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Evaluation and Comparison of the Effects of Moisture Content on Building Materials in Water Edge Construction: A Case Study of Munroe

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ABSTRACT: This study investigates the impact of moisture content on building materials in water edge construction, focusing on Munroe. Two structures a fully painted concrete and an exposed brick were analyzed for temperature stability, relative humidity, thermal performance, and moisture content.

The fully painted concrete structure demonstrated better temperature stability and lower relativehumidity compared to the exposed brick structure. Thermal imaging showed similar thermal profiles for both structures, but the exposed brick had higher moisture levels.

The painted concrete performed better overall in terms of moisture resistance. Both structures, however, would benefit from improved waterproofing and insulation. Recommendations include using advanced moisture-resistant materials and regular maintenance to enhance durability in water edge environments. This research underscores the importance of construction quality andmaintenance in managing the adverse effects of moisture content.

KEYWORDS: Moisture, Water edge construction, Materials, Munroe.

I. INTRODUCTION

Water edge construction presents unique challenges, particularly regarding moisture's impact on building materials. This study investigates these effects in Munroe, Kerala, focusing on salinity and humidity issues. It aims to assess how moisture content affects materials, compare the performance of different materials, and analyze the influence of construction quality. By identifying materials with varying resistance and conducting comprehensive experimental studies based on diverse environmental parameters, the research will provide detailed guidelines for selecting and utilizing materials, ultimately enhancing the resilience and sustainability of water edge constructions in similar environments.

1.1 Aim and ObjectivesAim:

To evaluate and compare the effects of moisture content on building materials in water edgeconstruction in case of Munroe.

Objectives:

1. To conduct a comprehensive review of existing literature on moisture-related challenges in coastal construction, including factors affecting material durability.
2. To find out different and existing materials case studies in Munroe.
3. To analyze the materials based on different parameters corresponding to moisture content.

II. LITERATURE REVIEW

Moisture is a term used to define the presence of small amounts of water. In buildings, moisturecan be found in all three states of water: solid, liquid and gas.

Accordingly, the term moisture transfer refers to all movements of liquid and vapour across the building envelope and the whole building. Liquid transport refers to the movement of clusters ofwater molecules through diffusion, gravity, pressure-induced flow and capillary suction. Vapour transport indicates the movement of single water molecules, which can occur through diffusion or convection.

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The former is driven by differences in vapour concentration (from more to less) and temperature (from hot to cold) between two zones; it is generally a slow process and may lead to significant accumulation of moisture within the envelope, thus presenting a risk of subsequent deterioration of materials. The latter refers to the condition in which water molecules are carried by air and migrate across the building envelope through convective flow, driven by a difference of air pressure (from high to low). This transport can take place through both controlled air flows, suchas ventilation sources and mechanical ventilation systems, or uncontrolled ones, such as holes, cracks and air infiltration.

From Floor to Walls

Capillary Rise: Moisture can rise from the ground through the foundation and into walls viacapillary action. This is especially common in materials like concrete and masonry.

Groundwater Penetration: Poor drainage or high-water table can lead to groundwater seepinginto the foundation, and subsequently, into walls.

Damp-proof Course (DPC): A layer or membrane designed to block capillary rise, preventingground moisture from reaching walls.

