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Research Article

Assessing the Condition and Damage of a Stilt Wooden Home in an Area Prone to Floods

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ABSTRACT

This study was intended to assess condition and damages of a stilt wooden house located in in Keningau, Sabah, in order to develop a proper home repair and restoration plan that can be scaled up to other houses of similar design in areas that are susceptible to flood and other environmental factors which can affect the structural integrity. The findings revealed that the chosen stilt wooden house has decayed severely that many parts of the house mainly the roof, the floors, the railing and stairs were in decrepit condition which could pose danger to the occupants. The results also implied that there were various factors that led to the condition of the house namely termite infestation and moist and weakened wood which could be due to the damaged zinc roof that caused rainwater to leak into the house, direct contact with floodwater and possibly leaky plumbing. A repair and restoration work was done by focusing on the parts of the house that needed immediate fix in order to ensure comfort and safety of the household. This study may shed more light on how to repair and restore as well as redesign wooden homes in order to be more resilient towards damaged caused by environmental variables.

Keywords: *Stilt house, Flood prone areas, Termite infestation, Sustainable home*

Introduction

Stilt wooden houses are becoming increasingly rare in the present-day Malaysia where people either purchase brick terraced house or build their own standalone houses which were constructed from ground up without stilts. There are still stilt houses in Sabah, Malaysia, and most of these houses are inherited houses which were built at least in the 1990s since the design of houses in the country has transformed profoundly over the years and this can be attributed to many variables such as climate condition, natural disaster, protection from breaking and entering, socioeconomic factors and individual preference.

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This study focused on a stilt wooden home in which its interiors and exteriors have decayed and degraded severely that it probably posed dangers to the occupants. The structures of certain parts of the house such as the porch roofs, the staircase to its porch, the porch railings and the kitchen floors have deteriorated to the extent that they have become too weak, flimsy and broken with some pieces were already gone. Hence, this required immediate attention.

Problem Statement

Some houses including stilt wooden houses in the countryside are situated in the lowland which is typically in the same level as the paddy field that occupies many areas in the interior and rural areas. As flood becomes increasingly frequent, these houses are heavily affected by the rise of water level which gradually affects their structural integrity. In addition, household income also affects the capacity for the occupants to maintain the condition of the houses as evidenced by the correlation between degradation of a house with the collective earnings of the household.

Objectives

1. To assess the condition of the stilt wooden house situated in the paddy field of Keningau, Sabah, Malaysia using a set of assessment criteria rating rubric
2. To assess the damage of the stilt wooden house with a set of subjective evaluation form
3. To develop a repair and restoration plan and carry it out by focusing on the parts that required immediate fix.

Sustainable Construction and Transformation of Houses on Stilts

Nursaniah, Machdar, Azmeri, Munir, Irwansyah and Sawab (2019) studied the stilt houses in Teunom settlement located in the West Coast region of Aceh and discovered several intentional construction design. The soft soil condition in that area due to its swampy flood-prone location which remains wet even during dry season resulted in the construction of stilt house with lower floors than stilt houses on the east coast. The tsunami tragedy that struck the area in 2004 saw the consolidation of wooden pillars which used to be on flat round stone but now they have been supported by pedestal foundation to help buffer the effects of earthquakes. However, the house plan remained simple and symmetrical to maintain its stability against tremors and earthquakes. The traditional home design with thatch leaves as its roof was replaced with zinc roof for greater protection from heat and rain. The research summed the findings on the gradual transformation of the traditional stilt house to a hybrid design that merged traditional concept with modern conventions in order to help these houses adapt to the environmental variables mainly in reducing the impact of disasters while providing safety, security and comfort to the occupants. The findings indicated that redesigning stilt house plan to better adapt to the climate change and environmental variables including natural disasters and rain is necessary and this is done with the incorporation of modern design while maintaining the aesthetic appeal of a traditional stilt house. This study signified the importance of taking into account the environmental variables in constructing, designing and renovating as well as repairing and restoring houses of traditional designs especially if they are built on stilts and are made of wood. This is imperative to ensure that the house can sustain and resist the effects of extreme weathers and natural disasters.

Snor Saiful and Tengku Anis Qarihah (2022) studied types of on-stilt houses and determined the type that suited Malaysia's mangrove coastal area. The findings revealed that most stilt houses in Asia and Oceania have been gradually renovated to become concrete in order to protect it from water damage although timber and bamboo are more environmentally friendly. The studied reviewed a specific house design that was popular in Sabah, timber stilt house, and confirmed that the design of the house could withstand water pressure as well as direct and prolonged contact with floodwater and it could maintain stability if built on shaky grounds. This study implied that it is necessary to blend organic materials such as timber and bamboo with industrial and processed materials such as cement in order to buffer the impact of undesirable phenomena such as flash

floods and rising water level in coastal settlements.

