BETTER PLACES FOR PEOPLE

Kuala Lumpur Pilot Study

July 2018

In Collaboration With
This project identifies design features that are known to have positive impacts on the health, wellbeing and productivity of office building occupants and relating those back to the physical features of buildings and employee perceptions.

This study looks at the performance of two office buildings one green and the other non green but both fitted out to a green interior specification. The findings indicate that the existing buildings shell and environmental performance, namely the cooling thermal performance and daylighting were the two main factors that effected the comfort levels for the employees day to day work in the workspace.
This report has been made possible by efforts of partner Green Building Councils, and in particular to the time dedicated by the malaysiaGBC project team. All of those involved are fully credited in the acknowledgements at the end of the report.

This study was sponsored by a grant funding by World Green Building Council (WGBC) and personal funding by malaysiaGBC.
This project is an attempt to build momentum on the topic of health, wellbeing and productivity in Kuala Lumpur.

The study intends to determine the Indoor Environmental Quality (IEQ) performance of Malaysia’s green-rated commercial office buildings, in comparison to the conventionally constructed non-green rated commercial office buildings.

The study analyses the features of building design and the health, wellbeing and productivity of occupants through the occupant satisfaction survey.
This study uses a post occupancy evaluation of two office buildings in Kuala Lumpur; one with GBI Building & Interiors Certification, and one without any green certification.

The post occupancy evaluation emphasises on perspective measurements of health, wellbeing and productivity of occupants in the workplace. These terms are used to encompass a whole range of broader feelings or perceptions of satisfaction and happiness.

**Pilot Case Study**: Lendlease Office in Kuala Lumpur; Menara Binjai and Menara JCorp.
Methodology

Summary of metrics framework and key relationships

Ref: Health, Wellbeing & Productivity in Offices; The next chapter for green building report, World Green Building Council, Sep 2014
To test the workspace that the physical design and operation affects the health, wellbeing and productivity of occupants.

This is studied using very direct measures as below;

- Monitoring of thermal and visual comfort by installing 3 Delta Ohm data loggers and 6 HOBO sensors for 2 weeks on different thermal zones of the office floor spaces
- Measuring PMV, & PPD, air temperature, mean radiant temperature, humidity, air velocity and illuminance.
The perception study tests a range of self-reported attitudes aiming to gain insight into health, wellbeing and productivity of occupants.

The completed occupancy comfort survey by occupants allows the study team to investigate the occupants’ level of satisfaction in relation to thermal and visual comfort, and the corresponding impact on their workspace conditions.

Images: Occupants comfort survey provided to the occupants
Lendlease is a leading international property and infrastructure group with operations in Australia, Asia, Europe and the Americas. Headquartered in Sydney, Australia, Lendlease has approximately 12,740 employees internationally.

This case study focuses on two of Lendlease’s office in Kuala Lumpur, occupied by the same group of people over a period of time. The initial study was conducted on an office floor in Menara Binjai (a green rated building) occupied by Lendlease employees.

The same Lendlease employees, then relocated to another office floor in Menara Jcorp (non-green rated building).

The relocation of Lendlease employee provided our Project Team an opportunity to study the impacts of a green building design vs. a non-green building design on the same group of occupants.
Case study location

Lendlease Office

MENARA BINJAI
GBI Silver-certified Green Mark Gold-certified
Completed in 2012
LEVEL 20
Capacity: 112 pax
Area: 1200 sq.m.

MENARA JCORP
Non-green-certified building
Completed in 1995
LEVEL 8
Capacity: 160 pax
Area: 1020 sq.m.

Images: Menara Binjai, Jalan Binjai Kuala Lumpur
Images: Menara JCorp, Jalan Tun Razak, Kuala Lumpur
Lendlease Office, Level 20, Menara Binjai

Images (clockwise from bottom left: Lendlease employees at Level 20, Menara Binjai, Jalan Binjai Kuala Lumpur

