense benefit to the scholars/academicians, building construction industries, the Building Construction Regulatory Bodies and the society.

The findings of this study will be of benefit to the scholar/academicians as it will enlighten them on the areas to make more improvement in their research processes. Also the findings of this study will the scholar/academicians to be able to improve their knowledge and be able to impact knowledge to the students

Building construction industries will benefit from the findings of this study as it will be an eye opener for them on the problem of dampness in building and also profound solution to the problem thereby give rise to better building construction in the state, nation and worldwide.

The findings of this study will be of benefit to the regulatory bodies as it will help them to be able to make laws, benchmarks and standard to guide building constructions in Nation.

The society will benefit from the findings of the study as the will have knowledge of the materials to go for when constructing their various buildings.

1.5 Scope of the study

The scope of the study will cover the prevalence of dampness in an existing building, effects of dampness in an existing building, the reasons for dampness in an existing building, the remedies to dampness in existing residential buildings. Due to time constraint building maintenance will not be covered in the study

1.6 Research questions

This research will be carried out to answer the following research questions:

1. What is the prevalence of dampness in an existing building in the Minna metropolis?

2. What are the effects of dampness in an existing building in the Minna metropolis?

3. What are the reasons for dampness in an existing building in the Minna metropolis?

4. What are the remedies to dampness in existing residential buildings in Minna metropolis?

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The review of related literature to this study is organized under the following subheadings:

2.1 Conceptual Framework

2.1.1 Dampness in Buildings

2.1.2 Causes of Rising Damp

2.1.3 Building Construction

2.1.4 Functional Requirement of Building

2.1.5 The Effects of Rising Damp

2.1.6 Dampness Preventive Techniques in building

2.2 Related Empirical Studies

2.3 Summary of Review of Related Literature

2.1.1 Dampness in Buildings

Dampness can be defined as water penetration through the walls and certain elements of a building (Halim et al., 2012). Dampness can also be defined as an excessive quantity of moisture contained in building materials and components which causes adverse movements or deterioration and results in unacceptable internal environmental conditions (Oryema and Sentongo 2022). Similarly Agyekum *et al*., (2017) defined dampness as the amount of moisture content present in a material and can be classified as capillary moisture content, equilibrium moisture content, hygroscopic moisture content, total moisture content and potential moisture content.

Most of the materials used in the construction of buildings are porous in nature. Thus, an appreciable quantity of water, also known as moisture, will be present in a relatively „dry building". A building element or component that retains this amount of water is said to be damp. Different qualitative terms used to denote the presence of excess water or moisture in buildings include dampness, condensation, damp patches, damp spots, water collection and moisture problem. According to (Agyekum, Ayarkwa, and Koranteng 2014) dampness is defined as the wetting of structural elements through moisture rise by capillary action. Dampness is the most frequent and main problem in buildings and contributes more than 50% of all known building failures (Halim, Harun and Hamid 2012). According to Sani, et al (2022), dampness is inextricably linked to most building deterioration.

A source of water close to a building will also be one of the problems associated with dampness. These problems include symptoms such as dirty spots on the building, biological plants like the growth of fungi, mosses and creeping plants, paint flaking, blistering (Halim, Harun and Hamid 2012).

Dampness is the most frequent and main problem in buildings and contributes more than 50% of all known building failures (Halim et al., 2012). According (Halim et al., 2012), dampness is inextricably linked to most building deterioration. A source of water close to a building will also be one of the problems associated with dampness. These problems include symptoms such as dirty spots on the building, biological plants like the growth of fungi, mosses and creeping plants, paint flaking, blistering etc. (Halim et al., 2012). In order to successfully diagnose and make appropriate recommendations for remedial actions, one should understand dampness and its impact on buildings.

Sources of dampness can also be classified as rising dampness, penetrating dampness and condensation and pipe leakages Sani, et al (2022). Dampness can also be classified as air moisture, condensation, penetrating dampness and internal plumbing leaks, below ground moisture or building specific sources Ekekezie, et al (2022). The following are types of dampness.

Rising Dampness: Rising dampness occurs as a result of capillary suction of moisture from the ground into porous masonry building materials such as stone, brick, blocks, earth and mortar (Siegesmun *et al.,* 2022). The moisture evaporates from either face of the wall (inside or outside), allowing more to be drawn from below. The height to which the moisture will rise is determined by the evaporation rate and the nature of the wall (Vogel *et al.,* 2020). The normal limit for rising dampness ranges from 0.5 m to 1.5 m above ground level. Rising dampness may show as a high-tide-like stain on wall paper and other interior finishes, and, when it is severe, as blistering of paint and loss of plaster. Damp walls encourage the growth of mould which in conjunction with high humidity, can lead to health problems to occupants (Desai *et al.,* 2022).

Rising damp is common in buildings around the world and it plays a major role in the decay of masonry buildings (Halim et al., 2012). It results from porous masonry sucking up water from the ground. The water rises up the wall, about one metre or more high and often deposits a horizontal 'tide mark' (Halim et al., 2012).

A number of published articles have been dedicated to defining the phenomenon of rising damp in addition to the provision of an in-depth understanding of the mechanisms involved. According to Agyekum and Salgin, (2017), 'rising dampness results from the capillary flow of water from the ground'. Agyekum, et al (2016) described rising dampness as 'ground water reaching the foot of a wall which tends to rise in the walling material and continues to do so due to capillary action to varying degrees of intensity'. According to Burkinshaw, (2010), rising damp is said to have occurred when water rises upwards through the pores of masonries, cracks in buildings, or the floors of buildings, with the water being sourced from the ground. Zainal et al (2019) defined rising damp as 'the upward transfer of moisture in a porous material due to capillary action'. Ubi, et al (2020) also defined rising damp as 'the upward vertical flow of water through a permeable wall structure'. In another study by Sellers, (2017) the issue of rising damp was not defined but it was demonstrated as walls that stand in water or saturated soils. This infers that a low level penetration damp could also be rising damp. Rising damp usually presents itself by salty brownish-yellow patches of plaster/decor just above skirting board height (Burkinshaw, 2012).

