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DAMPNESS IN RESIDENTIAL BUILDING IN NIGERIA: A CRITICAL ASSESSMENT OF SUB – URBAN AREAS.

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Abstract

Severe dampness in residential buildings in sub-urban areas has become a major problem to many owners and users alike. This scenario leads to deterioration in building to the extent that it ultimately undermines the structural elements. Soil profile, Silt content and pH value in conjunction with Site survey and Questionnaire were used to evaluate the causes and effects of dampness in Bosso and Kpakungu areas of Chanchaga local government area in Niger State of Nigeria. Sandy-clay soil type was dominant in the area with impervious base ranges from 4 to 9 meters deep, the silt content of sharp and plaster sands used for construction in the area were 6.8% and 10.2% respectively while the pH values for well water is 6.8 and 7.1 for stream water with traces of $CaSo_4$ and $CaCl_2$. Total disregard to standards and methods in construction processes as well as lack of proper maintenance are the major causes of dampness. It is recommended that through proper education and engagement of qualified professionals, wet free residential buildings can be achieved.

Key words: Building, Capillary Action, Building Standards, Rising damp, Soil Profile.

Introduction

Dampness in building becomes a problem if the moisture penetrates vulnerable materials or finishes, particularly in the occupied parts. Dampness and leaks caused by capillary action are perhaps the most problematic to treat, both for the difficulty to detect the origin of the leak and how to correct it. Dampness originates in many ways and has wide ranges of symptoms that require the expertise of the professional in the built environment to unravel. The building materials tend to attracts water molecules through its spore (capillary action) that causes rising damp through the walls and floors of houses unless preventive measures are taking to breach the difference in moisture gradient. This moisture will dissolve soluble salts from the building materials such as calcium sulphate ($CaSo_4$), and may also carry soluble salts from its source. If the moisture evaporates through a permeable surface, these salts will be left behind and form deposits on or within the evaporative surface (Seeley, 1987; Hutton, 1998; Anonymous, 2010).

Ikpo (2006) and Lekjep, Mangden and Edet (2006) state that buildings constructed without moisture barriers, inadequate roof eave and improper application of components are susceptible to dampness particularly if the water table is high and the effects of rain water. These can result to a serious health hazard and also aid the decay of skirting boards, raised ground floor members and affect paintwork, all these affects the building standards as well as undermines the structural integrity of building elements, limits the comfort of the occupants, and the attendance increase in maintenance cost of the structure (Mbachu, 1996; Oliver,1986).

It is the aforementioned problems that necessitate the study of the causes and effects of dampness in sub-urban areas where the symptoms are becoming worrisome within the neighborhood of the urban poor. Buildings are constructed with alter standards without the input or supervision of qualify professionals on a problematic soil usually swamp, in believe of saving money and desperation to leave in the city.

Therefore, this study is aimed at identifying the causes and effects of dampness in residential buildings in sub-urban area so as to proffer suggestions and methods for achieving comfortable and damp free buildings. In view of the above, the following specific objectives will be pursued;

- To determine the causes and effects of dampness in the residential building within the area.
- To determine the level of dampness in the residential building within the area.

- To examine the construction methods adopted in the area in relation to building standards in order to create the necessary awareness among the neighborhood.

Methodology

To achieve the aim of this study via the research objectives, both the primary and secondary sources of data were sourced;

Primarily, fieldworks for detailed study of construction techniques and materials adopted in building construction within the area of study were carried out, as it comply with standard building construction methods and codes as well as determining the level of dampness in the residential building within the area. The depth of ground water table as revealed by wells samples within the premises of the affected buildings and the geophysical investigation for geoelectric section or soil profiles in the study area were examined. Samples of materials used for building construction (water and sand) in the locality was collected and tested for in the laboratory. Oral interviews and Questionnaires were carried out and administered concurrently at random to same or different person within the stakeholders in the community in other to assess their opinions, impressions and experiences regarding the causes and effects of dampness in their neighborhood.

Secondarily, geophysical information for soil profiles of the areas was collected from deep well drilling company (ADEX NIG. LTD), also information from internets, extract from journals and relevant textbooks, seminar and conference papers forms the bulk of the materials used.

