GBI Professional Series 2017
Seminar on
INDOOR ENVIRONMENTAL QUALITY (IEQ)
16th November 2017 | 8:30am - 5:30pm | MyIPO, Menara UOA Bangsar

Programme

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<tr>
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<tr>
<td>08.30 am</td>
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<tr>
<td>09:00am</td>
<td>Welcome &amp; Opening Speech</td>
<td>MGBC/ASHRAE President</td>
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<td>09:15am</td>
<td>Mistake in GBI DA/CVA &amp; RVA Submission</td>
<td>Ir. Ng Yong Kong</td>
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Registration Fee

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GBI Professional Series
Seminar on IEQ: MISTAKES in DA, CVA & RVA Submission

16th November, 2017

By: Ir. Ng Yong Kong
GENERAL STRATEGIES / APPROACH

1. When in doubt, follow the intent of each criteria and use common sense.

2. Proposed / implemented strategies must have impact and should be commensurate with the project’s size.

GBI M&E Green Cost Items

Common MISTAKES

GENERAL REMARKS:
1.) If going green results in 'cheaper' costs, then the green agenda is achieved.
2.) Do not adopt technology of insignificant advantage for application in Malaysia but yet costly.
3.) Do not offer the excuse “it is a GBI requirement”: eg. when redundant meters or sensors are installed.
GENERAL STRATEGIES / APPROACH

1. Correct use of GBI Tools. Only propose design strategies that make a project better. **“One size does not fit all”**

2. When in doubt, follow the intent of each criteria and use common sense.

GENERAL STRATEGIES / APPROACH

3. Proposed / implemented strategies must have impact and should be commiserate with a project’s size.
2) Indoor Environmental Quality  21 pts

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<td>EQ1 Minimum IAQ Performance</td>
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<td>EQ8 Daylighting</td>
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<td>EQ9 Daylight Glare Control</td>
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<td>EQ10 Electric Lighting Levels</td>
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<td>EQ11 High Frequency Ballasts</td>
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<td>EQ12 External Views</td>
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<td>EQ13 Internal Noise Levels</td>
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<td>EQ14 IAQ Before &amp; During Occupancy</td>
<td>2</td>
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<tr>
<td>EQ15 Post Occupancy Comfort Survey</td>
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</table>
Establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in building, thus contributing to the comfort and well-being of the occupants:

Meet the minimum requirements of ventilation rate in ASHRAE 62.1-2007 or the local building code whichever is the more stringent.
ASHRAE STD 62.1-2016 - Ventilation For Acceptable Indoor Air Quality

Ventilation is the key to Sustainable IAQ and ASHRAE Standard 62.1 is the most widely used Standard by most Local Authorities and HVAC Engineers in the world.

EQ1: Minimum IAQ Performance

ASHRAE Std 62.1-2016 – Ventilation For Acceptable Indoor Air Quality

1.) Ventilation Rate Procedure (VRP)
2.) Indoor Air Quality Procedure (IAQ)
3.) Natural Ventilation
Ventilation Rate Procedure

Outdoor Air Ventilation Rate for Breathing Zone

\[ V_{bz} = R_p P_d + R_b A_b \]

People Component Building Component

Minimum cfm/Person \( \times \) Number of People + Minimum cfm/sq ft \( \times \) Building Area

NRNC – EQ1 : Minimum IAQ Performance

DON’T JUST SAY:
Meet the minimum requirements of ventilation rate in ASHRAE Standard 62.1 or the local building code whichever is the more stringent.
NRNC – EQ1 : Minimum IAQ Performance

MISTAKES
ii.) Some areas have no ventilation.
iii.) Only a few AHUs comply.

Using PAHU to supply fresh air to hotel guest rooms
Some submissions used 20 cfm / person or higher.

Is it acceptable?

Why some submissions used higher ventilation rate?
1.) Use old ASHRAE Standard 62.1
2.) Satisfy LEED requirement.
3.) Latest development in Europe?
   CIBSE, REHVA
   What are the consequences?