Methodology

A field visit to the house was done on 13th June 2024 in order to gain insight on the condition of the house. The first instrument was an assessment criteria rating rubric which contains six components: foundation and structural integrity, materials and durability, flood mitigation features, ventilation and climate adaptability, aesthetic and functional design and sustainability and environmental impact. Three third year Construction Technology students of Keningau Vocational College conducted this assessment using this rubric. Each component is scored based on five levels: excellent, good, satisfactory, need improvement and poor. The second instrument was an assessment rubric which required subjective evaluation of the assessors based on 10 criteria: foundation and structure, structural integrity, exterior walls and cladding, roof and ceiling, floors, windows and doors, interior walls and finishes, electrical and plumbing systems, environmental factors and pest infestation. The assessment was carried out by the same three third year students of Keningau Vocational College who conducted the first assessment. These instruments were inspired from the home maintenance and repair assessment tool of Smith and Fraser (2012) who developed theirs as part of a research programme in maintaining a safe and comfortable houses for the ageing population.

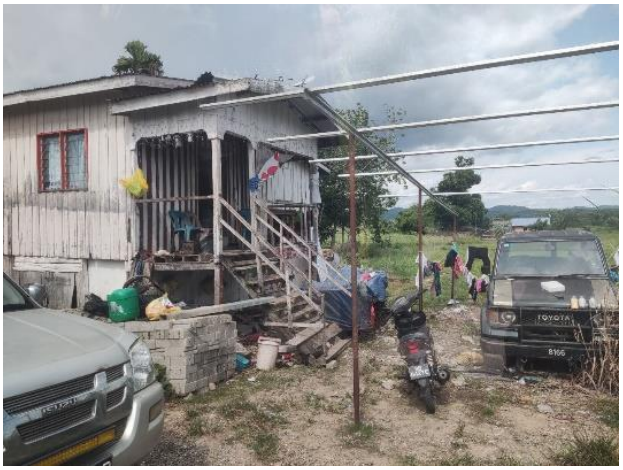


Figure 1. The Exterior Shot of the House

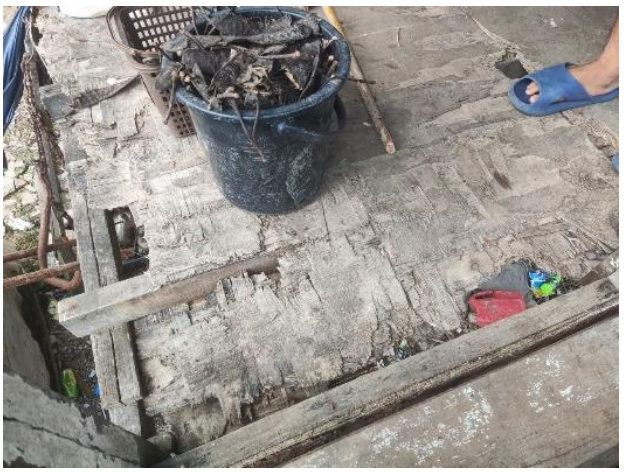


Figure 2. The Floor of the Porch

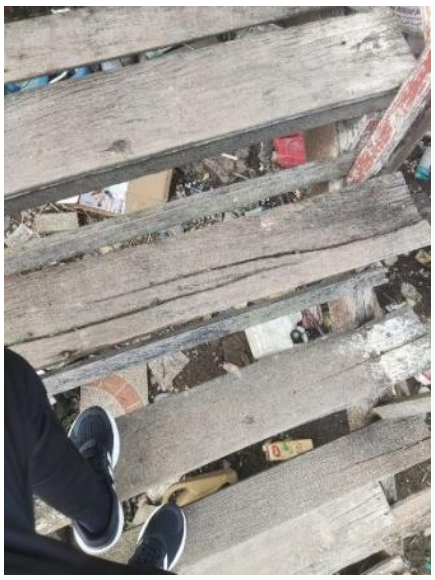


Figure 3. The Staircase

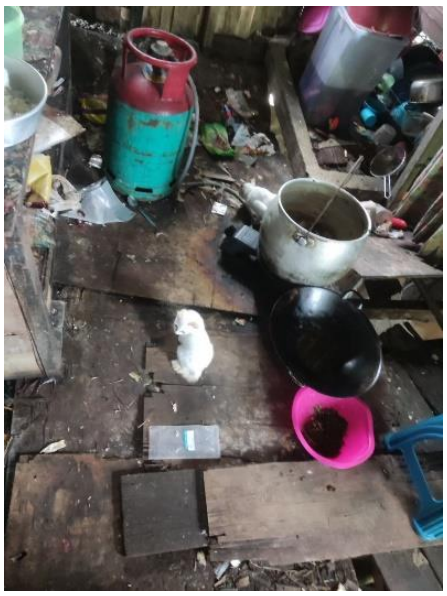


Figure 4. The Floor of the Kitchen

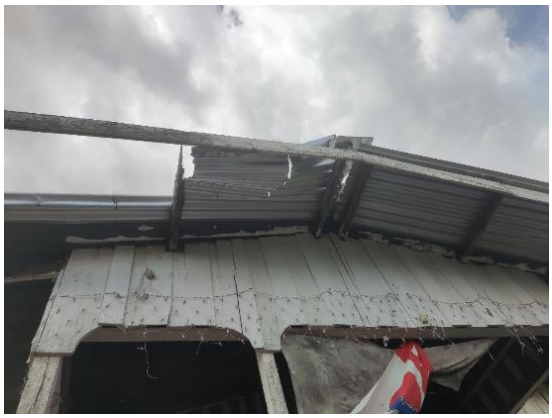


Figure 5. The Zinc Roof of the Front Part of the House

The repair and restoration work was done in a day by focusing on reinforcing the stairs with new wooden blocks covering the weakened treads and strengthening the support column, replacing the floors of the porch and the kitchen with new plywood and restoring the wooden railings at the porch. This was done by a group of 26 third year Construction Technology students with the supervision of two teachers specialized in the discipline.

Findings and Discussion

The findings from the assessment on the house condition which was conducted by the three third year Construction Technology students revealed that the house scored below average for each criterion and the overall results implied that the house barely met the criteria of well-built and well-maintained house.

Table 1. The Findings from the Assessment of the House Condition

Criteria	Assessor 1	Assessor 2	Assessor 3	Total (300)	Total percentage
Foundation & Structural Integrity (25)	11	6	13	30	40%
Materials and durability (20)	10	5	8	23	38%
