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Flow: Social Housing for the Fishing Community of Kerala, India.

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Abstract: Rehabilitation housing models usually account to maximise density by fitting large amounts of people into a small site, without catering to their quality of life and the general comfort of spaces. The "Pratheeksha" government housing in Trivandrum, Kerala is one such example where a large number of people from the local fishing community of the region were rehabilitated into an inadequate site area after losing their homes in the 2018 'Ockhi' cyclone. This new housing did not consider or prioritise the needs of its user and the climate of the region. Therefore this thesis project aims to better understand the socio-economic and cultural life of these fishing communities and redesign a better social housing model that is more apt to their livelihood and routine. The project focuses on recognising the role of sustainable architecture elements such as courtyards, roofs and permeable membranes in improving the living conditions in a warm and humid climate type.
Keywords: Kerala, Fisherman, Community, Responsive, Housing

1. Introduction

In urban areas, the majority of buildings consist of houses and is a major priority after a disaster, alongside critical facilities such as hospitals, offices and schools. Restoring basic urban infrastructure is essential (Lloyd-Jones, 2009). Rehabilitation in the built environment places a huge demand on the funds available for recovery, wherever hazards strike and become a disaster. 'Housing and infrastructure development often account for up to 50% of recovery disbursements' (ProVention/ALNAP, 2005).

Other than being expensive, in most cases it is executed gradually over a long period of time. This is because, reconstruction following a disaster strike is often inefficiently managed, uncoordinated, slowly initiated, and tends to overlook the affected community's long term needs. Post disaster rehabilitation housing models also usually tend to maximise its density by fitting large amounts of people into a small site, without catering to their quality of life and the general comfort of its spaces.

The "Pratheeksha" government housing in Trivandrum, Kerala is one such example where a large number of people from the local fishing community of the region were rehabilitated into an inadequate site area after losing their homes in the 2018 'Ockhi' cyclone. This new housing type did not consider or prioritise the needs of the user and the climate of the region. It was constructed as blocks of concrete houses that had neither character nor any sort of basic environmental qualities at both urban as well as unit level.

Therefore this thesis project aims to better understand the socio-economic and cultural life of these communities and redesign a housing model that is more apt to their livelihood and routine, which could also in turn positively influence their quality of spaces and social life. The project focuses on recognizing the role of sustainable architecture elements such as courtyards, roofs and permeable membranes in improving the thermal comfort. Each of these elements have been critically analysed to propose a set of architectural guidelines that needs to be considered while designing a house in a warm and humid climate type.

2. Research Questions

1. How dense can one built without compromising on the quality of indoor as well as outdoor spaces in a warm and humid climate type?
2. How to design openings for ventilation, daylight and privacy without the use of glass?
3. What is the potential of creating a permeable membrane using locally available materials so as to allow maximum ventilation while also providing privacy?
4. How can the roof design protect the building from sun and rain while enhancing ventilation?
5. What should be the key design configurations for the treatment of open spaces so that they become an integral part of the design?

3. Overview

3.1 Location

Thiruvanthapuram or Trivandrum, is located at the southernmost tip of Kerala, India at 8.48^{o}N latitude and 76.95^{o}E longitude. According to Koppen climatic classification it comes under the "Aw" type; which means that the region has warm temperatures, is fully humid and experiences rainfall mostly throughout the year with a pronounced dry season. It also means that its distinct seasons relate to the amount of rainfall it receives rather than its temperature.

3.2 Climate Analysis

Dry Bulb Temperature: Trivandrum is characterised by hot temperatures from Dec to April due to the fact that they experience dry months with very little precipitation. The temperature after these months almost remain a constant warm temperature, mostly within the comfort band due to the fact that they have higher precipitation.

Humidity: The monthly average relative humidity is high almost throughout the year due to the fact that it is a coastal region and due to heavy rainfall.

Rainfall: Trivandrum experiences high rainfall starting from June to Nov and very low levels from Dec to March.

Wind: The predominant wind direction of the region is from southwest.

