**CREDIT SM13 BUILDING USER MANUAL**

# BUILDING SYSTEM MANUAL

## (ACTIVE GREEN FEATURES)

## for Commissioning Specialist Works,

## GBI (Green Building Index) Certification of

# TROPICANA GARDENS OFFICE TOWER

*This manual is only an overall summary addresses key energy related system, indoor environment quality and water consumption to GBI sustainability goals. It shall be read in conjunction with other building O&M manuals & DA documents of GBI submission*

| | |
|---|---|
| Prepared by: | |
| **Soma Technical Sdn Bhd**<br>5, Jalan Putra Indah 9/11,<br>Putra Heights,<br>47650 Subang Jaya,<br>Selangor | |
| Date: 12 September 2022 | |

## PROJECT DESCRIPTION

Tropicana Gardens Office Tower is part of the mixed integrated development in Tropicana Indah, Petaling Jaya. Conveniently located in the heart of Petaling Jaya and nestled in the affluent Tropicana Indah neighbourhood, this office tower is located next to the Surian MRT station and easily accessible from either Persiaran Surian or Persiaran Tropicana.

Tropicana Gardens Office Tower is equipped with a range of green building features and design strategies. With a net floor area of approximately 31,266 square meter, Tropicana Gardens Office Tower is a 23-level commercial tower above Tropicana Gardens Mall which was completed by 2020.

Tropicana Gardens Office Tower has been awarded a **GBI Silver** rating under the GBI Non-Residential New Construction (NRNC) – Retail Tool.

## PROJECT AREAS

| | |
|---|---|
| GFA excld. Carpark | 31,266 sqm |
| GLA | 20,344 sqm |

## PROJECT TEAM

| | |
|---|---|
| **Owner / Developer** | **Tropicana Indah Sdn. Bhd.** |
| **Main Contractor** | **GD Capital Holdings Sdn. Bhd.** |
| **Architect** | **GDP Architects Sdn. Bhd.** |
| **Civil & Structure** | **TY LIN International Sdn. Bhd.** |
| **M&E Consultant** | **KTA Tenaga Sdn. Bhd.** |
| **Quantity Surveyor** | **KPK Quantity Surveyor Sdn. Bhd.** |
| **GBI Facilitator** | **Fenestra Malaysia Sdn. Bhd.** |
| **Commissioning Specialist (CxS)** | **Soma Technical Sdn. Bhd.** |

**CONTENTS**

## EE2 LIGHTING ZONING

*All individual or enclosed spaces to be individually switched; and the size of individually switched lighting zones shall not exceed 100m² for 90% of the NLA; with switching clearly labelled and easily accessible by building occupants;*
*Provide auto-sensor controlled lighting in conjunction with daylighting strategy for all perimeter zones and daylit areas;*
*Provide motion sensors or equivalent to complement lighting zoning for at least 25% of Landlord & Common Area.*

The summary of lighting control strategies applied in Tropicana Gardens Office Tower is as below:

1) **Individually switched lighting zones** shall provide flexible lighting options to the occupants, where only occupied spaces needed to be lighted. Zoned lighting coupled with educated awareness to the maintenance team provides great opportunity to save electricity. The individual lighting zones do not exceed **100m²** throughout the NLA.

2) **Motion sensor** coverage exceeds **25%** of Nett Lettable Area (NLA).

| Level | Floor | Motion Sensor |
|---|---|---|
| L22 | 21st | - |
| L21 | 20th | 15 |
| L20 | 19th | 14 |
| L19 | 18th | 15 |
| L18 | 17th | 15 |
| L17 | 16th | 15 |
| L16 | 15th | 15 |
| L15 | 14th | 15 |
| L14 | 13th | 14 |
| L13 | 12th | 15 |
| L12 | 11th | 15 |
| L11 | 10th | 16 |
| L10 | 9th | 16 |
| L9 | 8th | 16 |
| L8 | 7th | 16 |
| L7 | 6th | 16 |
| L6 | 5th | 16 |
| L5 | 4th | 15 |
| L4 | 3rd | 4 |
| L3 | 2nd | 7 |
| L2 | 1st | 4 |
| L1 | Ground | 7 |
| G | CC | 9 |
| LG | LG | 6 |
| B1 | B1 | 6 |
| B2 | B2 | 5 |
| B3 | B3 | 5 |
| B4 | B4 | 3 |
| **Total** | | **315** |

