Satisfaction and perception of residents with bioclimatic design strategies - A discovery from racial and ethnic perspective

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“Satisfaction and perception of residents with bioclimatic design strategies – A discovery from racial and ethnic perspectives”

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Introduction

Aim & Objectives
To assess the effects of recent adoption of bioclimatic design strategies in influencing the residents' comfort level via satisfaction and perception survey.

Purpose
Justifying the appropriateness of an old building to meet the needs of contemporary life.

Bioclimatic Design
Integrate the disciplines of human physiology, climatology & building physics (Olgyay, 1963)
Help to eliminate negative environmental impact completely via skillful & sensitive designs that encourage better use of building resources & significant operational savings (Yeang, 2008).

Dayasari RC
Est. 1966
Form of building: Low-rise
Layout: Courtyard arrangement
Orientation: North-South
Shape: Rectangle
Area: 43,185.06 m²
Built up area: 16,971.02 m²
Floor area: 18,212.51 m²
Capacity: 847
Density: 0.047
Room’s floor area: 16.35 m²
Room's volume: 45.78 m³
Window area: 6.41 m²
WWR: 0.66
The best practice of bioclimatic design strategies esp. natural ventilation & daylighting
Introduction
IMPLEMENTATION OF BIOCLIMATIC DESIGN STRATEGIES

Introduction
TYPICAL ELEVATION OF RESIDENTIAL BUILDING

Introduction
TYPICAL FLOOR PLAN & SECTION

Introduction
INTRODUCTION

LAYOUT & SECTION OF TYPICAL ROOM
Sample size

\[ n = \frac{N}{1 + N(e)^2} \]

where, \( n \) is sample size, \( N \) is the population size and \( e \) is the level of precision. In this study, the level of precision is 0.05 (95% of the confident level and ±5% margin of error from the overall population) (Yamane, 1967).

The questionnaires based on four performance indicator – architectural elements, visual comfort, thermal comfort & IAQ, and acoustic comfort (Jamaludin et al., 2014).

Use a Likert Scale format where each number generally responds to a specific scale.

-2: very poor/not at all/very uncomfortable/much decreased/too dark/very dissatisfied/very noisy; -1: poor/slightly/uncomfortable/decreased/dark/dissatisfied/noisy; 0: fair/moderate/neither/no changes; +1: good/very/comfortable/increased/bright/satisfied/quiet; +2: very good/extremely/very comfortable/much increased/too bright/very satisfied/very quiet.

ASHRAE 7 point of the thermal sensation scale has been adopted in the further questionnaires of thermal comfort (Singh, Mahapatra and Atreya, 2011).

Further survey - focusing on the usage pattern of the windows and ceiling fan.

Questionnaire

Research Methodology
## The result of satisfaction and perception survey

<table>
<thead>
<tr>
<th>The performance indicators</th>
<th>Likert scale / Residents’ responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-2</td>
</tr>
<tr>
<td>Architectural elements</td>
<td></td>
</tr>
<tr>
<td>The general room layout</td>
<td>1.5</td>
</tr>
<tr>
<td>The residential building layout</td>
<td>0.4</td>
</tr>
<tr>
<td>The adequacy of room in fulfill the needs</td>
<td>1.1</td>
</tr>
<tr>
<td>The overall quality of the residential building</td>
<td>1.1</td>
</tr>
<tr>
<td>The overall comfort level of the room</td>
<td>0.8</td>
</tr>
<tr>
<td>Visual comfort</td>
<td></td>
</tr>
<tr>
<td>The adequacy of daylighting in the room</td>
<td>4.2</td>
</tr>
<tr>
<td>The overall quality of daylighting in the room</td>
<td>1.5</td>
</tr>
<tr>
<td>Thermal comfort &amp; IAQ</td>
<td></td>
</tr>
<tr>
<td>The thermal comfort of the room</td>
<td>3.4</td>
</tr>
<tr>
<td>The ventilation &amp; IAQ of the room</td>
<td>1.9</td>
</tr>
<tr>
<td>Acoustic comfort</td>
<td></td>
</tr>
<tr>
<td>The noise/vibration level in the room</td>
<td>2.7</td>
</tr>
</tbody>
</table>