In the same vein Agyekum, Ayarkwa, & Koranteng, (2014), identified the causes of rising damp as follows: salt attack, porosity of Building Materials, workmanship. However, the visible symptoms of rising damp include dampness on the lower parts of walls, sometimes up to 1.5m in horizontal bands (Rirsch, 2010). Rising damp may also present itself as salty yellowy browny patches of plaster just above the height of skirting boards (Burkinshaw,

2010). It tends to cause many problems to a building with associated health, environmental, social and economic implications. Rising dampness serves as a platform for the growth of fungi in wood which causes rot, deterioration of wall plasters and paints, loosening of wall papers, staining of wall surfaces, crumbling of mortar, rusting of steel and iron fasteners, etc.

Penetration Dampness: Penetrating dampness is the term applied to the penetration of moisture laterally through the fabric of a building from the outside, typically as a result of defective roof coverings or damaged guttering, cracks in walls and opening (e.g windows). Dampness from rain penetration will vary with the weather conditions, including the direction and strength of the wind. Penetration damp is the term applied to the penetration of moisture through the fabric of buildings over a period of time. It is usually characterized by localized areas of damp or saturated wall/ceiling finishes Brandon, et al (2021). Water penetration through a building enclosure depends on the simultaneous occurrence of three things: the presence of water; an opening through which water can enter and a physical force to move the water Waldron, (2021). Penetration damp is caused by plumbing issues in a building or where a problem allows water to enter a building. Symptoms associated with penetration damp usually occur during wet weather. Though penetration dampness may look harmless but can cause damages to buildings even if it does not penetrate all walls of the building. Penetration dampness can lead to moss growth, heat loss, frost damage into masonry, etc.

Condensation: Condensation is one of the most common forms of dampness in buildings, mainly caused by warm moist air originating from activities such as cooking, washing, bathing or even by just breathing and condensing onto colder surfaces in the homes. Condensation describes moisture formation on a surface as a result of moist air coming into contact with a surface that is at a lower temperature. Factors that contribute to condensation

include high humidity of indoor air, low temperature of walls/surfaces and inadequate ventilation. Notable areas such as stair-halls/lobbies, stores, wardrobes/cupboards built against external walls and posterior view of furniture or pictures are prone to condensation due to poor-ventilation tendency which does not allow the walls to fully warm up (Karagiannis, Karoglou, Bakolas, Krokida & Moropoulou, 2017). Condensation can be detected with damp patches on outside plaster walls often appearing and disappearing regularly (Agyekum *et al*., 2013). Excessive condensation frequently results in severe mould growth on walls, ceiling and underneath bay windows which can in turn create health hazards. More than three-quarters of dampness problems in the United Kingdom are due to condensation or man-made moisture (Khosla *et al.*, 2022).

Dampness resulting from condensation occurs where water in the air of a room condenses on a cooler surface Koca, et al (2022). This is usually indicative of cold spots in the building, sometimes called cold bridges Koca, et al (2022). Condensation frequently results in severe mold growth which can in turn results in health hazards. Damp patches can appear on plastered walls in odd places, especially on outside walls, often appearing and disappearing on a regular basis (Burns, 2010). Condensation is mostly accompanied by mould which is black but can virtually be of any colour and is very common on walls and ceiling, underneath bay windows, etc. (Burns, 2010). Running water on windows and walls is the most immediate indication of a condensation problem. This problem leads to deterioration in the decorative condition of a property, stained curtains and decaying window frames. Condensation is also associated with the appearance of molds on the surface of wall papers and paints in poorly ventilated areas (Koca *et al.*, 2022).

Pipe and Roof leakage: Rain water may percolate through defective roof covering. In addition, faulty eaves and valley gutters may allow the rain water to descend through the top

supporting wall thereby causing dampness. Inadequate roof sloping of the roof may results to water ponds formed on flat roof, improper rainwater pipe connections, and defective junction between roof slab and parapet wall may prove to be the source of dampness. Ekekezie, et al (2022), opined that roof-loose or missing tiles including the hip and ridge will allow rain water to run down rafters, causing dampness patches on the ceiling and tops of walls. Also, leakages from faulty plumbing pipes is a serious source of dampness in buildings.

2. 1.2 Causes of Rising Damp

The following are the causes of rising damp in a building:

Salt Attack: Rising damp is caused by capillary suction of water through fine voids that occur in all masonry materials. Capillaries draw water from the soils beneath a building against the force of gravity leading to damp zones at the base of walls Wei, and Mydin (2017). In most cases, dampness contains some amount of salt. It must be noted that the main source of moisture rise is the availability of water in the soil, which in its natural form contains various types of soluble salts. The slow process of absorption of water into block wall with subsequent evaporation leads to gradual deposit of salts in masonry walls. The masonry wall acts as a filter system for impure water as the various soluble salts are drawn into the wall and are left behind.

Porosity of Building Material: The amount of water a material absorbs depend on the volume of the interconnected pore space. Rising damp occurs in materials with high rate of porosity such as sandcrete block and concrete Oduro, et al (2017). Materials with a lot of very small pores are generally less durable than materials with fewer but larger pores. All masonry materials, whether stone, brick, mortar, earth, or concrete block, are porous to some degree. Porosity is a rough guide to durability.