TIMEGUARD
A theben group company

## Presence And Motion Detectors

### Motion Detectors


**Description**

Common functions

- Motion detector (PIR)
- Automatic lighting control based on presence and brightness
- Mixed light measurement suitable for the control of fluorescent, incandescent, halogen lamps and LED
- Adjustable brightness switching value and switch-off delay

**Technical data**

| | TG MD360 DE WH | TG MD360 AP WH | TG MD360 MINI DE WH |
|---|---|---|---|
| Operating voltage | 230 V AC ±10% | | |
| Frequency | 50 Hz | | |
| Installation height | 3 m | | |
| Standby consumption | < 1 W | | |
| Minimum switching capacity | 10 mA | | |
| Setting range brightness | 10 - 1000 lux | | |
| Light switch off delay | 3 s - 18 min | | |
| Switching capacity light | µ contact 230 V AC | | |
| Incandescent, Tungsten, Halogen lamp load | 1000 W | | |
| Fluorescent lamp (Electronic) | 200 W | | |
| LED lamp | 200 W (PF 0.9 or higher) | | |
| Protection class | II | | |
| Ambient temperature | -20 °C...+40°C | | |
| Detection angle | 360° | | |
| Motion detection range | up to ø 6 m at 3 m mounting height | | |
| Type of protection | IP 40 | | |

3) **Photocell sensor** controlled perimeter lightings where daylight maybe sufficient, artificial lighting will be turned off. Having automated control over this ensures that lighting is not wasted when not required.

| Level | Floor | Photocell Sensor |
|---|---|---|
| L22 | 21st | 6 |
| L21 | 20th | - |
| L20 | 19th | 6 |
| L19 | 18th | 6 |
| L18 | 17th | 6 |
| L17 | 16th | 6 |
| L16 | 15th | 6 |
| L15 | 14th | 6 |
| L14 | 13th | - |
| L13 | 12th | 3 |
| L12 | 11th | 6 |
| L11 | 10th | 5 |
| L10 | 9th | 6 |
| L9 | 8th | 6 |
| L8 | 7th | 6 |
| L7 | 6th | 6 |
| L6 | 5th | 6 |
| L5 | 4th | - |
| L4 | 3rd | - |
| L3 | 2nd | - |
| L2 | 1st | - |
| L1 | Ground | - |
| G | CC | - |
| LG | LG | - |
| B1 | B1 | - |
| B2 | B2 | - |
| B3 | B3 | - |
| B4 | B4 | - |
| **Total** | | **86** |

Presence detector - Professional Line

# Dual HF

COM1
EAN 4007841 002978


## Function description

Twice as vigilant! High-frequency corridor sensor Presence Control PRO Dual HF COM1 for indoors, ideal for passageways and long corridors, installation height up to 3.5 m, for switching light 'ON' and 'OFF', DUAL-HF technology for detecting radial movement over up to 20 m in two directions, detection regardless of temperature, HF-sensor technology detects movement through glass, wood and stud walls, switches light 'ON' almost instantly.