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RESIDENTIAL NEW CONSTRUCTION (RNC)
RNC | INDOOR ENVIRONMENTAL QUALITY (EQ)

EQ1
MINIMUM IAQ PERFORMANCE
3 POINTS

REQUIREMENTS

A) Landed
   All habitable rooms to meet the minimum requirements of ventilation rate in the local building code.
   1
   >75% of the total habitable rooms to be provided with cross and/or stack ventilation.
   1
   All habitable rooms to be provided with cross and/or stack ventilation.
   2

B) Low-rise or High-rise
   All habitable rooms to meet the minimum requirements of ventilation rate in the local building code.
   1
   >75% of the total habitable rooms to be provided with cross and/or stack ventilation.
   1
   All public and circulation spaces to be naturally ventilated to meet the minimum requirements of ventilation rate in the local building code.
   1

APPROACH & IMPLEMENTATION
Cross ventilation is achievable by having openings on both sides of the room. The window facing the outdoor environment must be sized to comply with the minimum requirements for the ventilation rate in the local building code.

Stack ventilation refers to the flow of external air to an indoor space as a result of pressure or temperature differences, via buoyancy-driven ventilation. Compliance must be met through simulation.
Cross Ventilation

Minimum Size = 1 m²

Doors do not qualify

Stack Ventilation

Simulation required to demonstrate effectiveness
UBBL Requirements

Bylaw 39(1)

- Every room designed for residential, business or other purposes except hospitals & schools shall be provided with natural lighting and natural ventilation by means of one or more windows having total area not less than 10% of the floor area and shall have opening for uninterrupted air passage of 5%

Bylaw 39(2)

- Hospitals window area 15% and open able windows 10%

Bylaw 39(2)

- Schools window area 20% and open able windows 10%

RESIDENTIAL NEW CONSTRUCTION (RNC)
RNC | INDOOR ENVIRONMENTAL QUALITY (EQ)

EQ1 MINIMUM IAQ PERFORMANCE 3 POINTS

INTENT
Establish minimum indoor air quality performance to enhance indoor air quality in building, thus contributing to the comfort and well-being of the occupants.

DESCRIPTION
To ensure adequate fresh air supply to occupied spaces so as to maintain good air quality in building and to enhance indoor comfort through the provision of good natural ventilation design.
Sample Submission

**Target:** All public and circulation spaces to be naturally ventilated to meet the minimum requirements of ventilation rate in the local building code.

**INTENT**
Establish minimum indoor air quality performance to enhance indoor air quality in building, thus contributing to the comfort and well-being of the occupants.

**DESCRIPTION**
To ensure adequate fresh air supply to occupied spaces so as to maintain good air quality in building and to enhance indoor comfort through the provision of proper natural ventilation design.

**DA : COMMON MISTAKE**
Naturally Ventilated Public Spaces

**Target:** All public and circulation spaces to be naturally ventilated to meet the minimum requirements of ventilation rate in the local building code.

\[= AC \text{ Exhaust}\]
Discourage smoking.

**Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to Environmental Tobacco Smoke (ETS):**

- Prohibit smoking in the building, AND
- Locate any exterior designated smoking areas at least 10m away from entries, outdoor air intakes and operable windows

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**INTENT**
To minimize exposure of building occupants to Environmental Tobacco Smoke.

**DESCRIPTION**
Avoid health problems associated with tobacco smoke by preventing possible contamination in the building, thereby reducing health risks to occupants linked to “secondhand smoke”.

**REQUIREMENTS**
- Prohibit smoking in buildings, AND
- Locate any exterior designated smoking areas at least 10m away from entries, outdoor air intakes and operable windows.

**APPROACH & IMPLEMENTATION**
Prohibition of smoking in air-conditioned public building is already mandatory under Malaysian Law. This credit can be achieved by strictly enforcing prohibition of smoking in the building, through supervision or signage. If designated smoking areas are provided outside the building, ensure that the tobacco smoke does not enter the building or the ventilation system.
**EQ-2 Environmental Tobacco Smoke (ETS) Control**

*Probably the “cheapest point”*

To minimize exposure of building occupants to ETS
- Prohibit Smoking in the building, with signage.
- commonly referred to as Secondhand smoke.
- tobacco smoking is prohibited in many public area as stipulated under control of Tobacco Product Regulations 2004.
- Locate exterior designated smoking areas at least 10 m away from entries, outdoor air intakes or operable windows

**NRNC – EQ2 : Environmental Smoke Control**

**MISTAKES**
- Have one smoking area in a big building.
- No Smoking Signage or yet to be installed.
- RVA – Smoking area too near and smoke circulate back to indoor space.
Prohibit smoking in the building, by providing non-smoking signs at Lift Lobby area

Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to Environmental Tobacco Smoke (ETS)

Exterior designated smoking area at least 10m away from entries, outdoor air intakes and operable windows