Workmanship: The durability of a building is greatly dependent on the quality of workmanship, specifications, and the design details. Lack of understanding of design details, specification, and poor workmanship on the part of artisans has contributed to many modern buildings with maintenance problems Jigyasu, (2019). The quality of construction methods and the attention to details are of great importance. When artisans fail to comply with standards and specifications in design, the result leads to rising damp. Inadequate knowledge on the part of artisans makes it very difficult for them to understand and implement basic principles.

Bad design: it is important to consider the source of water that can penetrate through the building and the type of damp proof course to be provided mentioned during the design stage of the building.

2. 1.3 Building Construction

Buildings are structures that serve as shelters for man, his properties and activities. They must be properly planned, designed and constructed to obtain desired satisfaction from the environment. Abubakar, (2021) said that building is a structure used especially for a dwelling, factory, store, shop, or warehouse. Buildings existing to meet a primary physical need of shelter for man, his goods, his animals and all the mechanical and electrical equipment he requires for his present day existence. In addition to meeting this physical need, buildings and well related groups of buildings may also satisfy man's desire for mental and spiritual satisfaction from his environment. To achieve these, buildings must be well designed as well as efficiently constructed.

A building is essentially a space that is project from the natural environment and is constructed for a specific use. Structures are part of a building and cannot be conceived in isolation but must be conceived as part of the whole design architectural, structural services.

App, (2019) said that, the structure of the building is that of the building construction, which gives the construction sufficient strength to withstand the loads to which the whole building is subjected. A building structure does this by carrying the load imposed on it and transferring them safely to the foundation and hence the ground thus, every part of a building structure.

2. 1.4 Functional Requirement of Building

According to Ometar, (2002), structural stability is needed to maintain shape. It is the ability of a structure to retain, under load its original state of equilibrium. It can mean anything from resistance to a minor degree of movement to resistance to sliding overturning partial or complete collapse. Any phenomenon (which will be a potentials source of load) that can alter the load carrying behavior of structure, if not properly taken care of can lead to instability, a condition in which the support reaction is less than applied load. Thus to ensure stability, loads must be balanced by the moments due to reactions.

Functional Requirement of Building

The primary function of the wall is to enclose or divide space but in addition it may have to provide support. In order to fulfill these functions efficiently there are certain requirements which it must satisfy. They are the provision of adequate:-

Strength and stability: The strength of a wall is measured in terms of its resistance to the stresses set up in it by its own weight, by superimpose load and by lateral pressure such as wind: its stability in terms of its resistance to overturning by lateral forces and buckling caused by excessive slenderness. According to Ofori, (2010) the mode of failure of a wall by over loading, overturning or by buckling there the provision of adequate thickness and, possibly, lateral support are necessary in order to attain sufficient strength and stability.

In small-scale buildings of solid masonry construction the external wall thickness is rarely determined by strength requirements alone. The load on the wall of two storey domestic building pieced with average size window and door opening quite small and well within the bearing capacity of a normal half brick wall. This results in functional requirement other than that of strength being the determining factors as far as thickness is concerned. The latter is not normally, therefore, calculated in terms of strength for building up to three storeys in height.

Weather resistance: The external walls of a building, whatever their form is required to provide adequate resistance to rain and wind penetration. The actual degree of resistance required in any particular wall will depend largely upon its height and the locality and exposure. Oyewande (2002) said that wind force and rain fall vary considerably throughout the form of construction adequate for one locality may not be satisfactory in another. Within any locality there can also be variation of exposure for example, a site near the coast is likely to present greater problems of rain execution than one a mile or two in land. Such factors must be borne in mind. Reference to variations in rainfall can be seen from maps of average rainfall over the British Isles.

Fire resistance: A degree of fire resistance adequate for the particular circumstances is an essential requirement in respect of walls which, like upper floors, are often required to act as highly resistance fire barriers. They are used to compartmentalize a building so that a fire is confined to a given area, to separate specific fire risk with in a building, to form safe escape routes for the occupants and to prevent the spread of fire between buildings.

According to Chinwokwu (2000) the term fire resistance is a relative term applied to elements of structure and not to a material. It is not to be confused with noncombustibility. An element may in-corporate a combustible materials and still exhibit a degree of fire

resistance which will vary with the way in which the material is incorporated in the element. The degree of resistance necessary in any particular case depends on a number of factors.

Thermal insulation: The external walls of a building together with the roof must provide a barrier to the passage of heat to the external air in order to maintain satisfactory internal conditions without a wasteful use of the beating system. They should also serve to prevent the interior heating up excessively during hot weather. According to Ogunwusi (2009), adequate thermal insulation is attained of normal solid structural masonry and concrete necessitates impractical thickness of wall and it is necessary to incorporate in such consulting values in order to keep the thickness within reasonable limits frame walls of timber, which is a good insulating materials by their nature in corporate casualties and with appropriate internal lining they provide good insulation with a relatively small thickness of wall construction.

Sound Insulation: Only in exceptional circumstance are the sound insulation qualities of an external wall a significant factor in its design since the other functional requirements which must be fulfilled usually necessitate a wall which excludes noise sufficiently well in most circumstances. Windows, of course, provide weak points in this respect and in some circumstances these may have to be treated as double window environment and sciences, in order to attain a satisfactory degree of insulation. Sound insulation is, however, often significant factor in the design of internal walls. Weather exclusion and, generally, thermal insulation are not functional requirements of these walls but the prevention of the passage of sound from one enclosed space to another is often an important function they must fulfil.