## Technical specifications

| | |
|---|---|
| Type | Presence detector |
| Dimensions (L x W x H) | 75 x 120 x 120 mm |
| Mains power supply | 230 V / 50 – 60 Hz |
| Sensor Technology | High frequency |
| Application, place | Indoors |
| Application, room | corridor / aisle, Indoors |
| Installation site | ceiling |
| Installation | Concealed wiring |
| HF-system | 5,8 GHz |
| Electronic scalability | Yes |
| Mechanical scalability | No |
| Mounting height | 2,50 – 3,50 m |
| Optimum mounting height | 2,8 m |
| Detection angle | 360 ° |
| Angle of aperture | 140 ° |
| Sneak-by guard | Yes |
| Reach, radial | 20 x 3 m (60 m²) |
| Reach, tangential | 20 x 3 m (60 m²) |

| | |
|---|---|
| Twilight setting TEACH | Yes |
| Twilight setting | 10 – 1000 lx |
| Time setting | 30 s – 30 Min. |
| Constant-lighting control | No |
| Basic light level function | No |
| Functions | Normal / test mode, Semi-/fully automatic, Pushbutton / switch mode, Manual ON / ON-OFF |
| Settings via | Remote control, DIP switches, Potentiometers, Smart Remote |
| With remote control | No |
| Interconnection | Yes |
| Type of interconnection | Master/slave, Master/master |
| IP-rating | IP20 |
| Material | Plastic |
| Ambient temperature | -25 – 55 °C |
| Colour | white |
| Colour, RAL | 9010 |
| Manufacturer's Warranty | 5 years |
| Version | COM1 |
| PU1, EAN | 4007841002978 |

## EE3 ELECTRICAL SUB-METERING

*Provide sub-metering for all energy uses of ≥ 100kVA; with separate sub-metering for lighting and separately for power at each floor or tenancy, whichever is Office Tower.*

For the entire development, electricity metering is required for clear electricity usage hence meters shall be provided as follows:

1) Digital power meter (DPM) High Level Interfacing is provided to MSBs & EMSBs, SSBs, and DBs.

2) kWh meter with central billing facility has been provided to separately measure the electrical power usage of each tenancy. All kWh meters are connected to **Central Energy Billing System** (**CEBS**).

3) All the DPMs are linked to the **Central Electrical Monitoring System** (**CEMS**) for monitoring and control of the building systems.

The quantity of digital power meters installed in this building is summarized below:

| Electrical Services | Digital Power Meter |
|---|---|
| 33kV Switchgear | 4 |
| Main Switch Board (MSB & EMSB) | 35 |
| Sub-Switch Board (SSB) | 12 |
| CEMS | 54 |
| Distribution Board (DB) | 28 |
| **Total** | **133** |

## EE5 ADVANCED EE PERFORMANCE

*Achieve Building Energy Intensity (BEI)* ***≤ 150 kWh/m2 year****.*

Buildings are seen to be the main energy consumer. By optimizing the energy usage in the building, the pollution level due to energy production generation may be reduced. The objective of EE5 is to encourage enhancement of building EE performance thereby reducing the GHG ($CO_2$) emission.

The annual energy consumption for Tropicana Gardens Office Tower shall be ***≤ 150 kWh/m2yr.*** Energy Management System (EMS) is used to monitor the **BEI**. A holistic approach towards the design of the building envelope, mechanical and electrical system, is undertaken to ensure that Tropicana Gardens Office Tower can be an energy efficient low-rise commercial building.

The following main design strategies to reduce the energy consumption of Tropicana Gardens Office Tower shall be maintained:

i. **Chiller Plant Optimization**
ii. **Space Cooling and Thermal Comfort Controls**
iii. **Occupancy and Photo Sensors for Lighting Control**
iv. **Energy Efficient Light Fittings**
v. **KNX Lighting Control During Non-Peak Period**

The verified BEI for the completed building based on BAS reports of the total power consumption for the period from January 2022 to June 2022 is **117** kWh/$m^2$/year. Any increase in power consumption over an extended period may indicate a change in efficient building operations that requires rectification.

## EE7 POST OCCUPANCY COMMISSIONING

*Carry out post occupancy commissioning for all tenancy areas after fit-out changes are completed.*

*1) Design engineer shall review all tenancy fit-out plans to ensure original design intent is not compromised and upon completion of the fit-out works, verify and fine-tune the installations to suit.*

CxS is onboard to carry out Post Occupancy Commissioning together with M&E Designer and Sustainable Consultant. In the absent of CxS, M&E Designer and Sustainable Consultant in future, **Building Operator** shall perform the Post Occupancy Commissioning based on the **Tenant Fit-Out Guide** and **Building User Manual**.