BETTER PLACES FOR PEOPLE
Lendlease Office, Level 8, Menara JCorp

Images (clockwise from bottom left: Lendlease employees at Level 8, Menara JCorp, Jalan Tun Razak Kuala Lumpur
Plan: Lendlease Project Office Level 8, Menara JCorp, Jalan Tun Razak Kuala Lumpur
<table>
<thead>
<tr>
<th><strong>Level 20 of Menara Binjai</strong></th>
<th><strong>Level 8 of Menara JCorp</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Office</strong></td>
<td><strong>Office</strong></td>
</tr>
<tr>
<td>90% Open Plan</td>
<td>100% Open Plan</td>
</tr>
<tr>
<td>10% Cellular Office to external</td>
<td>0% Cellular Office to external</td>
</tr>
<tr>
<td>Side Core</td>
<td>Central Core</td>
</tr>
<tr>
<td><strong>Floor Area</strong></td>
<td><strong>Floor Area</strong></td>
</tr>
<tr>
<td>1050 meter square</td>
<td>1296 meter square</td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td><strong>Capacity</strong></td>
</tr>
<tr>
<td>112 Staff</td>
<td>160 Staff</td>
</tr>
<tr>
<td><strong>Density</strong></td>
<td><strong>Density</strong></td>
</tr>
<tr>
<td>10.7 mpp</td>
<td>6.375 mpp</td>
</tr>
<tr>
<td><strong>Floor to Ceiling</strong></td>
<td><strong>Floor to Ceiling</strong></td>
</tr>
<tr>
<td>2.7 meters</td>
<td></td>
</tr>
<tr>
<td><strong>Depth of Office</strong></td>
<td><strong>Depth of Office</strong></td>
</tr>
<tr>
<td>13-14 meters</td>
<td></td>
</tr>
<tr>
<td><strong>Glazing Performance</strong></td>
<td><strong>Glazing Performance</strong></td>
</tr>
<tr>
<td>Floor to Ceiling Double Glazed</td>
<td>Floor to Ceiling Dark glazing</td>
</tr>
<tr>
<td><strong>Office Fit Out</strong></td>
<td><strong>Office Fit Out</strong></td>
</tr>
<tr>
<td>White Walls, Ceiling- Floor Light Grey, Perimeter Blinds</td>
<td>White Walls, Ceiling- Floor Light Grey, Perimeter Blinds</td>
</tr>
<tr>
<td><strong>Building Certification</strong></td>
<td><strong>Building Certification</strong></td>
</tr>
<tr>
<td>GBI Certification</td>
<td>MS 1525</td>
</tr>
</tbody>
</table>
Study work flow

- PHYSICAL MEASUREMENTS 9/10/2017 - 25/10/2017
- 1st ROUND OF QUESTIONNAIRE SURVEY
- DATA ANALYSIS

1st ROUND OF QUESTIONNAIRE SURVEY

- Occupants on Level 20 Menara Binjai relocated to Level 8 Menara JCorp on 27/10/2017
- REPORT WRITING & PRESENTATION TO LENDLEASE
- DATA ANALYSIS

- PHYSICAL MEASUREMENTS 17/1/2018 – 5/2/2018
- 2nd ROUND OF QUESTIONNAIRE SURVEY
- DATA ANALYSIS

LEVEL 20 of MENARA BINJAI

LEVEL 8 of MENARA JCORP

BETTER PLACES FOR PEOPLE
INDOOR ENVIRONMENT HEALTH & WELLBEING

EIGHT FEATURES THAT MAKE HEALTHIER AND GREENER OFFICES

1. INDOOR AIR QUALITY & VENTILATION
   Healthy offices have low concentrations of CO2, VOCs (volatile organic compounds) and other pollutants, as well as high ventilation rates.
   WHY?: 101% increase in cognitive scores for workers in a green, well-ventilated office.

2. THERMAL COMFORT
   Healthy offices have a comfortable temperature range which staff can control.
   WHY?: Fall in staff performance when offices are too hot and 4% if too cold.

3. DAYLIGHTING & LIGHTING
   Healthy offices have generous access to daylight and self-controlled electrical lighting.
   WHY?: 46 minutes more sleep for workers in offices near windows.

4. NOISE & ACOUSTICS
   Healthy offices use materials that reduce noise and provide quiet spaces to work.
   WHY?: 66% fall in staff performance as a result of distracting noise.