2.1.5 The Effects of Rising Damp

The World Health Organization publications on “Damp and Mould” (WHO, 2009) indicated that, in Europe, between 10 and 50% of the indoor environment, where people live, work, and play, are damp as a result of humid conditions (Zhang *et al.*, 2022). Humid walls create

coldness, which require more heating energy leading to increase in energy bills. This buttresses the need to consider thermal conductivity materials of various types in relation to dampness. The rate of evaporation on the external wall is related to the nature of wall surfaces, climate, orientation and location (Bhamare *et al.,* 2019). As moisture evaporates from both sides of the wall, more water is drawn from the ground and a continuous upward flow of water occurs. The upward movement of water causes stains on internal walls, crumbling of plastered surface, paint peel off, and leaving a musty smell. On the external walls, signs of rising damp can usually be seen at the base of the masonry walls, where crumbling plaster and peeling paint are evidence. Severely affected masonry exhibits extensive decay, and powdery salt residue can clearly be seen at the base of the wall resulting into efflorescence, tide mark, mould, and fungi (Parsekian *et al.,* 2019). Dampness in walls of buildings lead to physical, biological, or chemical deterioration of building materials. The presents of damp also affect the quality of air in relation to human health and comfort. According to the WHO (2009), some occupants of damp rooms are at risk of experiencing health problems such as respiratory infections, allergic rhinitis, and asthma (Lu *et al.,* 2020). Damp also affect the structural integrity of timber products, walls, and thermal insulation in buildings.

In line with the opinions of Kportufe (2015) and Shad Muhammad (2020), and for easy strategies, this study summarizes the effects of dampness as follows: a) It causes rots to the wooden members provided in the building.

Efflorescence on building surface: The presence of dampness condition causes efflorescence on building surfaces which ultimately results in the disintegration of bricks, stones, tiles etc. and hence reduction of strength of the building component. Efflorescence occurs as a result of the presence of an appreciable quantity of salts in a rising dampness.

When rising dampness carry the salts up into the walls of the structure at the level where the moisture evaporates leaving behind the salts, this salt can often be seen as a whitish powder paint on the surfaces of walls. This situation decolorizes buildings (Kubal, 2008).

Bleaching and flaking off of paint and wallpaper: Dampness in building causes bleaching and flaking off of paints which results in the formation of coloured patches on the wall surfaces. This is as a result of the loss of adhesion between the paint and the wall surfaces because of the presence of moisture (Marshall, 2003).

Creates unhealthy living: Marshall, (2003) opined that dampness in building creates unhealthy living and working conditions for the occupants. Healthy indoor air is recognized as a basic right. People spend a large part of their time each day indoors: in homes, offices, schools or other private or public buildings. The quality of the air they breathe in these buildings is an important determinant of their health and well-being. The inadequate control of indoor air quality therefore creates a considerable health burden (World Health Organisation, 2009).

Softening and peeling off plaster from wall: It is the softening and crumbling of plaster into smaller particles or powder. This is as a result of non-quality materials or chemical reaction in the presence moisture (Marshall, 2003).

Corrosion of metals used in the construction of buildings: Corrosion has direct effects on reinforced concrete structures. It weakens the structure; reduces the bonding strength of the materials, limits the ductility, and reduces the shear capacity of the buildings. When corrosion occurs, the entire structure loses its strength and becomes very weak to the loads it was originally built to carry. It starts by reducing the effectiveness of each structural component, which in turn reduces the axial, and flexural strength of each element and makes it structurally weak. Corrosion also affects the iron rods which provide strength to the concrete

by eating and smoothing their grooves and cross-section. As a result of this, the bond strength is often compromised. This leads to slippage of the concrete and eventual collapse of the building or structure. Corrosion is also capable of significantly reducing the ductility of the overall structure, exposing it to crumbling under stress. Corroded sections of a building have lower ductility which have their response to earthquake and other natural disasters. Corrosion reduces shear capacity in beams and columns, concrete slabs and footings. This reduces the shear strength of the slabs close to the columns and increases the possibility of shear failure. Also in footings, corrosion can result to shear failure of the footing, anchorage failure, or flexural yielding of steel reinforcement

2.1.6 Dampness Preventive Techniques in building

Bajirao and Kumar (2022) recommended the following techniques for damp prevention:

- Use of damp proof courses (DPC): These are layers or membranes of water repellent materials such as bituminous felts, mastic asphalt, plastic sheets, cement concrete, mortar, metal sheets, stones etc. which are interposed in the building structure at all locations wherever water entry is anticipated or suspected. It should be laid at least 15cm above ground level. The damp proof course is provided horizontally and vertically in floors, walls etc.

- Water proof surface treatment: This entails filing up the pores of the material exposed to moisture by providing a thin film of water repellent material over the surface (internal / external). External treatment is effective in preventing dampness

- Integral damp-proofing treatment: this involves adding certain compounds (water proof sulphates, calcium chlorides etc.) to the concrete or mortar during the process of

mixing, which when used in construction acts as barriers to moisture penetration under different principles

- Cavity or hallow walls: As there is no contact between outer and inner walls of cavity wall, possibility of moisture penetration is reduced to a minimum. It prevents the transmission of heat through wall. The cavity wall tends to reduce the nuisance of efflorescence.

- Guniting (shotcrete): This entails forming an imperious layer of rich cement mortar (1:3) or fine aggregate mix for water proofing over the exposed concrete surface or over the pipes, cisterns etc. for resisting the water pressure. By this technique, an impervious layer of high compressive strength (600 to 700 kg/cm2) is obtained and is also very useful for reconditioning or repairing old concrete works

- Pressure grouting (cementation): a mixture of cement, sand and water under pressure into cracks, voids or fissures present in the structural component or the ground. In general, the foundations are given this treatment to avoid the moisture penetration. This technique is also used for repairing structures, consolidating ground to improve bearing capacity, forming water cut-offs to prevent seepage etc.