EQ3 : CO2 Monitoring and Control

Selecting

Criteria for Outdoor Air Monitoring

By Thomas M. Lawrence, Ph.D., PE., Member ASHRAE

ASHRAE Journal  ashr ae.org
EQ 3 : Carbon Dioxide Monitoring and Control

- EQ 3 – Install CO2 monitoring and control system with at least 1 CO2 sensor at all main return points on each floor to facilitate continuous monitoring and adjustment of OA rates to each floor and ensure independent control of ventilation rates to maintain CO2 level ≤ 1,000 ppm.
CO2

ELECTRONIC AIR FILTERS. COOLING COIL
BLOWER FAN

S/A DUCT

SPACE TEMPERATURE SENSOR

S/A
STATIC PRESSURE SENSOR

S/A
MOTORIZED SMOKE DAMPER

TYPICAL AHU CONTROL SYSTEM

LEGEND:

CO2  CARBON DIOXIDE SENSOR
MD   MOTORISED DAMPER
Mistakes in EQ 3

1.) No schematic drawings.
2.) Installed CO2 sensors in the supply duct.

3.) Installed too many CO2 sensors
   - hence more expensive

4.) Installed too few CO2 sensors

5.) CO2 sensors installed on top of the ceiling

EQ 4 Indoor Air Pollutants

Encourage use of non toxic products.

- Reduce detrimental impact on occupant health from finishes that emit internal air pollutants:

  Use low VOC paint and coating throughout the building. Paints and Coatings to comply with requirements specified in international labelling schemes recognized by GBI, AND

  Use low VOC carpet or flooring throughout the building. Use low VOC adhesive and sealant or no adhesive or sealant used.
COMMON MISTAKES:

1.) DA Stage: NO CATALOGS SUBMITTED
   : Provide proof of GBI recognized Certifications for Low VOCs or No VOCs.

2.) CVA Stage: i.) No Photographic evidence provided.
   ii.) No Catalogues submitted to show what were used.

EQ4 Indoor Air Pollutants
greenpagesmalaysia

greenpagesmalaysia is an information resource directory for green building products and services.

The primary objective – providing info on sustainable building products and services to architects, engineers, developers and others.

A user-friendly, online interface will be consistently updated.

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**EQ2 VOLATILE ORGANIC COMPOUNDS MINIMISATION**

Reduce the detrimental impact on occupant’s health from finishes that emit internal air pollutants.

4 points are awarded for any 2 of the following items, up to a maximum of 2 points:

1. Low VOC paint and coating to walls (at least 90% of all areas). OR no paint or coating used.
2. Low VOC paint and coating to ceilings (at least 90% of all areas). OR no paint or coating used.
3. Low VOC paint and coating to flooring (at least 90% of all areas). OR no paint or coating used.
4. Low VOC adhesive and sealant (at least 90% of all areas). OR no adhesive or sealant used.

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**EQ3 FORMALDEHYDE MINIMISATION**

Reduce the exposure of occupants to formaldehyde and promote good indoor air quality in the living spaces.

Use products with no added formaldehyde OR use products which comply with the formaldehyde emission rating recognised by CIQ, if glue is used in the manufacturing process.

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RESIDENTIAL NEW CONSTRUCTION (RNC)
RNC | INDOOR ENVIRONMENTAL QUALITY (EQ)

EQ4 DAYLIGHTING 3 POINTS

INTENT
Encourage and recognize designs that provide good levels of daylighting for building occupants.

DESCRIPTION
Demonstrate that a nominated percentage of the habitable rooms as defined under Uniform Building Code (UBC) has a Daylight Factor of minimum 0.5% as measured at floor level.

REQUIREMENTS

A) Landed
- ≥50% of habitable rooms, OR
- ≥75% of habitable rooms, OR
- ≥75% of all rooms

B) Low-rise or High-rise
- ≥50% of habitable rooms, OR
- ≥75% of habitable rooms
- All public and circulation spaces being naturally lit.

Static Calculation or Daylighting Simulation

Typical Section through External AC Ledge @ Office Living room level
EQ 4 : Daylighting

Mistake DA/CVA:
1.) Not achieving the percentage required
2.) Percentage calculated not using the habitable rooms.
Design system/s which reduce the risk of mould growth and its associated detrimental impact on occupant health:

Where it is demonstrated that the mechanical air-conditioned ventilation system will maintain a positive indoor air pressure relative to the exterior and can actively control indoor air humidity to be no more than 70% RH without the use of active control that will consume additional energy.