5. INTERIOR LAYOUT & ACTIVE DESIGN
   Healthy offices have a diverse array of workspaces, with ample meeting rooms, quiet zones, and stand-up desks, promoting active movement within offices.
   WHY?: Flexible working helps staff feel more in control of their workload and engenders loyalty.

6. BIOPHILIA & VIEWS
   Healthy offices have a wide variety of plant species inside and out, as well as views of nature from workspaces.
   WHY?: 7-12% improvement in processing time at one call centre when staff have a view of nature.

7. LOOK & FEEL
   Healthy offices have colours, textures, and materials that are welcoming, calming and evoke nature.
   WHY?: Visual appeal is a major factor in workplace satisfaction.

8. LOCATION & ACCESS TO AMENITIES
   Healthy offices have easy access to public transport, safe bike routes, parking and showers, and a range of healthy food choices.

EMPLOYEE ENGAGEMENT
Healthy offices have employees that are regularly consulted and their feedback is used to drive continuous improvement.

BETTER PLACES FOR PEOPLE
FIT WORKING AT THE HEART OF YOUR BUILDING

WORLD GREEN BUILDING COUNCIL

EUROS 27m

Why?: Savings through cutting absenteeism as a result of Dutch cycle-to-work scheme.
Part 1: Presenting the Evidence

Respondent Statistics

Level 20, Menara Binjai

- Total no. of staff: 110
- Total no. of respondents: 76
- Response rate: 69%

Level 8, Menara JCorp

- Total no. of staff: 160
- Total no. of respondents: 85
- Response rate: 53%
How long have you been working in this office?

Menara Binjai (N=76)

- Zone B (North): 83% on 5-10 years experience
- Zone A (West): 98% on > 10 years experience
- Zone C (East): 0% on < 1 year experience
- Total: 83% on 5-10 years experience

Menara Jcorp (N=85)

- Zone A (North): 98% on > 10 years experience
- Zone B (South): 83% on 5-10 years experience
- Zone C (East): 0% on < 1 year experience
- Total: 98% on > 10 years experience
Which is your age range?

Menara Binjai (N=76)

Menara Jcorp (N=85)
What is your gender?

Menara Binjai (N=76)

Respondents by Gender

Menara Jcorp (N=85)

Respondents by Gender
Do you always work in the same workspace or at the same desk?

Menara Binjai (N=76)

Menara Jcorp (N=85)
How do you find the **temperature** at your desk in the morning from **8:00 am to 12:00 pm**?

**Menara Binjai (N=76)**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Zone B (North)</th>
<th>Zone A (West)</th>
<th>Zone C (East)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm</td>
<td>5</td>
<td>10</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>Slightly warm</td>
<td>4</td>
<td>8</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Neutral</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Slightly cool</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Cool</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Cold</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

- **Total**
  - **Warm**: 27%
  - **Slightly warm**: 18%
  - **Neutral**: 4%
  - **Slightly cool**: 9%
  - **Cool**: 6%
  - **Cold**: 6%

**Menara Jcorp (N=85)**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Zone A (North)</th>
<th>Zone B (South)</th>
<th>Zone C (East)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Slightly warm</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Neutral</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Slightly cool</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Cool</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Cold</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

- **Total**
  - **Warm**: 18%
  - **Slightly warm**: 34%
  - **Neutral**: 3%
  - **Slightly cool**: 16%
  - **Cool**: 6%
  - **Cold**: 6%
How do you find the temperature at your desk in the afternoon from 12:00 pm to 3:00 pm?

Menara Binjai (N=76)

Menara Jcorp (N=85)
How do you find the **temperature** at your desk in the evening from 3:00 pm to 6:00 pm?

**Menara Binjai (N=76)**

**Menara Jcorp (N=84)**

<table>
<thead>
<tr>
<th>Office Zones</th>
<th>Warm</th>
<th>Slightly warm</th>
<th>Neutral</th>
<th>Slightly cool</th>
<th>Cool</th>
<th>Cold</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone B (North)</td>
<td>16%</td>
<td>36%</td>
<td>49%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone A (West)</td>
<td>16%</td>
<td>36%</td>
<td>49%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone C (East)</td>
<td>16%</td>
<td>36%</td>
<td>49%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>16%</td>
<td>36%</td>
<td>49%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Office Zones</th>
<th>Warm</th>
<th>Slightly warm</th>
<th>Neutral</th>
<th>Slightly cool</th>
<th>Cool</th>
<th>Cold</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone A (North)</td>
<td>28%</td>
<td>33%</td>
<td>39%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone B (South)</td>
<td>28%</td>
<td>33%</td>
<td>39%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone C (East)</td>
<td>28%</td>
<td>33%</td>
<td>39%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>28%</td>
<td>33%</td>
<td>39%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How do you think the condition **should be** in the morning from 8:00 am to 12:00 pm?