For any renovation, the Building Operator shall review the **tenancy fit-out plans** to ensure original design intent is not compromised and upon completion of the fit-out works, **verify,** and **fine-tune** the installation to suit. Full post commissioning of the building's energy related systems shall be carried out to verify their performance is sustained in conjunction with the completed fit-outs.

## EE8 EE VERIFICATION

*Use Energy Management System to monitor and analyse energy consumption including reading of sub-meters.*
*Fully commission EMS including Maximum Demand Limiting program.*

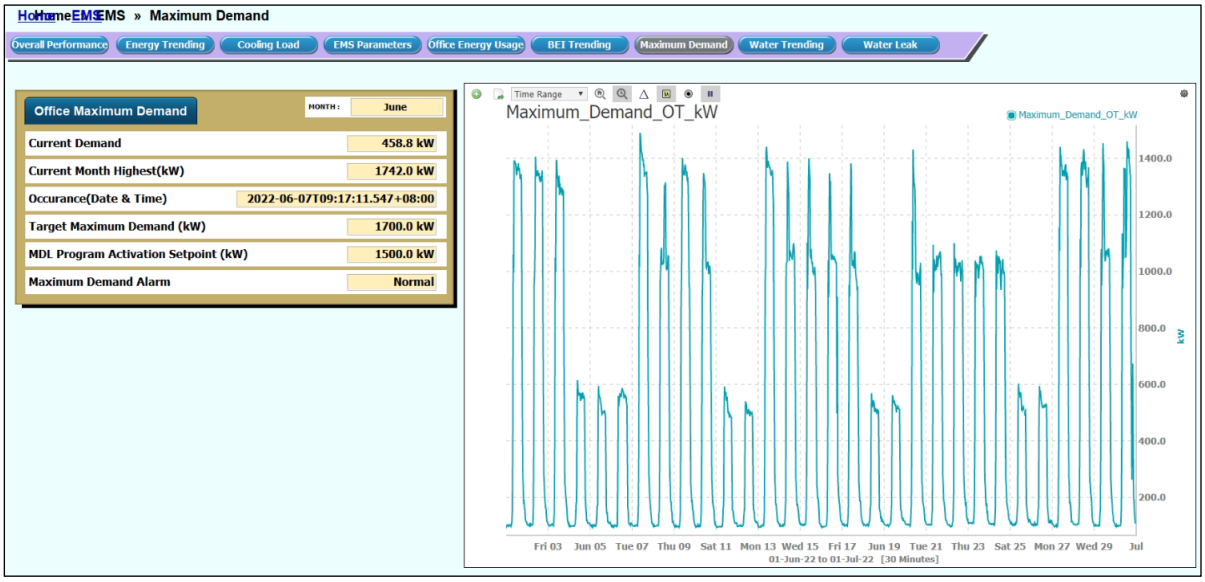
### Energy Management System (EMS)

The Building Management System has included a comprehensive **Energy Management System (EMS)** comprising of both hardware and software which is capable to provide monitoring (including graphics interface), control, and reporting the energy status of the whole building. The EMS will provide load profile in intervals over the day, weekly, monthly, and yearly **demand** and **energy consumption** in **kW** and **kWh**.