Construction Practices

- Temporarily seal HVAC ductwork after installation to keep out dust & water
- Keeping materials (insulation, etc.) dry; if they get wet dry immediately
During Construction

**EQ5 Mould Prevention**

Prevention of Mould Growth Problems.

**MISTAKES :**

1. DA - NONE OR NOT YET
2. CVA - .....how?
3. RVA - ......???
Mold stains
What are the Probable Causes?

- Design inadequacies?
  - Passive or active side?
- Installation defects?
  - Passive or active side?
- Lack or absence of proper commissioning?
  (Not mere TAB!)
- Operational shortcomings?
- Maintenance?
Provide a high level of thermal comfort system control by individual occupants or by specific groups in multi-occupant spaces to promote the productivity, comfort and well-being of building occupants:

Design to ASHRAE Standard 55 in conjunction with the relevant localised parameters as listed in MS 1525

Encourage provision of close comfort control.

Specifications Conditions likely to be thermally acceptable to at least 80% of the adult occupants in a space

6 Primary factors that must be addressed when defining conditions for thermal comfort are:

1.) Metabolic rate
2.) Clothing insulation
3.) Air temperature
4.) Radiant temperature
5.) Air speed
6.) Humidity
Can individual thermal controls be met with the provision of task fans? The definition of thermal comfort control means being able to control the temperature, air speed, humidity or radiant temperature. Using task fan is a mean of controlling the air speed which should be compliant to fulfilling the objective of this requirement.

YES, if the nett effect of the air speed temperature, humidity, etc. is within the comfort range as recommended in ASHRAE 55 with relevant localized parameters as listed in MS1525.

DA/CVA Submission Mistake:

1.) No Control.
2.) Controls installed wrongly
3.) The wrong person signing off.
Provide effective delivery of clean air through reduced mixing with indoor pollutants in order to promote a healthy indoor environment. Demonstrate that the Air Change Effectiveness (ACE) meets the following criteria for at least 90% of the NLA:

The ventilation systems are designed to achieve an ACE of ≥0.95 when measured in accordance with ASHRAE 129: Measuring air change effectiveness where ACE is to be measured in the breathing zone (nominally 1.0 m from finished floor level)
Reference Guide

REQUIREMENTS
Demonstrate that the Air Change Effectiveness (ACE) meets the following criteria for at least 90% of the NLA:
The ventilation system is designed to achieve an ACE ≥ 0.95 when measured in accordance with ASHRAE 129 -1997.
Measure air change effectiveness, where ACE is to be measured within the breathing zone (nominally 1.0 m from finished floor level).

APPROACH & IMPLEMENTATION
Compliance may be met either through measurement of the completed building in accordance to ASHRAE 129 or equivalent or using CFD simulations.
EQ 7 : Air Change Effectiveness

MISTAKES IN DA/CVA Submission:
Nil as the issue will be addressed during the DA Submission.
**Lighting, Visual & Acoustic Comfort**

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<td>EQ10 Electric Lighting Levels</td>
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<tr>
<td>EQ11 High Frequency Ballasts</td>
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<tr>
<td>EQ12 External Views</td>
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**Verification**

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<td>EQ15 Post Occupancy Comfort Survey</td>
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**NRNC - generic**

**EQ9 Daylight Glare Control**

Prevent daylighting from being made redundant.

- Reduce discomfort of glare from natural light. Where blinds or screens are fitted on all glazing and atrium as a base building, incorporate provisions to meet the following criteria;
  - a) Eliminate glare from all direct sun penetration and keep horizontal workspace lux level below 2000;
  - b) Eliminate glare from diffuse sky radiation for occupant workspace at viewing angles of 15° to 60° from the horizontal at eye level (typically 1.2m from floor level)
  - c) Control with an automatic monitoring system (for atrium and windows with incident direct sun light only - not applicable for fixed blinds/screens); AND
  - d) Equip with a manual override function accessible by occupants (not applicable for fixed blinds/screens) | 1 |
When your strategy includes internal blinds…

use only horizontal blinds (not vertical)

Use Horizontal Blinds

Automated Shading Device (Blackout Blind)

Manual Roller Shading Device (Opaque Blind)
Discourage over provision of artificial lighting.

Baseline building office lighting not to be over designed:

Demonstrate that office lighting design maintains a luminance level of no more than specified in MS1525 for 90% of NLA as measured at the working plane (800mm above the floor level).