2.2 Related Empirical Studies

Kofi (2013) carried out a study on Preliminary Strategies of Dampness in Walls of Residential Buildings in Four Climatic Zones in Ghana. A questionnaire survey of inhabitants of 5,800 residential buildings was conducted in the Dry Equatorial, South Western Equatorial, Tropical Continental and the Wet Semi Equatorial climatic zones in Ghana to identify the most severe symptoms associated with dampness in the walls of residential buildings. Onsite building investigations were also conducted by trained assessors to identify

the lead source of dampness in the walls of these residential buildings in Ghana. Data were analyzed using frequency and severity index. Majority of the houses surveyed were of lateritic materials and sand Crete block walls. The results showed that the most dominant symptoms in the walls of the residential buildings surveyed were hygroscopic salts, decayed skirting, dampness below 1.5m and mould growth on walls up to 1m high. These symptoms point to the presence of rising dampness as the lead source of dampness in the walls of these residential buildings. The results provide a platform for addressing the problem of rising dampness in buildings.

The similarities between the study and the present study is that the two study are based on dampness. While the differences between the study and the present study is that the present study is carried out in Minna Niger state, Nigeria while the study is carried out in Ghana.

Zakariyyah (2020) carried out a study on Dampness Patterns in Halls of Residence in Lagos Metropolis: A case study of the University of Lagos. The objectives were to evaluate the incidence and causes of dampness in the halls of residence in the institution. As a preliminary strategies of dampness evaluation in halls of residence, the institution used is the University of Lagos, as a case study. This is selected based on its location and proximity. Survey method was adopted for the collection of primary data through a well-structured questionnaire. The study population consists of undergraduate and postgraduate halls of residence while the sample frame is undergraduate male hostels. The four undergraduate male hostels are taken as the sample size, using the census as the sampling technique. From the four male halls of residence; eighty rooms and two maintenance staff per block were selected using a purposive sampling technique. Analyses were done using mean, percentage, and relative importance index. The results revealed the presence of the four types of dampness, with dampness from leaking pipes as the most prevalent. The dampness originated from a combination of a host of

factors, with those emanating from the negligence of maintenance culture and lack of materials/workmanship consideration as the top two causes. The study concluded that symptoms of the four dampness types are in existence in the four sampled halls of residence and the factors causing dampness are many and all-encompassing, but if the issue of maintenance and materials/workmanship are professionally handled, dampness will reduce, hence better comfort and building longevity can be guaranteed. The symptoms of buildings deterioration and defects can be minimised with ease of maintenance and through the use of professionals that are apt in the knowledge of materials and components inter-relationship. The study emphasised the significance of a healthy building and recommended that such should be procured with all hands-on deck and handled by the professionals in the built environment.

The similarities between the study and the present study is that both study are based on dampness while the difference between the two study is that the present study make us mean and standard deviation while the study make use mean percentage to analyse it research questions.

Magaji (2022) carried out a research on evaluation of dampness in residential building in Kaura-Namoda Zamfara state, Nigeria. As one of the most damaging failures that occur in buildings, dampness in all its forms affects both old and modern types of buildings. As an important function, buildings should seek to prevent water penetrations and give envelop to their occupants. This study sought to examine dampness which is non-structural defect in the walls and floors of Residential Buildings in Kaura Namoda. A case study approach which involves a three-stage protocol of damp investigation, thus visual inspection, non-destructive tests using a moisture meter and destructive testing was employed. Survey method was adopted for the collection of primary data through a well-structured questionnaire. The results

from the visual investigation showed that dampness was seen on the external and internal walls of the building and was accompanied by symptoms such as damp patches in horizontal bands, flaking of mortar, blistering of paint, surface efflorescence and stains. The findings revealed that various forms of dampness existed within the building, including rising damp, penetration damp and, rain water splash back and lateral penetration. A further investigation with the moisture meter showed that dampness was more pronounced in the external walls. Also, destructive tests revealed that the dampness in the bathroom walls were due to plumbing leakages. This study has shown that it is possible to apply the principles of damp for appraisal of dampness or otherwise in buildings.

The similarities between the study and the present study is that both study focus on dampness a building construction. While the difference between the study and the present study is that the present study is carried out in Minna, Niger state while the study is carried out in Kaura-Namoda Zamfara state, Nigeria.

Ekekezie (2022) conducted a study on investigation of the causes, effects and preventive measures of dampness in buildings in Enugu metropolis. The aim of this study is to examine the causes, effects and preventive measures for dampness in buildings in Enugu metropolis. Survey method was adopted for the collection of primary data through a well-structured questionnaire distributed to seventy-two (72) registered professionals in the building industry. The population of the study is 87. The sample size was got using Taro Yamane (1973) formular. Data obtained were analyzed using simple percentage, relative important index and weighted mean. This study has revealed that the factor with the most significant impact in causing dampness is flooding followed by leakages in roof and plumbing system; while, the factors with the most insignificant impact in causing dampness in building is moisture trapped during construction and defective building orientation. Effects of dampness: It

reduces the whole life of the structure; blistering, bleaching of paints & disfiguring of wall; causes rots to the wooden members; destruction of floor carpets; floors of the building remain ugly; deterioration, peeling off of plaster; corrosion of metals used in building; mould growth; unhygienic conditions; unpleasant smell and poor air quality. The study recommends that provision of good roof, integral water proofing, special construction techniques, avoidance of leakage of water; provision of damp proof membrane and provision of damp proof course are good preventive measures for dampness in buildings.