Background Of Study Area

Kpakungu and Bosso are towns in sub-urban areas of Chanchaga Local Government and Bosso Local Government Areas of Niger state Minna, Nigeria respectively (see Figure 1). The state lies on latitude 3.20^0 East and longitude 11.30^0 North. Kaduna State and FCT are her borders to the North-East and South-East respectively; Zamfara State borders the North, Kebbi State in the West, Kogi State in the South and Kwara State in the South West and The Republic of Benin along Agwara Local Government Area boarders her North West. The soil types as in other parts of the state are Ku soil and Ya soil. Ku soil is susceptible to little erosion, while the Ya soil has better water holding capacity.

The temperature is not different from that obtained in Minna with average temperature range between 21°C and 42°C with the annual relative humidity mean of between 50 – 55%. Niger State experiences distinct dry and wet seasons with annual rain fall varying from 1,100mm in the northern part to 1,600mm in the southern parts. The rainy seasons last for about 150 days in the northern to about 120 days in the southern parts of the state.

The Inhabitants of Kpakungu and Bosso comprises mostly of civil servant; students, farmers, business people and self employed. The house types are mostly of modern1, 2, and 3 bed room's bungalow and the traditional rectangular plans with courtyards arranged in compound form. The wall materials are made mostly of conventional sandcrete blocks with galvanized zinc as roofing sheets.

Basic Properties Of Water And Sand

Laboratory quantitative analysis was carried out on sharp and plaster sands, as well as, well and stream waters to test for properties that have effect on damp movements and chemical reactions, according to British Standards (B.S).

Silt content in Sands, and $_{P}H$ values and soluble salt in Water (well and stream) which are the two basic materials that can influence the damp movement within the building structure were carried out. The silt content of sharp and plaster sands used for construction in the area were 5.8% and 8.5% respectively as presented in Table 1. While the $_{P}H$ values for well water is 6.8 and 7.1 for stream water with traces of Calcium Sulphate ($CaSo_4$) and Calcium Chloride ($CaCl_2$).

Result and Discussion

From the result of preliminary investigation carried out on the study area, the roof structures adopted were found to be mostly conventional hip roof systems with eave extensions of 500mm to 600mm.

The buildings are mostly bungalows with few two to three storey structures. The level of exposure of the external walls of most buildings in the locality to direct sun rays and heat is low, while that of rainwater is found to be high. It was also observed that the level of maintenance in the area is abysmally low. The problem of roof leakages due to improper roof design and choice of materials has also contributed to causes of dampness of building within the settlements.

Analysis of Construction Techniques and Methods within the Area.

A thorough investigation and analysis of method and techniques of construction adopted in the area reveals that in most cases fewer people adopted the standard damp proof course (DPC) and damp proof membrane (DPM); instead cement/sand mix in ratio 1:6 is used for floors. It was also found that the hardcore thickness of 150mm adopted in most of the buildings as against the required 300m is inadequate (especially where ground water levels were close to the ground surface). In areas where the ground water level is deep down and of stepper terrain, dampness is not visibly seen in buildings at such locations, whereas where the water level is high up, dampness is prevalent in most buildings found in the locality.

Analysis of Interview and Questionnaire Administered.

A total of 126 questionnaires were administered to residents and 46 stakeholders were interviewed at random in the case study areas to reveal basically the following; Interest or Tenancy holdings that exist on the building, Age of the properties, Dampness experienced in the house, Areas of dampness experienced, Causes and effects of dampness, And the expected remedies.

About 77% of the respondents experienced dampness on various components in their buildings at various level of severity; floor, walls, ceiling, and fascia board with 73%, 60%, 84% and 49% respectively, While 37% experienced dampness in the entire components of building as indicated by the researcher. Reasons indicated for occurrence of dampness were; Negligence of landlord to regular maintenance with 65%, negligence of tenants to maintenance with 53%, vagary of weather (rain, rising water table etc) with 30%, while 44% accounted for non-application of rightful construction methods and materials.

It can safely be concluded therefore that dampness was inevitable when maintenance was relegated to the background. Hence regular maintenance and use of rightful construction methods will go a long way to reduce, if not out-rightly avert dampness in buildings.

Report on Geophysical Investigation in the Area.

Eight pre-drilling geophysical investigation reports on ground water development from 'ADEX NIG. LTD', four each for Bosso and Kpakungu areas and physical investigation of some selected wells in the areas were used to collect data on the soil profile of the areas under consideration.