### The usage pattern of windows and ceiling fan

<table>
<thead>
<tr>
<th>Residents’ responses (%)</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Frequently</th>
<th>Every time</th>
</tr>
</thead>
<tbody>
<tr>
<td>The frequency of ceiling fan usage in a day</td>
<td>0.4</td>
<td>3.1</td>
<td>10.9</td>
<td>26.0</td>
<td>59.7</td>
</tr>
<tr>
<td>The fan speed is often used</td>
<td>0.4</td>
<td>2.7</td>
<td>17.1</td>
<td>29.6</td>
<td>50.2</td>
</tr>
<tr>
<td>The frequency of the windows is kept open in a day</td>
<td>18.3</td>
<td>14.8</td>
<td>21.0</td>
<td>30.4</td>
<td>15.6</td>
</tr>
<tr>
<td>The reason for not opening the windows</td>
<td>3.4</td>
<td>16.1</td>
<td>6.3</td>
<td>9.8</td>
<td>20.5</td>
</tr>
</tbody>
</table>

### Thermal sensation votes

<table>
<thead>
<tr>
<th>ASHRAE 7 point sensation scale / Residents’ responses (%)</th>
<th>-3 Cold</th>
<th>-2 Cool</th>
<th>-1 Slightly cool</th>
<th>0 Neutral</th>
<th>+1 Slightly warm</th>
<th>+2 Warm</th>
<th>+3 Hot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residents’ responses (%)</td>
<td>0.4</td>
<td>7.0</td>
<td>8.7</td>
<td>39.3</td>
<td>25.2</td>
<td>16.5</td>
<td>2.9</td>
</tr>
</tbody>
</table>
The result of satisfaction and perception survey on architectural elements according to the race and ethnicity

**The general room layout**

- Malay
- Chinese
- Indian
- Others

**The residential building layout**

- Malay
- Chinese
- Indian
- Others

**The adequacy of room in fulfill the needs**

- Malay
- Chinese
- Indian
- Others

**The overall quality of the residential building**

- Malay
- Chinese
- Indian
- Others
Result & Discussion

The overall comfort level of the room

-2 Very uncomfortable
-1 Uncomfortable
0 Neither
+1 Comfortable
+2 Very comfortable

Responses (%)

Racial & ethnic

Malay
Chinese
Indian
Others
The result of satisfaction and perception survey on visual comfort, thermal comfort & IAQ and acoustic comfort according to the race and ethnicity.
Racial & ethnic

The noise/vibration level in the room

-2 Very noisy  -1 Noisy  0 Neither  +1 Quiet  +2 Very quiet

Responses (%)

Malay

Chinese

Indian

Others
The usage pattern of windows, ceiling fan and the thermal comfort based on ASHRAE 7 sensation scale according to the racial and ethnic groups

**The frequency of ceiling fan usage in a day**

- Malay: 100%
- Chinese: 100%
- Indian: 100%
- Others: 100%

**The frequency of the windows is kept open in a day**

- Malay: 0%
- Chinese: 0%
- Indian: 0%
- Others: 0%

**The fan speed is often used**

- Malay: 100%
- Chinese: 100%
- Indian: 100%
- Others: 100%

**The reason for not opening the windows**

- Insect
- Safety
- Rain
- Dust
- Privacy
- Monkey
- Others

*The result & discussion*

The usage pattern of windows, ceiling fan and the thermal comfort based on ASHRAE 7 sensation scale according to the racial and ethnic groups.
Numerous differences were discovered by comparing the responses among the race and ethnic groups, obviously on thermal comfort and indoor air quality, visual comfort, the usage pattern of windows and ceiling fan, and thermal sensation.

The dissimilarities of beliefs, traditions, and ways of life influence the behaviour and thermoregulatory responses (Katsuura, et al., 1993; Chung and Tong, 1990; Yang and Wang, 2013).
The majority of the respondents are at a **comfort level** in all performance indicators of architectural elements, visual comfort, thermal comfort and indoor air quality. Therefore, the bioclimatic design strategies including daylighting and natural ventilation at an old residential building are **still appropriate** to meet the needs of contemporary life. However, there is still room for **improvement**, especially on the **acoustic comfort**.

The **racial and ethnic** composition considerably influence the satisfaction and the perception level of respondents. Therefore, these aspects should be **highly considered** in implementing the improvement measures to ensure the comfort level of the room.

For further research, it is necessary to have **greater number of respondents** exceeding the minimum number of feedbacks with a 95% of confident level and ±5% margin of error to represent the overall population. The combination of **subjective and objective evaluation** would give a more **comprehensive** result for the investigated issues.


Thank you

"We shape our buildings; thereafter they shape us."
- Winston Churchill -