**Menara Binjai (N=76)**

Distribution of Expected Temperature in the Morning (8am - 12pm) by Zones

- Zone B (North): 12%
- Zone A (West): 72%
- Zone C (East): 16%

**Menara Jcorp (N=85)**

Distribution of Expected Temperature in the Morning (8pm - 12pm) by Zones

- Zone A (North): 24%
- Zone B (South): 58%
- Zone C (East): 19%
How do you think the condition should be in the afternoon from 12:00 pm to 3:00 pm?

Menara Binjai (N=76)

Menara Jcorp (N=85)
How do you think the condition should be in the evening from 3:00 pm to 6:00 pm?

**Menara Binjai (N=76)**

**Menara Jcorp (N=85)**

![Bar chart for Menara Binjai](chart1.png)

- **Zone B (North)**: 21%
- **Zone A (West)**: 59%
- **Zone C (East)**: 20%

![Bar chart for Menara Jcorp](chart2.png)

- **Zone A (North)**: 19%
- **Zone B (South)**: 47%
- **Zone C (East)**: 34%
How do you find the quality of the air in your office space? 
1: Stuffy – 5: Fresh

Menara Binjai (N=76)

Menara Jcorp (N=85)
How do you find the quality of the air in your office space?
1: Strong Odors – 5: Fresh

Menara Binjai (N=76)

Menara Jcorp (N=85)
How do you find the quality of the air in your office space?
1: Dry – 5: Humid

Menara Binjai (N=76)

Menara Jcorp (N=85)
How do you find the overall quality of the air in your office space?

**Menara Binjai (N=76)**

Distribution of Satisfaction Level with the Air Quality by Zones

<table>
<thead>
<tr>
<th>Zone</th>
<th>Count</th>
<th>Satisfaction Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone B (North)</td>
<td>0</td>
<td>1 (Very dissatisfied)</td>
</tr>
<tr>
<td>Zone A (West)</td>
<td>5</td>
<td>2 (Dissatisfied)</td>
</tr>
<tr>
<td>Zone C (East)</td>
<td>10</td>
<td>3 (Neutral)</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>4 (Satisfied)</td>
</tr>
</tbody>
</table>

**Menara Jcorp (N=84)**

Distribution of Satisfaction Level with the Air Quality by Zones

<table>
<thead>
<tr>
<th>Zone</th>
<th>Count</th>
<th>Satisfaction Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone A (North)</td>
<td>0</td>
<td>1 (Very dissatisfied)</td>
</tr>
<tr>
<td>Zone B (South)</td>
<td>5</td>
<td>2 (Dissatisfied)</td>
</tr>
<tr>
<td>Zone C (East)</td>
<td>10</td>
<td>3 (Neutral)</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>4 (Satisfied)</td>
</tr>
</tbody>
</table>

17% 43% 40%

13% 54% 33%
If you experience thermal discomfort (temperature & humidity), which of the following best describes it? Choose 3 options

Menara Binjai (N=76)

Menara Jcorp
Overall, how **satisfied** are you with the **temperature** in your workspace?

**Menara Binjai (N=76)**

**Menara Jcorp (N=83)**
How do you find the lighting in your workspace for office activities?

**Menara Binjai (N=76)**

- Zone A (West): 17%
- Zone B (North): 45%
- Zone C (East): 38%

**Menara Jcorp (N=84)**

- Zone C (East): 4%
- Zone A (North): 42%
- Zone B (South): 55%
The lighting inside the office space makes the visual colour effects of objects look: Unnatural or Natural

Menara Binjai (N=76)

Menara Jcorp (N=84)
Overall, how satisfied are you with the level of visual comfort in your workspace (both natural & artificial lighting)?