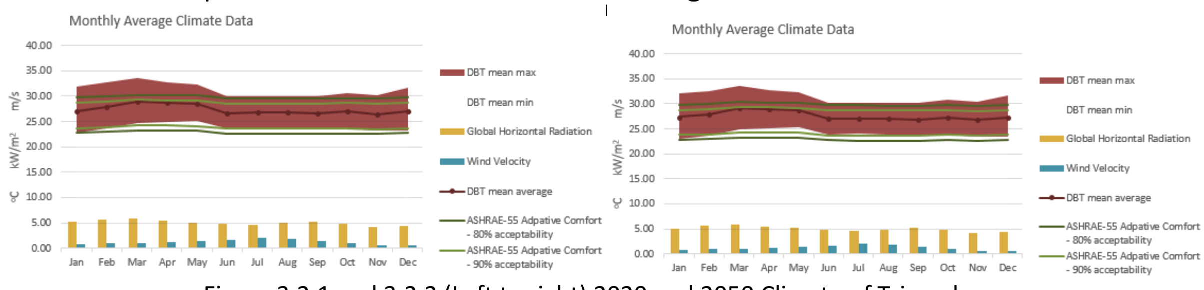

Figure 3.2.1 and 3.2.2 (Left to right) 2020 and 2050 Climate of Trivandrum

3.3 Climatic Strategies

Air movement: Studies show that higher air velocity adds to the feeling of comfort. Therefore cross ventilating a space is crucial in such climates to ensure good air circulation. Generally speaking, air velocities less than 1.5 m/s are acceptable in a residential context (CIBSE BEE-Tropical, 2017).

Shading: In locations within the tropical belt, shading is necessary in all orientations. Shading walls and roofs are as important as shading the windows. Extending roof eves that shade the walls and double roofs can be adopted for this purpose in such climates. For openings, horizontal shading devices will be more effective than vertical ones due to the high solar altitude and heavy rains. Diffuse radiation also adds significant thermal loads to internal spaces. Therefore screens, louvers, and jallis can be used for protection.

Thermal mass: In tropical zones where diurnal swing is minimal, thermal mass that does not absorb too much solar radiation during the day is desirable. Coupling the indoors with the outdoors when temperatures are not too high and are in comfort zone is recommended. Therefore a lot of shaded large openings and spill out spaces which help to blur the boundary between the indoors and outdoors are necessary. Whereas when the temperatures go beyond the comfort zone, decoupling the building from the external for a few hours during the peak cooling load period is recommended. Fig. 2.3.1 shows the external dry bulb temperature of Trivandrum on an extreme day and highlights the hours where decoupling strategy should be adopted.

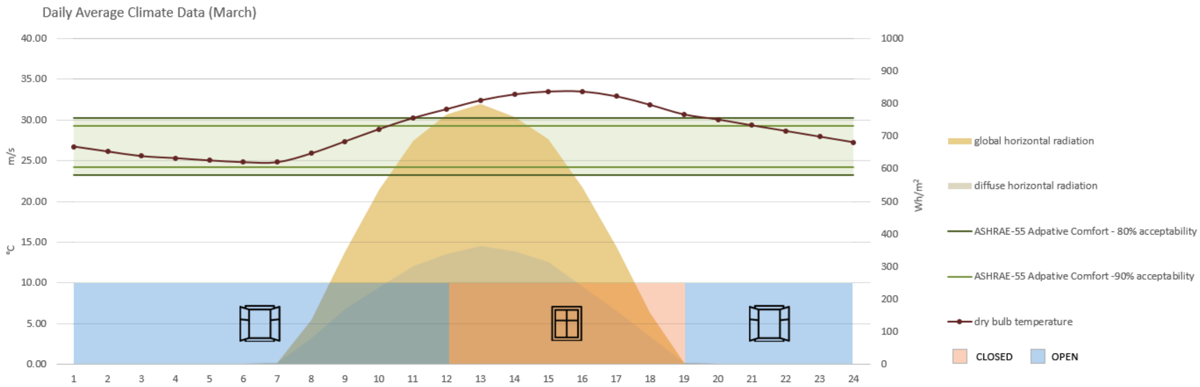

Figure 3.3.1. An extreme day graph highlighting hours were decoupling strategy has to be adopted

3.4 Rebuilt government housing and performance analysis:

The cyclone ‘Ockhi’ of 2018 had rendered a huge number of fishing families along the coast of southern Kerala homeless. The government of Kerala had rebuilt housing for the 192 affected families, called the “Pratheeksha” (Hope) housing project. These fishing families along the coast where moved 500 meters inland to a new site of 3.8 acres (Figure 3.4.1).