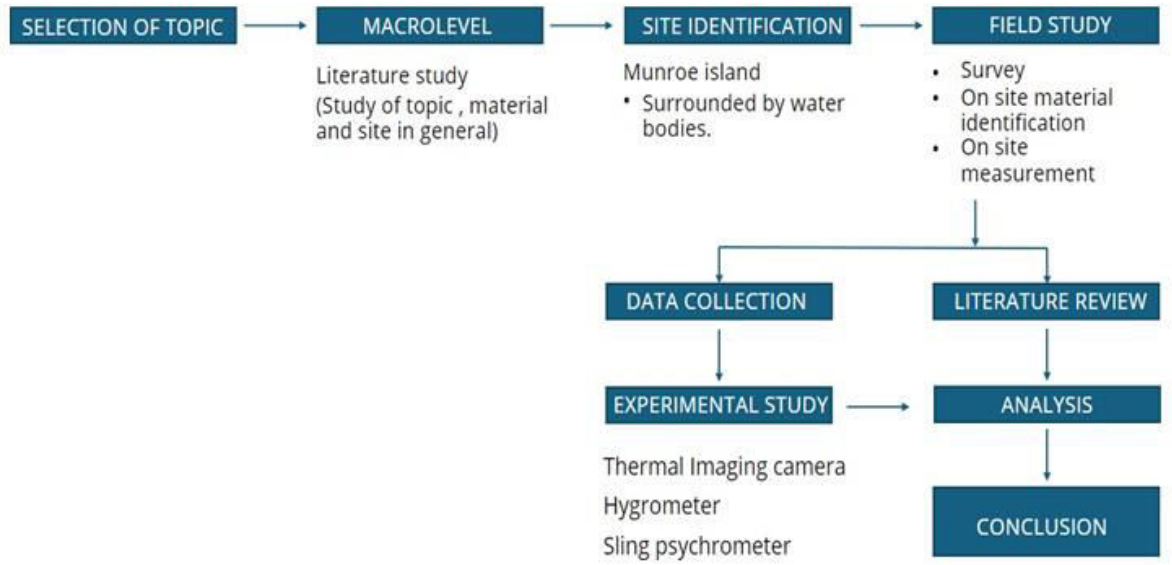
From Walls to Roof

Wicking: Similar to capillary rise, moisture can pick up through wall materials, potentiallyreaching the roof structure.

Air Movement: Moisture-laden air can move upwards through the building, depositing moistureon cooler surfaces, including the roof structure.

(Capillary rise kinetics of some building materials
M. Karoglou , A. Moropoulou, A. Giakoumaki, M.K. Krokida)

III. METHODOLOGY



IV. DATA ANALYSIS AND FINDINGS

Case 1: Fully painted concrete structure

A Small residence built of long time surroundedby small water bodies that affects the building conditions and its strength.
Built using concrete flooring, concrete walls withplastering, and sheets for roof.

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Figure 1: location showing Residence 1

Observations

- Permanent failures of paints and coatings.
- Corroding of walls and floor.

CASE 1	EXTERIOR			INTERIOR		
	MAX	MIN	VALUE	MAX	MIN	VALUE
TEMPERATURE	33.3*C	26.8*C	33*C	33*C	26.8*C	31.7*C
HUMIDITY	89%	68%	75%	89%	68%	80%

Table 1: Temperature and Humidity of Residence 1

Case 2: Exposed brick structure

A Small residence built of long time surroundedby small water bodies affects the building conditions and its strength.

Built using exposed brick painted outside,terracotta roof.

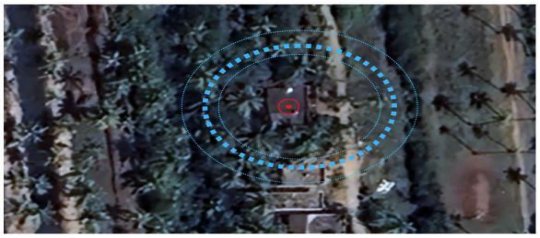

Figure 2: location showing Residence 2

Observations:

- Permanent failures of paints and coatings
- Corroding of walls and floor
- Moisture presence found in walls

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CASE 1	EXTERIOR			INTERIOR		
	MAX	MIN	VALUE	MAX	MIN	VALUE
TEMPERATURE	32.9*C	26.8*C	32.7*C	33*C	26.8*C	31.9*C
HUMIDITY	89%	68%	81%	89%	68%	80%