Menara Binjai (N=75)

Menara Jcorp (N=84)
When during the day is visual comfort most often a problem? Tick all that apply.

Menara Binjai

Menara Jcorp

Distribution of Problematic Time Periods in Terms of Visual Comfort by Zones

Before 8am | 8-10am | 10-12pm | 12-2pm | 2-4pm | 4-6pm | After 6pm | Never
---|---|---|---|---|---|---|---
Zone B (North) | 32% | 40% | 27% | 23% | 39% | 38%
Describe any other issues related to your thermal and/or visual comfort in your workspace

Menara Binjai (N=76)
NO ISSUE - 61

LIGHT SENSOR ISSUES:
- Artificial lighting is automated based on light level which at times makes it difficult to adjust / read.
- Lights turn themselves on and off a lot in the afternoon. Very distracting.
- Automatic light sensors don’t always work as expected.
- Sensitivity at the light sensor inaccurate sensing where after it turn off than it is too dim to work.

Menara Jcorp (N=85)

GLARE ISSUES
- Glare issues.
- Too glaring on the laptop screen. My visual getting worse in just 1 year plus working in this office.
- The window is behind my workstation and the glare from the windows does hurt my eyes.
- Work area against the glass window has bad lighting and the glare from the window doesn’t help our eyesight. Eyesight condition has deteriorated.
Describe any other issues related to your thermal and/or visual comfort in your workspace

Menara Binjai (N=76)

LIGHTING ISSUES
• Light is a bit dim. On raining days, they are a bit dark.
• Natural day light is good but after dark the overhead lighting is very poor. The perimeter plaster board ceiling means that the standard lighting cannot be installed closed enough to the desk along windows.

ACOUSTIC ISSUE
• I experience a lot of sound discomfort especially after lunch.

Menara Jcorp (N=85)

THERMAL COMFORT ISSUES
• There's no specific time range, sometimes it feels warm because of the A/C performance around the sitting place.
• Too cold and sometimes too warm. Presence of split unit sometimes worsened it as I sit at the end of the A/C making it too cold.
• Warm in the morning to 8 am, required manual turn on and off.
• When you are sweating in the office it will take sometime for the body to cool off.
Describe any other issues related to your thermal and/or visual comfort in your workspace

Menara Binjai (N=76)
NO ISSUE - 69

GLARE ISSUES
• Glare from windows are hurting the eyes.
• More blinds are required.
• The window blinds are too thin.
• Too much glare from windows is causing migraine and even after shifting.

GENERAL
• Unsatisfactory environment in the meeting rooms.

Menara Jcorp (N=85)

THERMAL COMFORT ISSUES
• Problems with thermal comfort.
• Extremely cold temperature hampering the health condition.
• Seating position below air condition makes it cold all the time.
• Sometimes it gets pretty cold.
• Temperature fluctuate a lot.
• The place is too cold.
• Too cold.
Overall, how does thermal comfort affect your level of work productivity?

Menara Binjai (N=74)

Menara Jcorp (N=84)
Overall, how does visual comfort affect your level of work productivity?

Menara Binjai (N=74)

Menara Jcorp (N=84)
All things considered, how **satisfied** are you with your personal workspace?

**Menara Binjai (N=75)**

<table>
<thead>
<tr>
<th>Office Zones</th>
<th>Count</th>
<th>Distribution of Overall Satisfaction Level with the Workspace by Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone B (North)</td>
<td></td>
<td><img src="image1" alt="" /></td>
</tr>
<tr>
<td>Zone A (West)</td>
<td></td>
<td><img src="image1" alt="" /></td>
</tr>
<tr>
<td>Zone C (East)</td>
<td></td>
<td><img src="image1" alt="" /></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>5% 44% 51%</td>
</tr>
</tbody>
</table>

**Menara Jcorp (N=84)**

<table>
<thead>
<tr>
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<th>Count</th>
<th>Distribution of Overall Satisfaction Level with the Workspace by Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone A (North)</td>
<td></td>
<td><img src="image1" alt="" /></td>
</tr>
<tr>
<td>Zone B (South)</td>
<td></td>
<td><img src="image1" alt="" /></td>
</tr>
<tr>
<td>Zone C (East)</td>
<td></td>
<td><img src="image1" alt="" /></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>8% 49% 43%</td>
</tr>
</tbody>
</table>
Part 2: Measuring Outcome

Binjai
This relatively new building main orientation with high performance glass receives heat gain from the east, west and north. The glare and acoustics were by far the biggest issues for Menara Binjai. Due to the larger northern façade facing the main street thoroughfare, the acoustics level and discomfort was felt more in this building. In general, most employees found their workspace in Binjai better than JCORP.