From the Optivent and thermal (TAS) analysis shown below (Fig. 3.4.2 and 3.4.3) it is clear that the building is very poorly performing. There is no sense of comfort in the indoor spaces.

Figure 3.4.1 Pratheeksha government housing bird’s eye view

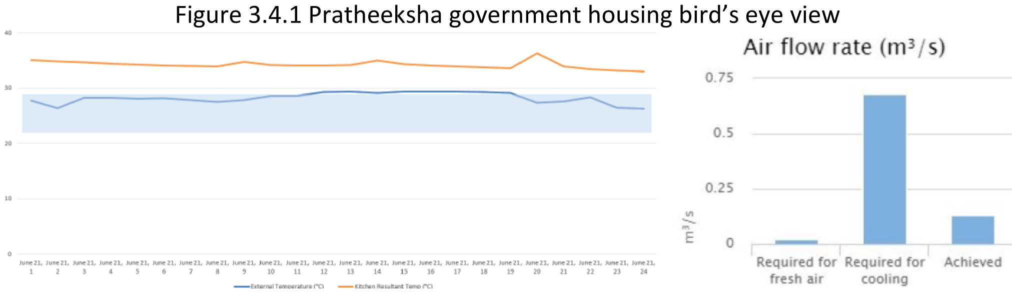

Figure 3.4.2 and 3.4.3 (Left to right) Thermal analysis (TAS) and airflow analysis (Optivent)

4. Proposed design

4.1 Unit plans

Both types were planned around a central courtyard that pulls the SW wind into it; and the rest of the spaces were zoned by placing the night spaces (bedrooms) with higher height on the SW shading the daytime spaces on the NE with shorter height.

Type 01 units: One unit caters to one family only. If and when the family wants to expand they are given the provision to expand vertically by adding up to a maximum of two extra bedrooms on the first floor.

Type 02 units: One unit caters to two families, one occupying the ground floor and the other occupying the first and second floors. If and when the family on the ground floor wants to expand they are given the provision to do so by converting the existing ground floor living room into a bedroom and using the available courtyards as a form of semi open outdoor living area. For the family occupying the first floor, they are given the provision to expand vertically by adding up to a maximum of two extra bedrooms on the second floor.

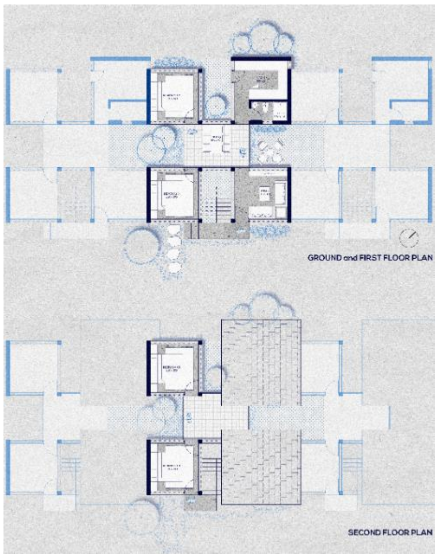

Figure 4.1.1 and 4.1.2 (Left to right) Type 01 plans and type 02 plans


Figure 4.1.3 and 4.1.4 (Left to right) Courtyard and Type 02 front facade

4.2 Site plans

Both proposals are planned with streets and courtyards that help to capture the SW winds.

Density level 01**:** Caters to a total of 128 families, which is 67% of the 192 families of the government project. In this proposal both type 01 and type 02 unit plans are alternated; thereby accommodating less density. Nevertheless in this proposal the outdoor spaces will be less congested.