DA Submission Document

1. Submit narrative (summary) page, describing how the lighting design meets this criteria compliance;

2. Submit typical lighting layout floor plans complete with manually calculated or simulated lux levels meeting MS 1525.
CVA Submission Document

REQUIRED SUBMISSION FOR CVA
1. Submit narrative (summary) page, describing as-installed lighting systems meeting this criteria compliance
2. Submit As-Built drawings showing lighting layout plans.
3. Submit photometric measurements of all typical floors to demonstrate compliance with this criteria.
4. Furnish photos of typical floor lighting installation.
5. Describe any deviation or addition to the DA submission.

Common Mistakes

1. DA STAGE:
   i.) Fail to submit design layout plans showing lux level compliance
   ii.) Submitting simulated design layout plans with lux level exceeding MS 1525

2. CVA STAGE:
   i.) Submitting measurement results of lux level exceeding MS 1525
Encourage high IEQ fixtures.

<table>
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<tr>
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<tr>
<td><strong>EQ11 High Frequency Ballasts</strong></td>
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</table>

*Increase workplace amenity by avoiding low frequency flicker that may be associated with fluorescent lighting:*-

Install high frequency ballasts in fluorescent luminaires over a minimum of 90% of NLA. | 1 |

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NRNC - generic

**EQ11 High Frequency Ballasts - MISTAKE**

**DA:**
Catalogues not submitted

**CVA:**
Few High Frequency Ballasts installed in the Building.
EQ12 External Views

Encourage external views as part of IEQ.

Reduce eyestrain for building occupants by allowing long distance views and provision of visual connection to the outdoor.

Demonstrate that ≥ 60% of the NLA has a direct line of sight through vision glazing at a height of 1.2m from floor level.

Demonstrate that ≥ 75% of the NLA has a direct line of sight through vision glazing at a height of 1.2m from floor level.
**EXTERNAL VIEWS**

**Office Cubicle**

**EXTERNAL VIEWS**

**Glass Meeting Room with Operable Blinds**
RESIDENTIAL NEW CONSTRUCTION (RNC)
RNC | INDOOR ENVIRONMENTAL QUALITY (EQ)

EQ5  EXTERNAL VIEWS  1 POINT

Sample Submission

<table>
<thead>
<tr>
<th>Location</th>
<th>External View Location</th>
<th>External Area</th>
<th>Walk</th>
<th>Internal Atrium View (sensitive)</th>
<th>Internal Atrium View (courtyard)</th>
<th>Total External View Area</th>
<th>ILA (RE)</th>
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Legend
- Atrium View
- Walk
- Internal Atrium View (sensitive)
- Internal Atrium View (courtyard)
- View Direction

Internal Atrium View

Legend
- Courtyard
- Tenanted Space
NRNC - generic

EQ12 External Views  2

MISTAKES:

Not meeting the percentage – trying hard.
Control excessive internal noise level to assure good IEQ. MISTAKE: NOT MEETING THE CRITERIA.

Maintain internal noise levels at an appropriate level. Demonstrate that 90% of the NLA do not exceed the following ambient internal noise levels:

- Within the entire baseline building general office, space noise from the building services does not exceed 40dBAeq.

OR

- Within the baseline building office space, the sound level does not exceed 45dBAeq for open plan and not exceed 40dBAeq for closed offices.
### Lighting, Visual & Acoustic Comfort

| EQ8 Daylighting     | 2 |
| EQ9 Daylight Glare Control | 1 |
| EQ10 Electric Lighting Levels | 1 |
| EQ11 High Frequency Ballasts | 1 |
| EQ12 External Views | 2 |
| EQ13 Internal Noise Levels | 1 |

#### Verification

| EQ14 IAQ Before & During Occupancy | 2 |
| EQ15 Post Occupancy Comfort Survey | 2 |

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**NRNC - generic**

**EQ14  IAQ Before & During Occupancy**

Ensure achievement of high sustainable IAQ.

*Reduce indoor air quality problems resulting from the construction process in order to help sustain the comfort and well-being of building occupants. Develop and implement an Indoor Air Quality (IAQ) Management Plan for the Pre-Occupancy phase as follows:*
During Occupancy Stage:
Where a permanent air flushing system of at least 10 airchanges/hour operation is installed for use during occupancy stage

MISTAKE:
FLUSHING NOT PROPERLY DONE & DOCUMENTED

Ensure occupants truly benefit from the design intents.