JCORP
Thermally, this workspace endured colder spots in comparison to Binjai with the balancing of thermal comfort not optimised to the 24 degree C target temperature creating discomfort for the employees. The general consensus is the air quality is stuffy and this may be due to an older mechanical & ventilation system. Lighting luminance performance in the reading showed lower levels then the Malaysian standards of 300-400 lux.
Over the course of months before the move of Lendlease site office staff from a GBI-Platinum green building (Menara Binjai) and interiors to a non-green building (Menara JCorp, retro fitted with new interior), we had the chance to monitor the indoor environmental performance of their green building.

Lendlease knew it was imperative for the new non-green office to have the same indoor environmental quality as the previous green office in terms of open plan, open pantry & touch down lounge, flexible work space, flexible meeting spaces and maximized daylight, views, optimum air performance, low VOC materials and introduction of indoor planting.

The impact of building orientation, façade material (building shell) mechanical & ventilation systems were the significant issues that impacted the overall thermal and comfort levels in both buildings.

Although not all IEQ aspects in Menara Binjai are excellent, employees are generally more satisfied working in Menara Binjai (green building) than in Menara JCorp (non-green building).
Appendix I – Data from Delta OHM

Ambient Temperature (°C)

Time

Menara Binjai 1
DeltaOhm 4476

DeltaOhm A

Menara JCorp 1

DeltaOhm B

Menara JCorp 2

DeltaOhm 6135
Appendix I – Data from Delta OHM

### TABLE 5.2.1.2
Acceptable Thermal Environment for General Comfort

<table>
<thead>
<tr>
<th>PPD</th>
<th>PMV Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10</td>
<td>-0.5 &lt; PMV &lt; +0.5</td>
</tr>
</tbody>
</table>

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**Predicted Mean Vote (PMV)**

- **Menara Binjai 1**
- **Menara Binjai 2**
- **West/Zone A: DeltaOhm 6135**
- **Menara JCorp 1**
- **DeltaOhm A**
- **Menara JCorp 2**
- **DeltaOhm B**

**NORTH / ZONE B: DeltaOhm 4476**
TABLE 5.2.1.2
Acceptable Thermal Environment for General Comfort

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</table>

Appendix I – Data from Delta OHM
Ambient Temperature (°C)

Time

12:00 AM  1:00 AM  2:00 AM  3:00 AM  4:00 AM  5:00 AM  6:00 AM  7:00 AM  8:00 AM  9:00 AM  10:00 AM  11:00 AM  12:00 PM  1:00 PM  2:00 PM  3:00 PM  4:00 PM  5:00 PM  6:00 PM  7:00 PM  8:00 PM  9:00 PM  10:00 PM  11:00 PM  12:00 AM

Temperature

21.5  22  22.5  23  23.5  24  24.5  25  25.5  26  26.5

Appendix II – Data from Delta HOBO

WORLD GREEN BUILDING COUNCIL

BETTER PLACES FOR PEOPLE
Appendix II – Data from Delta HOBO
Appendix II – Data from Delta HOBO
Upper limit is 0.6 m/s
Lower limit is 0.2 m/s

For temperature between 23 to 24 Deg C
Appendix II – Data from Delta HOBO

Mean Radiant Temperature (°C)

- Menara Binjai A
- Menara Binjai B
- Menara JCorp A
- Menara JCorp B

Time

12:00 AM  1:00 AM  2:00 AM  3:00 AM  4:00 AM  5:00 AM  6:00 AM  7:00 AM  8:00 AM  9:00 AM  10:00 AM  11:00 AM  12:00 PM  1:00 PM  2:00 PM  3:00 PM  4:00 PM  5:00 PM  6:00 PM  7:00 PM  8:00 PM  9:00 PM  10:00 PM  11:00 PM  12:00 AM