The similarities between the study and the present study is that both study focus on dampness and also adopt survey research design. The difference between the study and the present study is that the present study is carried out in Minna metropolis of Niger state while the study is carried out in Enugu metropolis.

2.3 Summary of Review of Related Literature

The review of related literature is discussed under the following subheadings: Dampness in Buildings, Causes of Rising Damp, Building Construction, Functional Requirement of Building, The Effects of Rising Damp and Dampness Preventive Techniques in building. It deduced from the study that the ultimate objective of any dampness study is to identify the lead source of moisture in order to recommend actions to remedy the problem. A source of water close to a building will also be one of the problems associated with dampness. These problems include symptoms such as dirty spots on the building, biological plants like the growth of fungi, mosses and creeping plants, paint flaking, blistering etc. Adequate and relevant literatures were reviewed in the study.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Design of the Study

The study adopt the descriptive survey research design used to strategies for controlling dampness in an existing building in Minna (Niger state). Survey design according Nworgu (1991) is aimed at collecting data on and describing in a systematic manner, the characteristics features or facts about a given population

3.2 Area of the study

The study will be carried out in Minna metropolis.

3.3 Population for the Study

The population for the study consists of 80 respondents comprising 70 residential occupant and 10 building contractors.

3.4 Sample and Sampling Technique

There will be no sampling since the population was small and manageable.

3.5 Instrument for Data Collection

The researcher designed a structured questionnaire as an instrument that will be used in collecting data for the study. The questionnaire was made up of four sections (A, B, C, D and E). Section 'A' contains items on personal information of the respondents. Section 'B' seeks the prevalence of dampness in an existing building in the Minna metropolis. Section 'C' find the effects of dampness in an existing building in the Minna metropolis. Section 'D' find out the reasons for dampness in an existing building in Minna metropolis. While section E will seek the remedies to dampness in existing residential buildings. The questionnaire items

were based on four points scale types. Items for section 'B, C, D and E contain four responses category each. The response categories for section B, C, D and E are strongly Agree (SA), Agree (A), and Disagree (D) and strongly disagree (SD). These response categories will be assign numerical values of 4, 3, 2 and 1 respectively. Respondents were require checking (√) against the response category that best satisfies their opinion.

3.6 Validation of instrument

The instrument will be validated by three lecturers in the department of Industrial and Technology Education, Federal University of Technology, Minna and contributions on the appropriateness of the instrument will be considered in the production of the final copy of the research instrument.

3.7 Reliability of instrument

In order to determine the reliability of the research instrument, a pilot test will be conducted using fifteen in other locations. During the test, the questionnaires were distributed by the researcher. The questionnaire was filled by the respondents and then returned to the researcher. The data collected will be analyzed using Crombach Alpha.

3.8 Administration of instrument

The instrument that will be used for the data collection will be administered to the respondents by the researcher and three research assistant in the study area.

3.9 Method of data analysis

Data collected will be analyzed using mean and standard deviation for the research questions. A four (4) point rating scale will be to analyze the data as shown below.

Strongly Agree	(SA)	=	4points (3.5 – 4.0)
Agree	(A)	=	3points (2.5 - 3.49)
Disagree	(D)	=	2points (1.5 – 2.49)
Strongly Disagree	(SD)	=	1point (1.0 – 1.49)

Therefore, the mean value of the 4 point scale is:

$$\bar{X} = \frac{4+3+2+1}{4} = \frac{10}{4} = 2.5$$

3.10 Decision Rule

The cutoff point of the mean score of 2.50 will be chosen as the agreed or disagreed point. This will be interpreted relatively according to the rating point scale adopt for this study. Therefore, an item with response below 2.49 and below will be regard or consider as disagreed while an item with response at 2.5 and above was regard or considered as agreed.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

4.1 Research Question 1

What is the prevalence of dampness in an existing building in the Minna metropolis?

Table 4.1: Mean responses of the residential occupants and residential building contractors on the prevalence of dampness in an existing building in the Minna metropolis.

N_1= 70 **N_2=10**

S/N	ITEMS	$\bar{X}$	SD	Remark
1	Rising damp	3.17	.813	Agreed
2	Penetrating damp	2.96	.767	Agreed
3	Condensation-caused damp	3.77	.546	Agreed
4	Defective Plumbing	3.80	.548	Agreed
5	Insulation condensation	3.14	.980	Agreed
6	Leakage through foundations	2.64	1.131	Agreed

N=90

$\bar{X}$= mean of the respondents

N_1 = No. of residential occupants

N_2= no. of residential building contractors

SD = standard deviation of the respondents

Table 4.1 showed that the respondents agreed on all items from 1 to 6. This is because none of the mean response was below 2.50 which was the beach mark of agreed on the 4-points response options. The standard deviation score ranged between 0.546 and 1.131. This showed that the responses of the respondents on the items were not divergent.

4.2 Research Question 2

What are the effects of dampness in an existing building in the Minna metropolis?

Table 4.2: Mean response of the residential occupants and residential building contractors on the effects of dampness in an existing building in the Minna metropolis.

N_1= 70 **N_2=10**

S/N	ITEMS	$\bar{X}$	SD	Remark
1	The appearance of mould or mildew on walls, floors or ceilings	3.53	.540	Agreed
2	Water droplets on walls	3.71	.458	Agreed
3	Dark or discoloured patches on walls or plaster	3.48	1.045	Agreed
4	Excessive condensation on windows, not just during the winter	3.60	.963	Agreed
5	Rotting woodwork, such as skirting boards.	3.78	.522	Agreed
6	Surface efflorescence just above skirting/floor	3.73	.654	Agreed

N=80

$\bar{X}$= mean of the respondents

N_1 = No. of residential occupants

N_2= no. of residential building contractors

SD = standard deviation of the respondents

Table 4.2 showed that the respondents agreed on all items. This was because none of the mean response was below 2.50 which was the bench mark of agreed on the 4-point response options. The standard deviation score ranged between 0.522 and 1.045. This showed that the responses of the respondents on the items were not divergent.