An average of 1 meter top soil was reported followed by 4-9 meters weathered basement that is hard enough at the basement to hinder free percolation of water that results to early saturation and flooding during raining season. This might be the cause of the high level of dampness (78%) in the foundation of buildings in area under consideration.

Test of Efflorescence of Sandcrete Block in the Area.

Three Samples of blocks were selected randomly from six (6) different block production sites, three each for well and stream water. Tests of efflorescence were carried out on the samples and the average result is as shown in the Table 2. The average area of surface covered with these deposits of salts found in blocks used in constructing walls in the locality is 22.3%. The efflorescence developed on block walling in the area could therefore be classified as "mild". Most of the walling units in the area are therefore liable to efflorescence which could be a factor for the prevailing dampness.

Summary Of Findings From The Research Work

The main trust of this research work has primarily been on establishing the problems of dampness in residential buildings in case study areas.

The following were deduced as experiences of dampness among the residents and professionals;

- About 75% of the residents experiences rising dampness at the foundation level and other forms of dampness at varying level in other areas like; Walls, Fascia boards, Ceilings, and faulty pipes.
- Dampness is prevalent within the wet or rainy season of particular note in this case in the problem of applying appropriate construction techniques as well as use of right type building materials when erecting residential buildings in the area.
- Sands found in the area contain high silt content; this affects the workability of its products. The amount of water required hydrating the cement and sand mix for construction affects its final strength, as excess water evaporates and leaves capillary pores that reduce the strength and increases the permeability.
- The shallow impervious base in the area account for early submerges of the soil during the raining session.

This accounts for dampness experienced in the above mentioned areas of the buildings. It results in:

a. Penetrating dampness through the floor, wall and roof structures from external source of dampness such as rain water on surface of walls, ground affecting floor and so on. (see Figure 1, 2 and 3)
b. Internally, defects from plumbing works as a result of break down from sanitary wares could release water no matter how small this is left unchecked over a long period of time.
c. Efflorescence experienced on surfaces of walling units as a result of the presence of soluble salt deposits arising from the use of hard water obtained in wells in Kpakungu and Bosso used for production of blocks as well as construction of buildings.

Conclusion

Based on the findings above, it can be concluded that the causes of dampness is multi- faceted but soil characteristics and lack of adherence to building construction standards played a major role. All stakeholders complained about the effects of this menace and desired a permanent solution to the problems associated with it in the community, however, lack of resources to adhere to building standards, lack of technical know how on the part of the operatives, lack of improper implementation of building codes and regulations by the local authority, and lack of maintenance culture are the main hindrance to their dream of wet free living space.

Recommendations

Every building is constructed to provide a comfortable, safe and serene habitation for its occupants. Intruding elements, natural or manmade, should be properly taken care of to avoid the consequence associated with poor living environments. In this case the following recommendations are hereby made:

- The construction site must be properly investigated for adequate design against dampness before the construction is carried out to avoid their occurrence when work has been finished.
- Use of appropriate and proper techniques in the construction process cannot be overemphasized. For example, where the ground water level is high as noticed in most

parts of the study areas, the application of damp proof membrane and the inclusion of damp – proof course to check the permeation of water through capillary action in the Foundation level and the walls should be carefully observed.

- The water available in study areas used constructions purpose should be treated to check the level of hardness created by the presence of salts. The method used in treating portable water should be utilized. In this way, the mortar for wall construction and rendering as well as the mix for block production will be devoid of such salts.
- The pitch of roof structures should be steep enough to allow free flow of all rainwater.
- The eave projections in buildings in the study areas should be adequately provided, not less than 600mm deep. This will ensure that the upper parts of the walls are dry to avoid down ward transmission of water to affect the lower parts of the buildings.
- The mortar mix used for rendering as well as for construction in the study areas should be rich (1:3) in cement content to avoid easy peeling off.

TABLE 1 – Test for Silt in Sand Use for Block Production and Wall Rendering in Kpakungu and Bosso Areas.

	SAND			PLASTER		
SAND						
SAMPLE	1	2	3	1	2	3
Silt thickness (mm)	5.7	6.4	9.6	10.0	10.0	10.2
Sand depth (mm)	98	96	102	95	103	98
Silt contents (%)	5.8	6.7	9.4	10.5	9.7	10.4
Average silt contents (%)		6.8%				10.2%

Source: Author's field report, 2011.