Provide for the assessment of comfort of the building occupants:

Conduct a post-occupancy comfort survey of building occupants within 12 months after occupancy/building completion. This survey should collect anonymous responses about thermal comfort, visual comfort and acoustic comfort in a building. It should include an assessment of overall satisfaction with thermal, visual and acoustic performance and identification of thermal-related, visual-related and acoustic-related problems.

AND
### Table 1: Comfort Indicators

<table>
<thead>
<tr>
<th>Comfort Category</th>
<th>A - Thermal Comfort</th>
<th>B - Acoustics</th>
<th>C - Indoor Air Quality</th>
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<td>63</td>
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<td>3 Percentage</td>
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<td>86%</td>
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### Table 2: Additional Comfort Indicators

<table>
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<tr>
<th>Comfort Category</th>
<th>D - Lighting Levels</th>
<th>E - Cleanliness</th>
<th>F - Others</th>
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<td>63</td>
<td>30%</td>
</tr>
<tr>
<td>3 Percentage</td>
<td>30%</td>
<td>70%</td>
<td>5%</td>
</tr>
</tbody>
</table>
MISTAKE :

DA : Usually None

CVA : 1.) Asking questions not related to IEQ.
2. ) No Corrective Actions taken.

IN1: INNOVATION IN DESIGN AND ENVIRONMENTAL DESIGN INITIATIVES

- Recycling Fire Fighting Water System (Wet Sprinkler and Wet Riser systems, where applicable) during regular testing. Not applicable for Hose Reel System.

Probably one of the more economical and innovative design.
Recycling Fire System Water (Sprinkler and Wet Riser systems, where applicable) during regular testing

MISTAKES:

DA Submission:
1.) Submission for Wet Riser System only.

CVA Stage:
1.) Piping not connected.
2.) Piping connected wrongly.
3.) Recycling with only 20mm dia flow switch test pipes - this is encouraged but is not the important pipe.

NB: Piping to be recycled should be 65 mm dia. with the flowrate meter when testing the sprinkler pump and alarm gong. Recycling with additional 65mm dia. pipe connecting discharge from pumps before the flowrate meter.

IN1: Herb and/or Food Garden (Landed-25% of landscaped area. Low-rise and High-rise-10% of landscaped area or 20m² whichever is the larger)

MISTAKES:

DA — i.) NOT MEETING THE PERCENTAGE OR AREA REQUIRED.
   ii.) FAILED TO PROVIDE A LIST OF HERBS, FRUITS OR VEGETABLES PLANTS.

CVA — i.) NOTHING WAS PLANTED.
   ii.) GRASS PLANTED.
   iii.) NOT MEETING THE %age OR AREA.
IN1: INNOVATION IN DESIGN AND ENVIRONMENTAL DESIGN INITIATIVES

- Charging Station for Hybrid or Electric Car (5% of the total parking spaces provided, up to a maximum of 20 nos)

MISTAKE: DA – SUBMITTED
CVA – i.) NOT PROVIDED
ii.) NOT ENOUGH TO MEET THE CRITERIA

Fire Sprinkler Recycling Pipe

This is the correct pipe for recycling
IN1: WATER METERING AND LEAK DETECTION SYSTEM

Water Metering & leak detection system
WE5 : NRNC ( 2 points )
i.) 1st Point – No major issue.
ii.) 2nd Point – BIG PROBLEM
- RNC : Innovation for large water usage that had significant impact.

MISTAKES:

WE5
DA SUBMISSION :
1.) No installation details to show usage covered and no. of water meters used.
2.) Too many meters used.
3.) Using “high end” meters
CVA : 2nd Point – cannot interface with BMS m3 or m3/Hr. ???
What was the problem?
MISTAKES:

WE5: CVA MISTAKES

1.) Plumber bought and installed the Mechanical or Pulse or Digital Water meter that cannot interface with BMS for 2\textsuperscript{nd} point.
   WHY? – Not Specified.

2.) System Integrator do not provide Pulse Card or Controller.

Third party High Level interfacing

- Building Automation system
- Utilities Metering System
- Energy management System
System Diagram

AMR – Automatic Meter Reader

Digital Water Meter

Modbus RS485

Ethernet Converter

MISTAKES:

1.) SENSORS INSTALLED WRONGLY
2.) TOO FEW OR TOO MANY SENSORS
3.) SENSORS NOT ABLED TO COMMUNICATE WITH BMS AND VSDs

NREB IN: CAR PARK MECHANICAL VENTILATION FANS PROVIDED WITH VSDs AND CONTROLLED BY CO/CO2 SENSORS
Thank You

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