4.3 Research Question 3

What are the reasons for dampness in an existing building in the Minna metropolis?

Table 4.3: Mean response of the residential occupants and residential building contractors on the reasons for dampness in an existing building in the Minna metropolis.

		N_1= 70		N_2=10
S/N	ITEMS	$\bar{X}$	SD	Remark
1	Capillary suction of water through fine voids	3.45	.842	Agreed
2	Porosity of Building Materials	3.58	.690	Agreed
3	Poor quality of workmanship	3.81	.504	Agreed
4	Lack of understanding of design details	3.82	.387	Agreed
5	Poor quality of construction methods	2.98	.938	Agreed
6	Moisture rising up the wall from the ground	3.69	.557	Agreed
7	Rainwater traveling from the wall top	3.61	.692	Agreed
8	Rain beating against the external wall	3.51	.589	Agreed
9	Condensation of atmospheric moisture	3.68	.615	Agreed
10	Improper orientation of walls	3.80	.405	Agreed

N=80

$\bar{X}$= mean of the respondents

N_1 = No. of residential occupants

N_2= no. of residential building contractors

SD = standard deviation of the respondents

Table 4.3 showed that the respondents agreed on all items. This was because none of the mean response was below 2.50 which was the bench mark of agreed on the 4-point response options. The standard deviation score ranged between 0.405 and 0.938. This showed that the responses of the respondents agreed on all items on the items were not divergent.

4.4 Research Question 4

What are the remedies to dampness in existing residential buildings in Minna metropolis?

Table 4.4: Mean response of the residential occupants and residential building contractors on the remedies to dampness in existing residential buildings in Minna metropolis.

		N_1= 70		N_2=10
S/N	ITEMS	$\bar{X}$	**SD**	Remark
1	Installation of Damp Proof Material	3.40	.754	Agreed
2	Application of Cement grouting	3.66	.476	Agreed
3	Injection of Liquid Damp Proof Products	3.45	.605	Agreed
4	Integral damp proofing	3.70	.488	Agreed
5	Use of surface treatment	3.65	.813	Agreed
6	Adoption of cavity wall construction	3.69	.466	Agreed

N=80

$\bar{X}$= mean of the respondents

N_1 = No. of residential occupants

N_2= no. of residential building contractors

SD = standard deviation of the respondents

Table 4.4 showed that the respondents agreed on all items. This was because none of the mean response was below 2.50 which was the bench mark of agreed on the 4-point response options. The standard deviation score ranged between 0.466 and 0.754. This showed that the responses of the respondents agreed on all items on the items were not divergent.

Findings of the study

The following are the main findings of the study; they are prepared based on the research questions.

What is the prevalence of dampness in an existing building in the Minna metropolis

- Rising damp
- Penetrating damp
- Condensation-caused damp
- Defective Plumbing
- Insulation condensation
- Leakage through foundations

What are the effects of dampness in an existing building in the Minna metropolis?

- The appearance of mould or mildew on walls, floors or ceilings
- Water droplets on walls
- Dark or discoloured patches on walls or plaster
- Excessive condensation on windows, not just during the winter
- Rotting woodwork, such as skirting boards.
- Surface efflorescence just above skirting/floor

What are the reasons for dampness in an existing building in the Minna metropolis?

- Capillary suction of water through fine voids
- Porosity of Building Materials
- Poor quality of workmanship
- Lack of understanding of design details
- Poor quality of construction methods
- Moisture rising up the wall from the ground
- Rainwater traveling from the wall top
- Rain beating against the external wall
- Condensation of atmospheric moisture
- Improper orientation of walls

What are the remedies to dampness in existing residential buildings in Minna metropolis?

- Installation of Damp Proof Material
- Application of Cement grouting
- Injection of Liquid Damp Proof Products
- Integral damp proofing
- Use of surface treatment
- Adoption of cavity wall construction

Discussion of findings.

The result from table 4.1 shows the findings on the prevalence of dampness in an existing building in the Minna metropolis. The findings of the study revealed the Rising damp, Penetrating damp, Condensation-caused damp, Defective Plumbing, Insulation condensation, Leakage through foundations. The findings of the study is inline with The findings of the study is in line with Congedo *et al.* (2022) who stated that Rising damp occurs when the water rises upwards through the pores of masonries, cracks in buildings, or the floors of buildings, with the water being sourced from the ground, through the pores of masonries or cracks through a process known as capillary suction or capillarity.

Table 4.2 shows the result of the findings on the effects of dampness in an existing building in the Minna metropolis. The findings of the study revealed the The appearance of mould or mildew on walls, floors or ceilings, Water droplets on walls, Dark or discoloured patches on walls or plaster, excessive condensation on windows, not just during the winter, Rotting woodwork, such as skirting boards, Surface efflorescence just above skirting/floor. The finding of the study is inline with Maagi *et al.* (2022) stated that dampness is inextricably

linked to most building deterioration. A source of water close to a building will also be one of the problems associated with dampness.

The results from table 4.3 reveal the findings on the reasons for dampness in an existing building in the Minna metropolis. The findings of the study revealed that Capillary suction of water through fine voids, Porosity of Building Materials, Poor quality of workmanship, Lack of understanding of design details, Poor quality of construction methods, Moisture rising up the wall from the ground, Rainwater traveling from the wall top, Rain beating against the external wall, Condensation of atmospheric moisture, Improper orientation of walls. The findings of the study is in line with Capillary suction becomes stronger as the pore size gets smaller; if the pore size is fine enough; damp may rise many inches in a wall until the upward suction is balanced by the downward pull of gravity.