TABLE 2 – Test of Efflorescence of Sandcrete Block

SAMPLE	Well	Stream
Area of block faces (m^2)	0.30	0.30
Area of block covered with salt deposit (m^2)	0.36	0.98
Percentage (%) area of face covered with salt deposit	12.1	32.5
Average percentage (%) area of efflorescence		22.3%

Source: Author's field report, 2011.

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APPENDICES

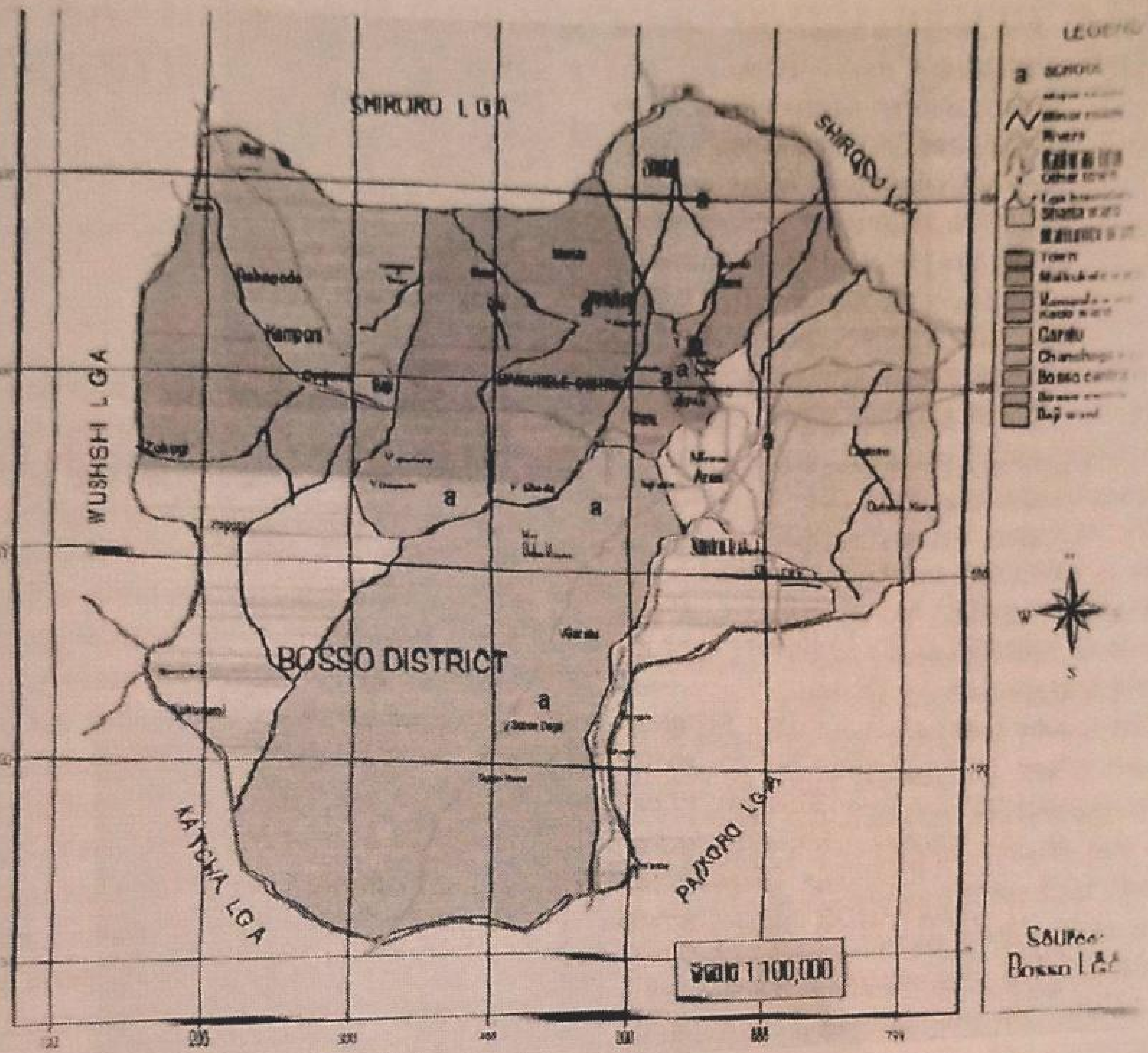

Figure 1. Map of study Area.