Table 2: Temperature and Humidity of Residence 2

Thermal Imaging

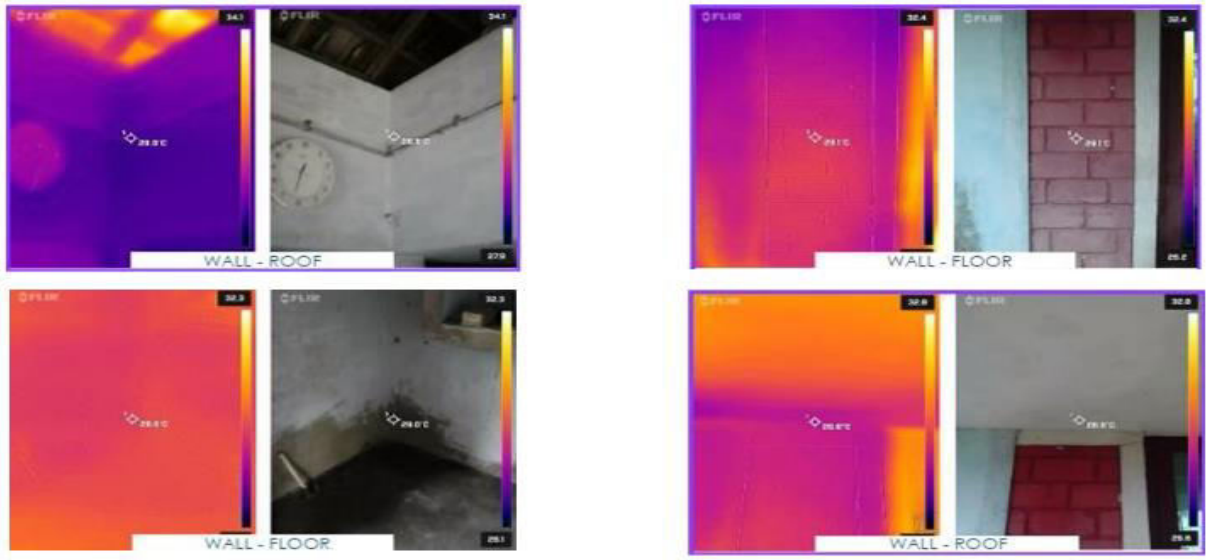

Figure 3: Thermal imaging of Residence 1 and 2

V. RESULTS AND DISCUSSION

Parameters based results

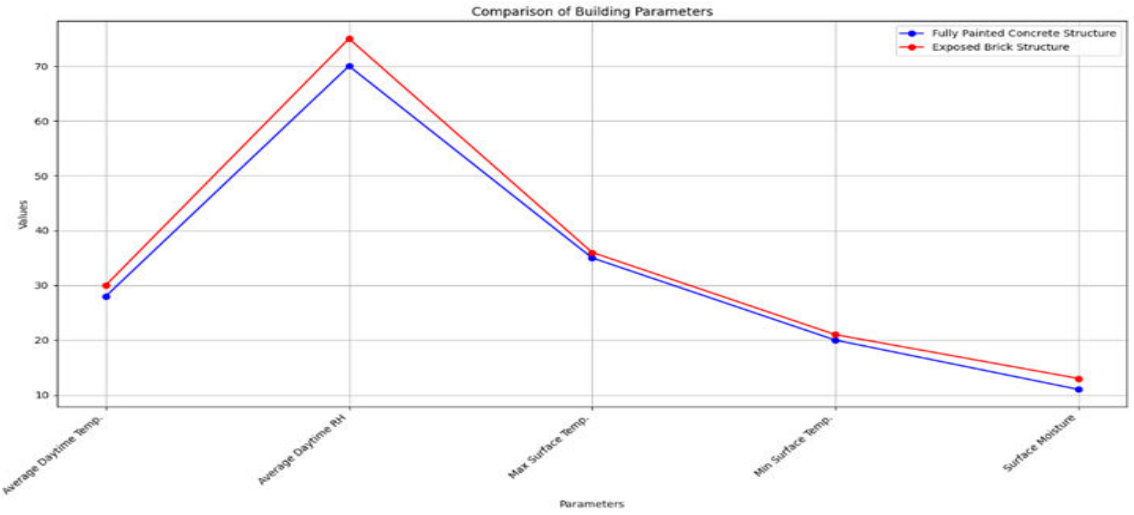

Figure 4: Line graph showing parameters-based analysis of 2 Residences

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When exposed to water-edge environments like Munroe Island, an exposed brick surface tends toretain more moisture compared to a fully painted concrete structure,