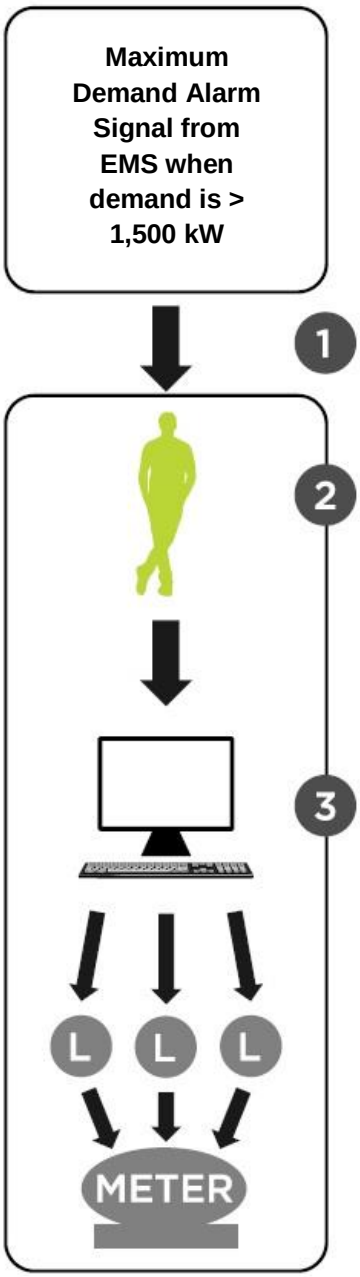
The EMS was supplemented with the building layout and system schematic to allow clear identification of location and system information that is provided by the EMS. For each DPM and DWM, a minimum logging interval shall be kept.

### Maximum Demand Limiting Program (MDL)

The program shall monitor the building energy use and be capable of predicting the **maximum demand** in **kW**. Operator could shed load via **Semi-Automated** manner to limit the demand to target MD. Loads which may be shed shall be nominated on a schedule. This shall be arranged on a **priority basis**. Each load shall also be given an **associated reasonable kW** value. The system shall provide the facility for the operator to select the **demand limit** and the loads available for shedding. The maximum demand period shall parallel that of the Electricity Supplier **half hour cycle** for maximum demand.



**Event Notification Process When MDL Alarm Activates**




1. When the **Maximum Demand** have exceeded the **pre-determined limit** of **1,500 kW**, a **Maximum Demand Alarm signal** will be issued by EMS.

2. **Operation Manager** shall decide to execute **semi-automated Load Shedding Strategies**.

3. **Operation Engineer** shall initiate pre-planned semi-automated MD measures through **BMS** and **KNX Lighting Management System** workstations at Building Control Room.

The following **MDL Programs** shall be implemented:

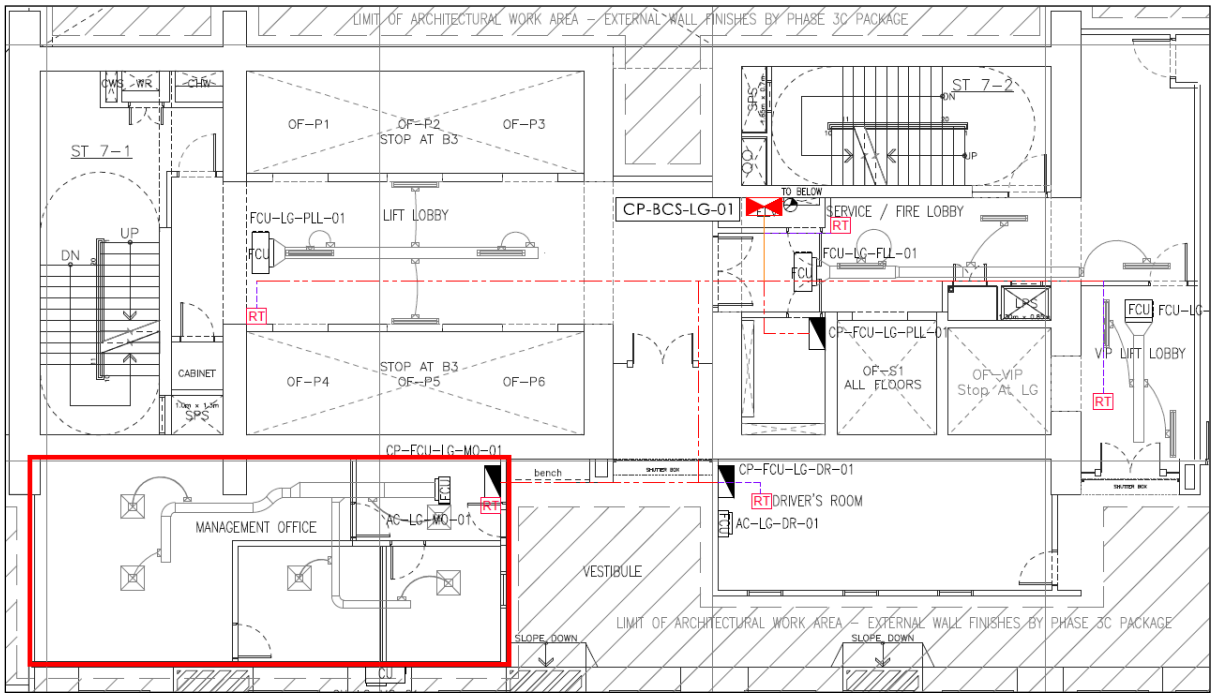
i. Reset **ACMV Temperature Set Points**.