Density level 02: Caters to a total of 160 families, which is 83% of the 192 families of the government project. In this proposal only type 02 unit plans are used, thereby accommodating a higher density. But here, there is a possibility of the spaces being more congested.

Figure 4.2.1 and 4.2.2 (Left to right) Density level 01 and density level 02

5. Analytical studies

5.1 Outdoor wind analysis (CFD)

Both proposals (Density level 01 and 02) are performing really well. Although when comparing courtyards of the two design proposals, there is a difference of 1 m/s in the minimum wind speed recorded from density level 01 to 02. This is due to the increase in unit height of the latter which restricts the free passage of wind through these courtyards.

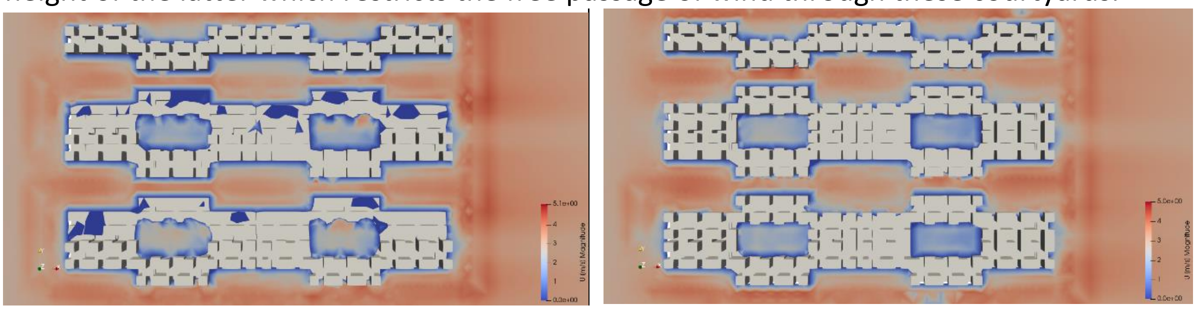

Figure 5.1.1 and 5.1.2 (Left to right) Density level 01 and density level 02

5.2 Indoor air flow/ ventilation analysis (Optivent)

Type 01 and 02 bedrooms were tested on an extreme day when decoupling strategy is used to see if desired air flow is still being achieved through the terracotta jallis and through the shut louvered panels with the louvers kept open at an angle. Air flow rate for both buoyancy driven scenario and buoyancy plus wind driven scenario is observed. The former assuming units more towards the center of the site has low wind speeds and the latter assuming units towards the periphery of the site receives higher wind speeds. From figures 5.2.3, 5.2.4, 5.2.8 and 5.2.9 it is clear that desired air flow is being achieved even on an extreme day in both peripheral as well as central units where wind speeds could be low.

Figure 5.2.1 to 5.2.4. (From left to right) Type 01 bedroom windows, air flow rate of central units and peripheral units

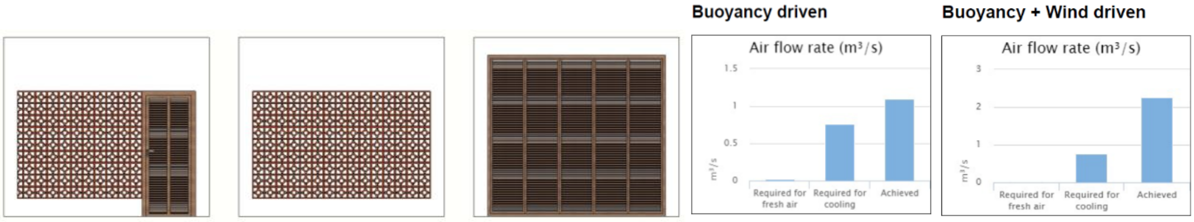

Figure 5.2.5 to 5.2.9. (From left to right) Type 02 bedroom windows, air flow rate of central units and peripheral units

5.3 Thermal analysis (TAS)

Type 01 and 02 unit's ground floor living rooms were tested on a typical (August 2nd) and an extreme day (March 21st).