Flood mitigation features (20)	6	5	3	14	23%
Ventilation and climate adaptability (15)	6	3	6	15	33%
Aesthetic and functional design (10)	3	2	6	11	36%
Sustainability and environmental impact (10)	5	3	4	12	40%
Total (100)	41	24	40	102	42%

It could be deduced that the house needed immediate repair and restoration work and it therefore necessitated for damage assessment to be carried out in order to help determine the possible course of action.

Table 2. Key Summary of the Damage Evaluation of the House

Assessor	Summary
1	• Balcony and stair structure slightly compromised • Walls and floors decaying due to flooding and termites • Leaking pipes causing moss growth • Accumulated water forming puddles on the ground
2	• Stilts and pillars rotting due to exposure to rainwater • Structure weakened by heavy weight • Moist wood causing a layer of termite infestation • Rusted zinc roof with holes allowing rainwater to enter, leading to a humid interior and accelerated decay • Newly erected concrete walls misaligned with wooden walls, leading to vine growth reaching the upper parts of the house • Weakened soil due to persistent puddles • House condition fostering an infestation lair for termites
3	• Termites causing decay in joints, beams, floors, and walls due to infestation • Rusty zinc roof with holes • Faded paint • Exposed wiring

The reviews from the assessor indicated that the rainwater and termites might be the main factors that affected the fixtures and the different parts of the house. Most parts of the houses mainly the walls and the floors and the joints and beams that connected these became weakened and moist due to water exposure that came from rainwater and this was directly attributed to the condition of the zinc roof that has deteriorated to the degree that it became rusty with numerous holes in it which allowed rainwater to leak into the interior of the house. The condition of the walls and floors as well as wooden furniture inside the house that became moist led to the infestation of termites which then accelerated the decaying of the house. The already weakened floor continued to become weaker as it could not properly bear the weight of the furniture inside the house such as the refrigerator and the stove. Another possible factor was the leaky pipes which allowed water to seep into the walls and floors which may have the same effects as the rainwater. This could be corroborated by Webb, D. (2024) who posited termites become drawn to conditions created by a combination of factors such as items containing cellulose such as old magazines, newspapers, cardboard boxes and paper products left in the open air inside the house, leaky plumbing, holes and cracks on roots, walls and foundation as well as direct contact with water.