1. **Porosity:** Exposed brick is inherently more porous than concrete, which means water canseep into its surface more easily and increase moisture content.
2. **Absorption:** Brick absorbs water at a higher rate than concrete, making it more prone totaking in moisture from the environment.
3. **Capillary Action:** Brick is also more susceptible to capillary action, where water movesupward through the brick's pores, further raising moisture levels.
4. **Lack of Protection:** Without a protective layer like paint, exposed brick is especiallyvulnerable to water ingress and moisture retention.

In contrast, a fully painted concrete structure offers better protection against moisture. The painthelps by:

1. **Sealing Pores:** It fills in the pores of the concrete, which reduces its ability to absorbwater.
2. **Protecting from Water Ingress:** The paint acts as a hydrophobic layer that prevents water from penetrating the concrete.
3. **Reducing Capillary Action:** Paint also minimizes capillary action, which lessens theamount of water that can rise through the concrete.

it's important to remember that even painted concrete can absorb some water. Regular maintenance and inspections are essential to ensure the structure remains sound in water-edge areas.

Based on SurveySalinity Issues
Respondents identified salinity as a major factor affecting both the fully painted concrete and
exposed brick structures. Salinity was noted to accelerate material degradation and exacerbateexisting issues.

Construction Quality
The survey indicated that the construction quality of both structures was suboptimal. Issues included inadequate insulation, basic waterproofing methods, and overall lack of maintenance.

Based on Observations
Based on observations we can tell that such constructions with these materials are not so good enough and not effective as its structural integrity keeps on decreasing and facing more damage.

- There were no proper drainage systems.
- water getting logged on sun shades
- long exposure to water was a serious issue.
- no such implementations to keep the water off form the structure.
- construction techniques or methods are not appropriate in such water edge areas.

VI. CONCLUSIONS AND RECOMMENDATIONS

This study investigates the effects of moisture content on building materials in water edgeconstruction, focusing on materials identified in selected site.

1. **Thermal Performance:** The painted concrete structure had fewer thermal anomalies, indicating better thermal insulation. The exposed brick structure showed uneven heatingand cooling, suggesting potential moisture and heat loss areas.
2. **Moisture Resistance:** The painted concrete had lower moisture levels, while the exposed brick absorbed more moisture, leading to potential structural issues like efflorescence andmortar weakening.
3. **Construction Techniques:** Both structures used basic construction methods with minimal insulation and waterproofing. The painted concrete benefitted from its protectivepaint layer.

VII. RECOMMENDATIONS

1. **Fully Painted Concrete:** Maintain the painted surface and consider advanced waterproofand insulating paints.

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2. **Exposed Brick:** Apply sealants, inspect and repair mortar joints, and adopt modern insulation and waterproofing techniques.
3. This research highlights the importance of construction quality and maintenance in managing moisture effects in water edge environments

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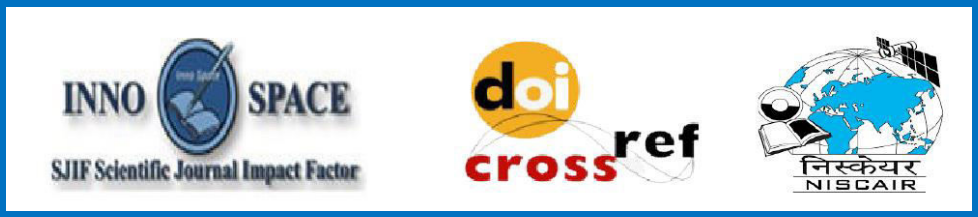

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