Typical day: All windows are kept open to their maximum capacity throughout the day and night on a typical day. And as shown in figure 5.3.1 the resultant temperatures are within the ASHRAE 55 comfort band on a typical day for all 24 hrs. A 1.14ºC of drop is seen from the maximum external dry bulb temperature to the maximum resultant temperature.

Extreme day: All windows are kept open to their maximum capacity throughout most of the day and night except during 8 hours in the afternoon and in the evening (12 pm to 8 pm) when the external temperatures are peaking outside the comfort. And as shown in figure 5.3.2 the resultant temperatures are now within the ASHRAE 55 comfort band even on an extreme day as well for all 24 hrs. A 4.42ºC of drop is seen from the maximum external dry bulb temperature to the maximum resultant temperature.

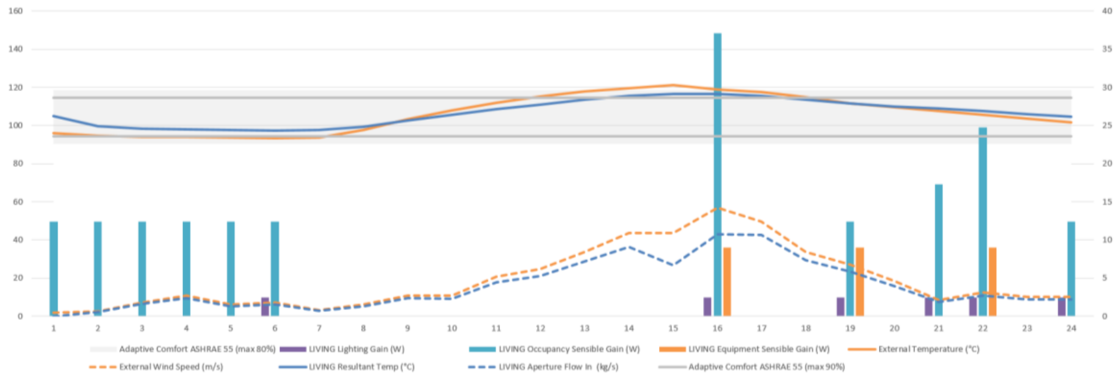

Figure 5.3.1 Type 01 Living room on a typical day

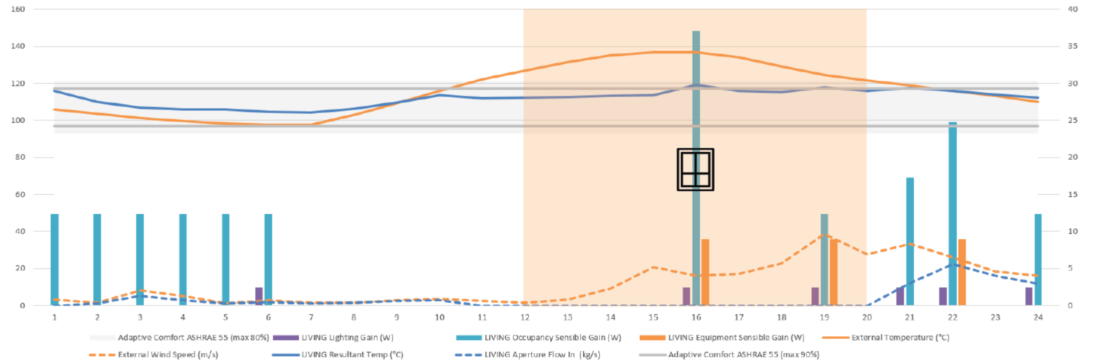

Figure 5.3.2 Type 01 Living room on an extreme day

6. References

Dick, J., Monteith, I., Rainbow, M., Rawal, R. and Fung, W., 2017. *CIBSE BEE: Tropical.* London: CIBSE.

Lloyd-Jones, T., 2009. *The built environment professions in disaster risk reduction and response.* [Online] Humanitarian Library. Available at: <https://www.humanitarianlibrary.org/resource/built-environment-professions-disaster-risk-reduction-and-response-0>