On 8th August 2024, a group of 26 third year Construction Technology students with the assistance of two teachers from the same discipline as well as several teachers who volunteered to provide assistance and support, embarked on a fieldwork to this house and they completed the repair and restoration work which encompassed the replacement of the kitchen and porch floors together with the beams and joints, replacement of the railings as well as reinforcing the staircase.

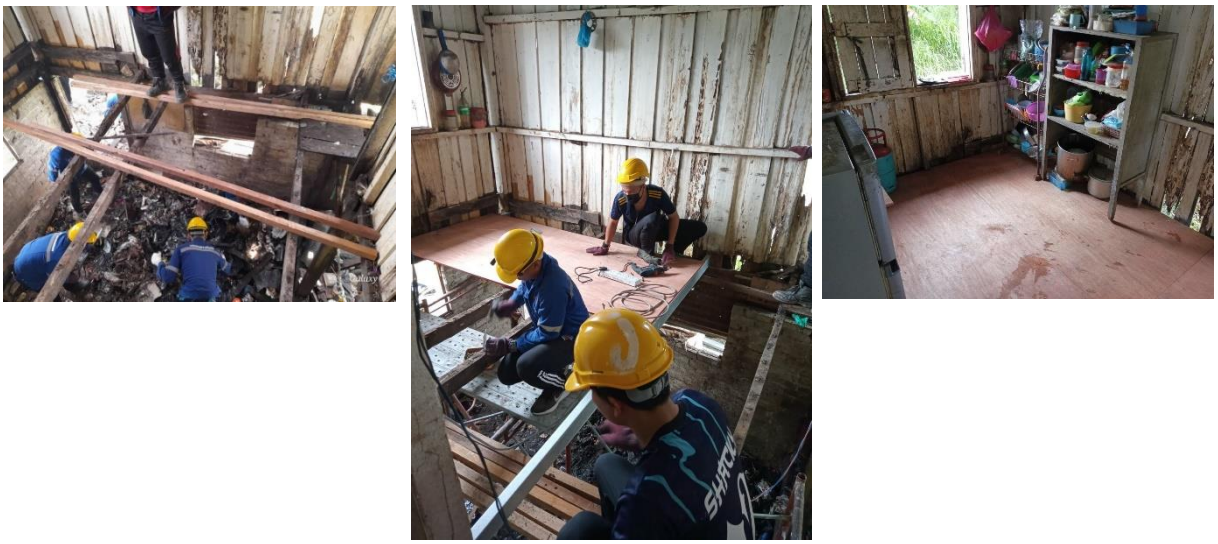
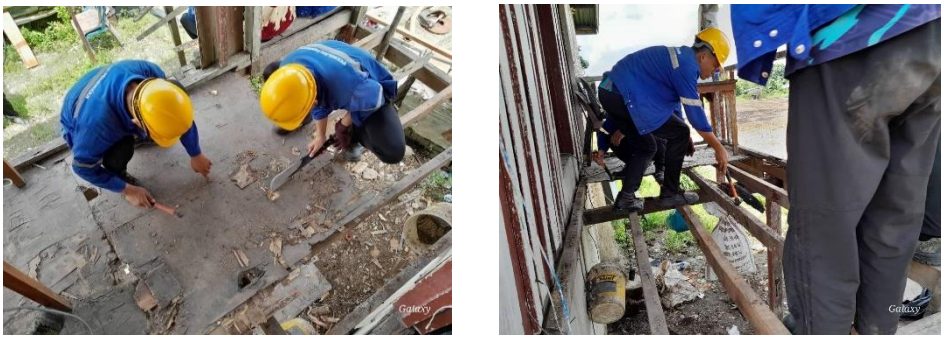