ii. Schedule **Fire Pumps Testing** during Low MD period.

## EE9 SUSTAINABLE MAINTENANCE

*Ensure the building's energy related systems will continue to perform as intended beyond the 12 months Defects & Liability Period:*
*At least 50% of permanent building maintenance team to be on-board one (1) to three (3) months before practical completion and to fully participate (to be specified in contract conditions) in the Testing & Commissioning of all building energy services.*
*Provide for a designated building maintenance office that is fully equipped with facilities (including tools and instrumentation) and inventory storage.*
*Provide evidence of documented plan for at least 3-year facility maintenance and preventive maintenance budget (inclusive of staffing and outsourced contracts).*

The designated **Maintenance Office** at **LG** level that is fully equipped with facilities (including tools and instrumentation) and inventory storage are provided for the building maintenance team in the building. This room shall be kept for sustainable maintenance.




**Maintenance Office at LG**

**Maintenance organization chart** shall be updated periodically.

**Facility maintenance** and **preventive maintenance budget** (inclusive of staffing and outsourced contracts) shall be prepared **yearl**y.

A list of **Maintenance Tools**, **Instrumentation** and **Inventory** shall be prepared by the maintenance team.

## EQ1 MINIMUM IAQ PERFORMANCE

*Meet the minimum requirements of ventilation rate in ASHRAE 62.1:2007.*

The purpose is to establish and maintain the minimum indoor air quality (IAQ) performance to enhance indoor air quality in the building, thus contributing to the comfort and well-being of the occupants. Ventilation system shall ensure that the outdoor ventilation rate meets the minimum requirements of ventilation rate in **ASHRAE 62.1:2007** or the local building code whichever is the more stringent. As ASHRAE 62.1:2007 is more stringent, the outdoor ventilation rate shall meet ASHRAE 62.1:2007 requirement.

Outdoor air is ducted to the AHU room where it is mixed with return air, filtered, cooled, and supplied to the open plan office space via ducting to VAV boxes. The outdoor air damper to each AHU is a motorized volume damper controlled by a CO2 sensor for energy efficiency purposes. In other words, $CO_2$ sensor in the return air duct and motorized volume dampers control the amount of fresh air allowed into the floor AHU.

The ventilation rate requirements set out in **ASHRAE 62.1:2007** for the Office Tower is as following:

**Office = 2.5L/s per person + 0.3L/s per $m^2$**

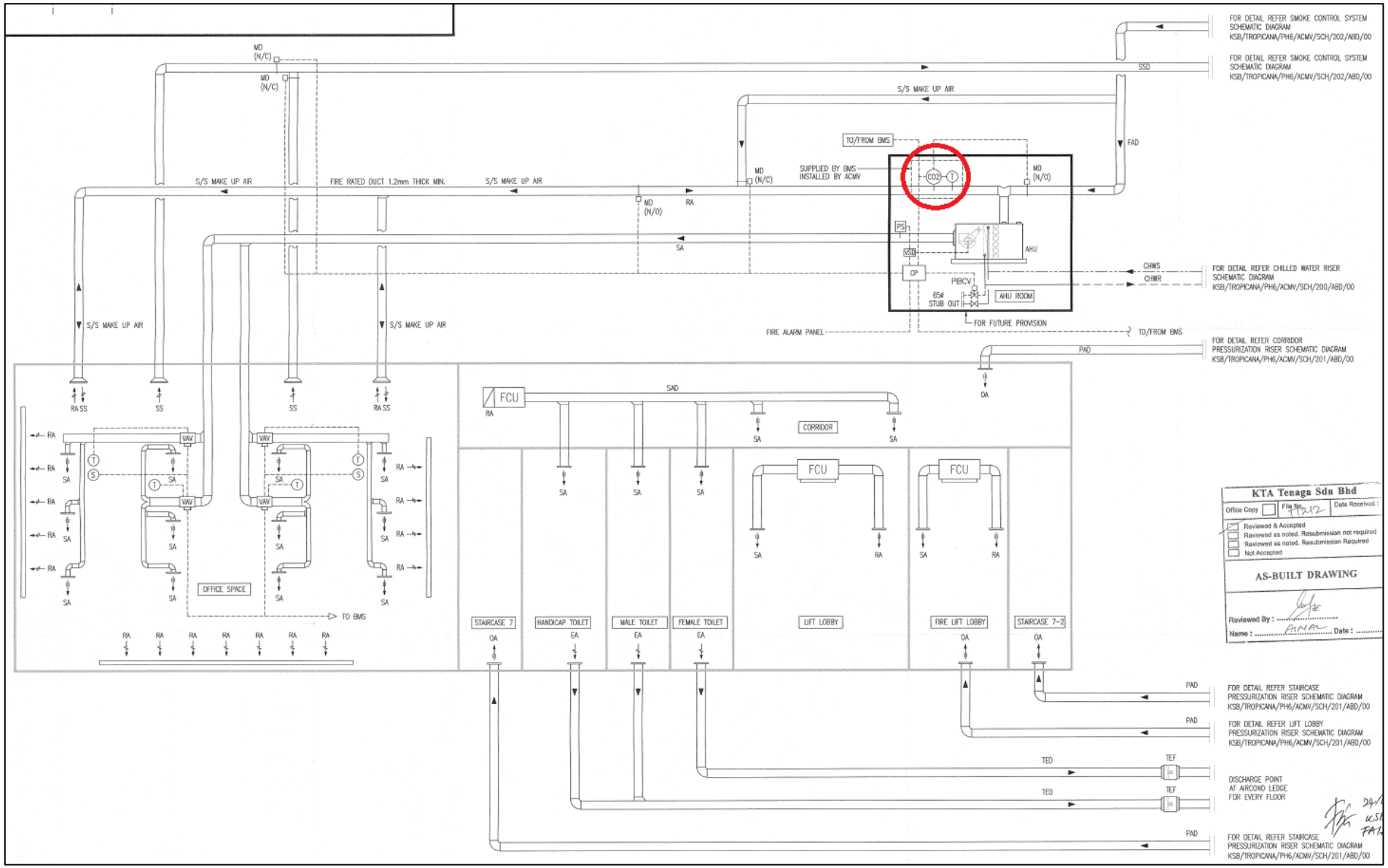
## EQ3 CARBON DIOXIDE MONITORING AND CONTROL

*Install carbon dioxide (CO2) monitoring and control system with at least one (1) CO2 sensor at all main return points on each floor to facilitate continuous monitoring and adjustment of outside air ventilation rates to each floor and ensure independent control of ventilation rates to maintain CO2 level ≤ 1,000ppm.*

In general, the $CO_2$ sensor was mounted in the **return air duct** to regulate the outdoor air based on the **$CO_2$ level** in the rooms. This measure is part of the strategy to improve the energy efficiency of the building. The data from the sensors is used to control the motorised volume damper (labelled as MD) automatically if $CO_2$ level is **≥ 900ppm**. The MD is installed at the outdoor air duct and will be regulated to provide fresh air to the various spaces to ensure that the $CO_2$ level is **≤ 1000ppm**. If the $CO_2$ level is ≥1000ppm and the outdoor air damper is at 100% open, variable speed drive (VSD) of AHU will ramp up to increase the supply air flow from the respective AHU until lower limit of $CO_2$ level (≤ 1000ppm) is achieved.