The results from table 4.4 reveal the findings the remedies to dampness in existing residential buildings in Minna metropolis. The findings of the study revealed that Installation of Damp Proof Material, Application of Cement grouting, Injection of Liquid Damp Proof Products, Integral damp proofing, Use of surface treatment, Adoption of cavity wall construction. The findings of the study is inline with Ubi *et al.* (2020) opined that rain penetration from the wall can be treated by providing adequate wall thickness or cavity walls, exposed wall faces should be of good quality and have a low water absorption capacity and covered with cement plaster. Similarly, Le Moigne *et al.* (2018) asserted that condensation can be treated by increasing background heat, ventilation of cold surfaces, reducing moisture generation. In another finding, it revealed that treatment method has a significant impact on residential buildings.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Study

The main focus of this research study was to assess the factors controlling dampness in an existing building in Minna (Niger state).

Chapter 1 of the study discussed the background of the study, the statement of problem, purpose, significance, scope and the research questions were all stated and discussed for the conduct of this research.

The review of related literature looked into Dampness in Buildings, Causes of Rising Damp, Building Construction, Functional Requirement of Building, The Effects of Rising Damp, Dampness Preventive Techniques in building. Various views of different authors concerning the topic were harmonized in a comprehensive literature review and empirical studies.

A survey approach was used to developed instrument for the study; the respondents identified as the population of the study were the residential occupants and residential building contractors. The entire respondents were used. A number of 80 questionnaires were administered. The instrument used was analysed using frequency count, and mean scores. The research questions were discussed base on the findings from the responses and results of the instrument used.

Implication of the study and conclusions were also drawn from the findings discussed. Recommendations and suggestions for further study were formulated and stated according to the findings of the study.

5.2 Implication of the Study

The findings of the study had implications for government, Residential building contractors and residential building occupant. From the outcome of the study, it implies that If the

identified areas where put in place it will bring about standard building in the Minna Niger state.

5.3 Conclusion

Based on the findings of the study, the following conclusions were drawn: Dampness is a major contributing factor to building defection and it impact negatively on residential building, thereby reducing the life-span of the building and endanger the life of occupants. Based on visual inspection and interview carried out, the data showed that dampness exists in landed residential buildings. From this research paper it could be denoted that, factors like faulty construction method, poor construction materials, lack of maintenance and poor drainage system should be avoided, beginning from the pre-construction, during construction and post construction stage by the professionals involved to avoid dampness or any building defect. Problem associated with various forms of dampness and the necessary measures of treatment needed to pro-long the life span of a building were also disclosed.

5.4 Recommendations

Based on the findings of the study, the following recommendations were made:

1. Construction industry professionals must be involved in all the stages of the design and construction processes.
2. The materials to be used for construction must be tested and confirmed authentic.
3. Competent and qualified artisans must be involve in the construction and maintenance of building infrastructures

5.5 Suggestion for Further Study

The following are suggested for further studies:

1. Strategies of factors contributing to the dampness on existing building in other state.
2. Strategies of factors contributing to poor maintenance n existing building in Niger state.

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Appendix A

QUESTIONNAIRE

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

A QUESTIONNAIRE ON ASSESSMENT FOR CONTROLLING DAMPNESS IN AN EXISTING BUILDING IN MINNA (NIGER STATE)

INTRODUCTION: Please kindly complete this questionnaire by ticking the column that best present your perception about the topic. The questionnaire is for research purpose and your view will be confidentially and strictly treated in response to the purpose of the research work.

SECTION A

PERSONAL DATA

. Residential Occupant: ☐

Building Contractor: ☐

Note: A four (4) point scale is used to indicate your opinion, tick the options which best describe your agreement as shown below:

Strongly Agree	(SA)	=	4points
Agree	(A)	=	3points
Disagree	(D)	=	2points
Strongly Disagree	(SD)	=	1points

Section B: What is the prevalence of dampness in an existing building in the Minna metropolis

S/N	Skill Items	Scale			
		SA	**A**	**D**	**SD**
1	Rising damp				
2	Penetrating damp				
3	Condensation-caused damp				
4	Defective Plumbing				
5	Insulation condensation				
6	Leakage through foundations				

Section C: What are the effects of dampness in an existing building in the Minna metropolis?

S/N	Items	Scales			
		SA	**A**	**D**	**SD**
1	The appearance of mould or mildew on walls, floors or ceilings				
2	Water droplets on walls				
3	Dark or discoloured patches on walls or plaster				
4	Excessive condensation on windows, not just during the winter				
5	Rotting woodwork, such as skirting boards.				
6	Surface efflorescence just above skirting/floor				

Section B: What are the reasons for dampness in an existing building in the Minna metropolis?

S/N	Items	Scales			
		SA	A	D	SD
1	Capillary suction of water through fine voids				
2	Porosity of Building Materials				
3	Poor quality of workmanship				
4	Lack of understanding of design details				
5	Poor quality of construction methods				
6	Moisture rising up the wall from the ground				
7	Rainwater traveling from the wall top				
8	Rain beating against the external wall				
9	Condensation of atmospheric moisture				
10	Improper orientation of walls				

Section E: What are the remedies to dampness in existing residential buildings in Minna metropolis?

S/N	Skill Items	Scale			
		SA	A	D	SD
1	Installation of Damp Proof Material				
2	Application of Cement grouting				
3	Injection of Liquid Damp Proof Products				
4	Integral damp proofing				
5	Use of surface treatment				
6	Adoption of cavity wall construction				