Figure 6. The Process of Substituting the Kitchen Floor



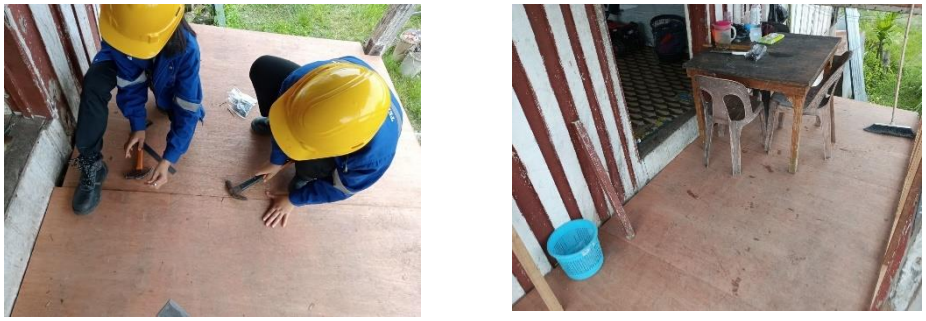


Figure 7. The Process of Substituting the Porch Floor

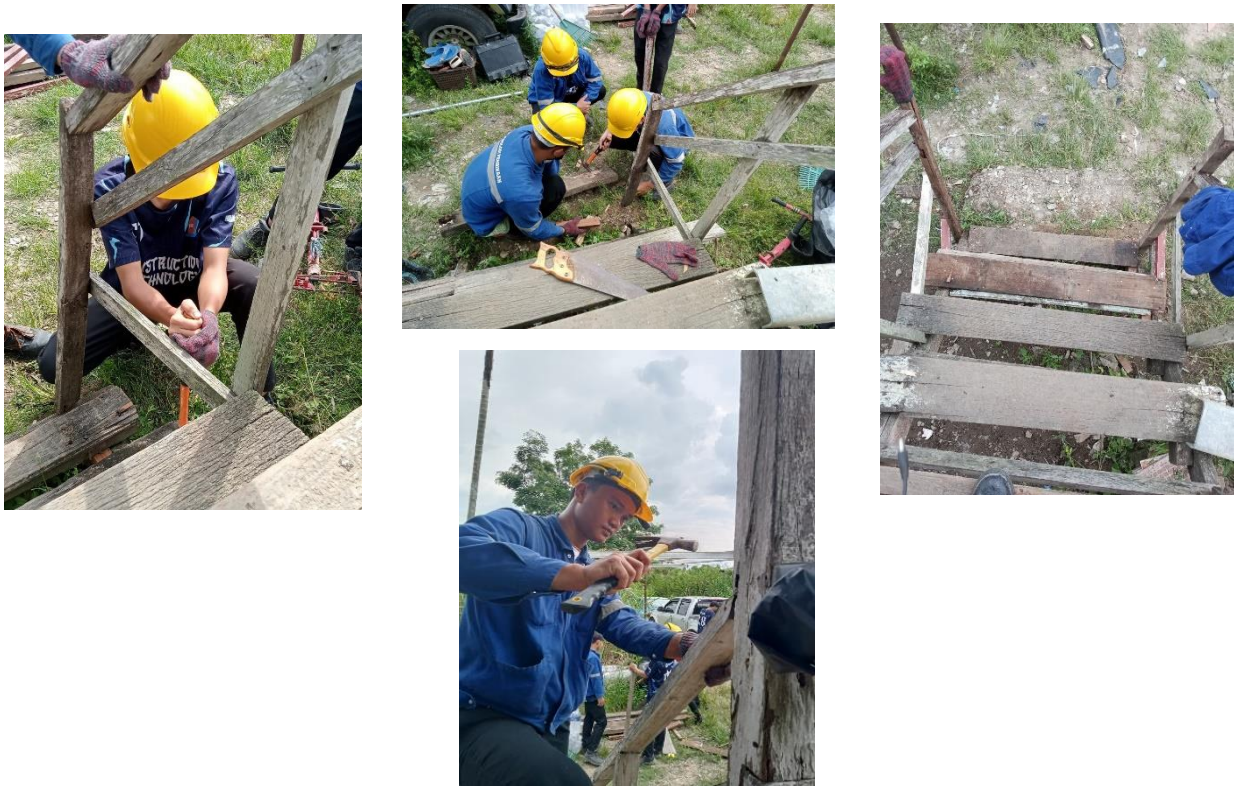


Figure 8. The Reinforcement of the Stairs

Figure 9. The Replacement of the Railings at the Porch

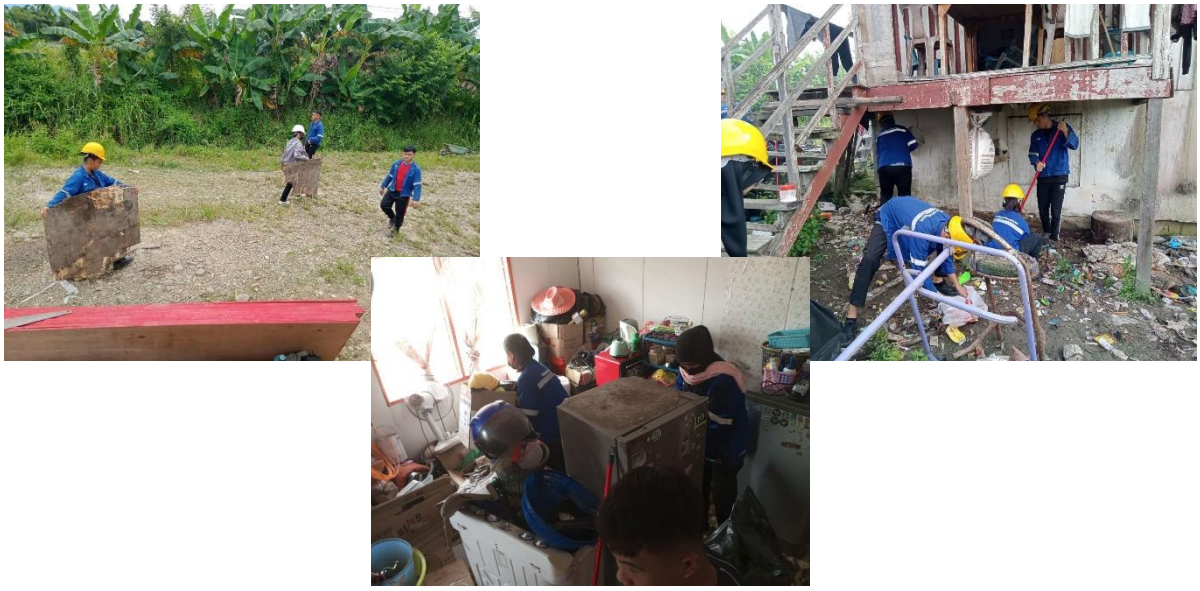


Figure 10. Furniture Rearrangement and Trash Removal to Ease the Restoration Work

Recommendations

A repair and restoration plan must be developed based on results of the assessment of the condition of the house and the damage it has sustained due to various factors namely rainwater, termites and flood as well as the location of the house along with the design and aesthetic aspect including its original construction as a stilt wooden house. Based on the assessment of the damages that the house has sustained, it became apparent that repair and maintenance plan and service should prioritize the most critical damage which often becomes the root cause of the other damages in a house if it remains neglected without due diligence in inspecting and repairing it.

Given the condition of the home, the repair and restoration work should focus on the parts that can pose immediate danger to the occupants such as the floors, the staircase and the railings as well as the likely root of cause for the rapid deterioration of the house which was the decrepit zinc roofing which exposed the furniture and the interior of the house to rainwater which rendered the wood moist which further weakened it and susceptible to termite infestation. Another feasible solution is to create a raft foundation which is frequently used in places without strong soil and this can help the house remain stable while mitigating the effects of floodwater or moist soil as a result of persistent puddles.

Due to various factors including the location of the home that was built on the ground below irrigation system as well as the weakened foundation of the house, it was advisable for the occupants to relocate to a new home at least for a temporary period of time if major renovation on the house or new a construction of a new house with a stronger foundation were to be considered.

Due to the fact that most houses are built in lowlands and weathers have become increasingly more erratic and slightly extreme, such repair and restoration plan can be scaled up and expanded to help assess and maintain the conditions of other houses in the countryside of the state.

Conclusion

This research can provide us better insight and understanding on the living conditions of the low-income population who live in traditionally built houses that they either construct themselves or inherit from the previous generation. Their needs are different than those who live in condominiums, apartments and terraced houses that average income earners tend to purchase. It is of paramount of interest for construction and home maintenance services as well as vocational institutions to have clearer understanding of the condition and experience of those who live in houses located in certain

areas in order to devise a more practical plan to assist them as well as to improve home construction and maintenance for certain segments of the society in certain locations.

This research also showed the long-term detrimental effects of a minor damage such as a leaked roof or moist wood on a house if it is not detected in advance and followed by an immediate repair. As trivial as it may seem it can gradually lead to more damages that can compromise the structural integrity of the entirety of a house where it requires more repair work that takes longer time and costs more money. It is also important to acknowledge that some damages continue to be increasingly dangerous to the occupants. Hence, it is pivotal for a house assessment and maintenance to be carried out regularly in order to detect early sign of deterioration and conduct the necessary repair to prevent it from affecting other parts of a house.

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