Scanned by TapScanner

Figure 2.Building under construction showing DPM and Oversight Concrete

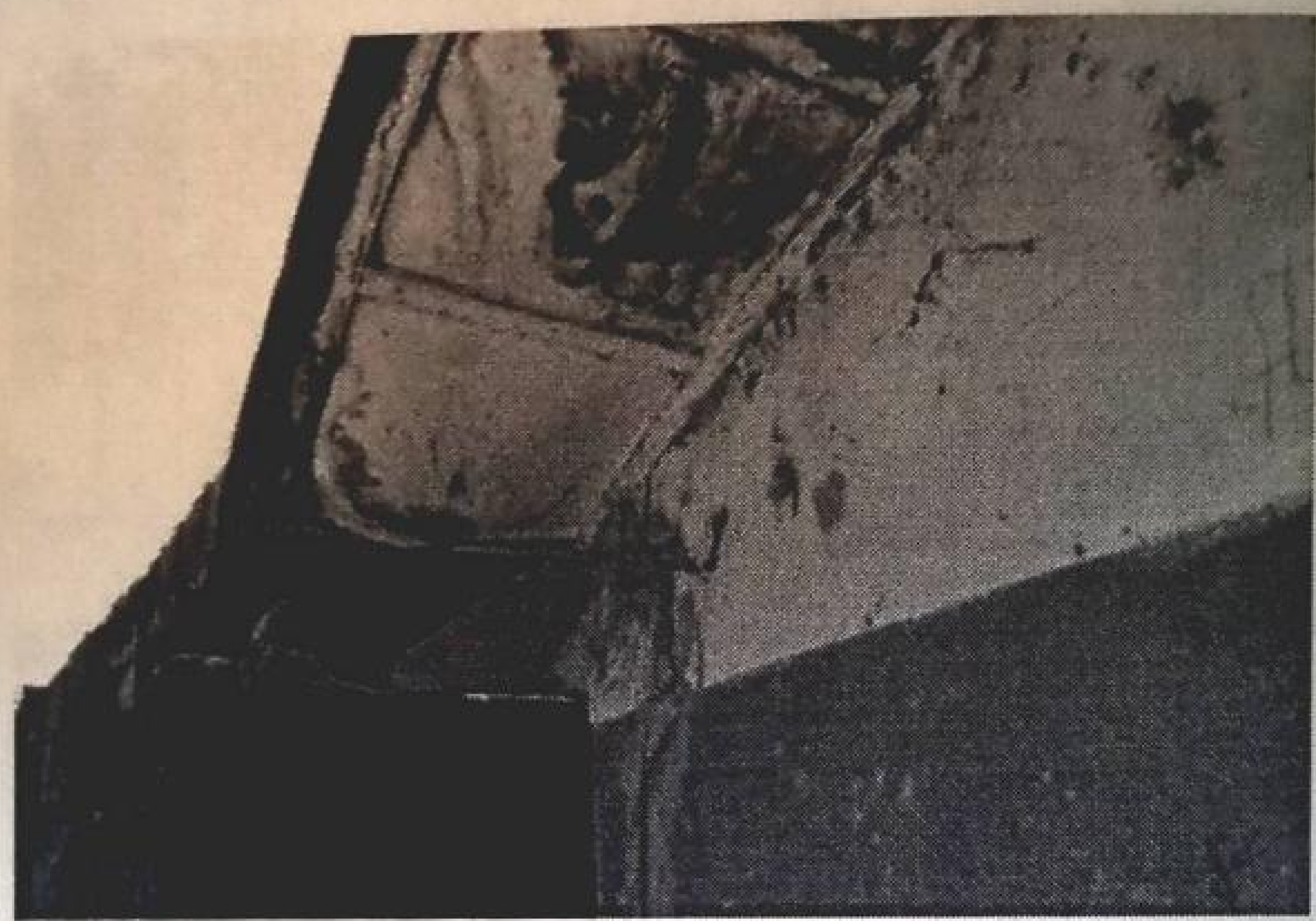

Figure 3. Damped facial board, ceiling and joist member.

Figure 4. Severely Damped foundation and block walls.