The measuring range of the $CO_2$ sensors used will be within **0-2000ppm** (parts per million) and the accuracy will be **± 30ppm $CO_2$** or **± 3% of measured value**.

The following is the typical AHU schematic diagrams with installed $CO_2$ sensors:

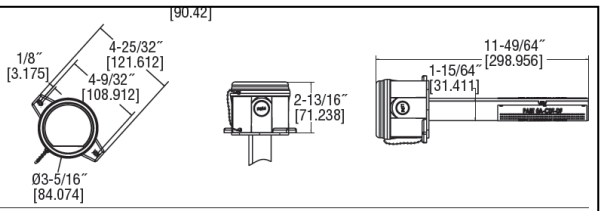

FOR DETAIL REFER SMOKE CONTROL SYSTEM SCHEMATIC DIAGRAM KSB/TROPICANA/PH6/ACMV/SCH/202/ABD/00
FOR DETAIL REFER SMOKE CONTROL SYSTEM SCHEMATIC DIAGRAM KSB/TROPICANA/PH6/ACMV/SCH/202/ABD/00
MD (N/C)
MD (N/C)
SSD
S/S MAKE UP AIR
TO/FROM BMS
FAD
S/S MAKE UP AIR
FIRE RATED DUCT 1.2mm THICK MIN.
S/S MAKE UP AIR
MD (N/C)
SUPPLIED BY BMS INSTALLED BY ACMV
MD (N/O)
MD (N/O)
RA
SA
PS
VSD
AHU
CP
CHWS
CHWR
FOR DETAIL REFER CHILLED WATER RISER SCHEMATIC DIAGRAM KSB/TROPICANA/PH6/ACMV/SCH/200/ABD/00
PIBCV
65ø STUB OUT
AHU ROOM
FOR FUTURE PROVISION
S/S MAKE UP AIR
S/S MAKE UP AIR
FIRE ALARM PANEL
TO/FROM BMS
PAD
FOR DETAIL REFER CORRIDOR PRESSURIZATION RISER SCHEMATIC DIAGRAM KSB/TROPICANA/PH6/ACMV/SCH/201/ABD/00
OA
RA SS
SS
SS
RA SS
FCU
SAD
RA
SA
CORRIDOR
SA
VAV
RA
SA
OFFICE SPACE
TO BMS
FCU
FCU
STAIRCASE 7
HANDICAP TOILET
MALE TOILET
FEMALE TOILET
LIFT LOBBY
FIRE LIFT LOBBY
STAIRCASE 7-2
OA
EA
EA
EA
OA
OA
KTA Tenaga Sdn Bhd
Office Copy
File No.
Date Received :
Reviewed & Accepted
Reviewed as noted. Resubmission not required
Reviewed as noted. Resubmission Required
Not Accepted
AS-BUILT DRAWING
Reviewed By :
Name :
Date :
PAD
FOR DETAIL REFER STAIRCASE PRESSURIZATION RISER SCHEMATIC DIAGRAM KSB/TROPICANA/PH6/ACMV/SCH/201/ABD/00
PAD
FOR DETAIL REFER LIFT LOBBY PRESSURIZATION RISER SCHEMATIC DIAGRAM KSB/TROPICANA/PH6/ACMV/SCH/201/ABD/00
TED
TEF
TED
TEF
DISCHARGE POINT AT AIRCOND LEDGE FOR EVERY FLOOR
PAD
FOR DETAIL REFER STAIRCASE PRESSURIZATION RISER SCHEMATIC DIAGRAM KSB/TROPICANA/PH6/ACMV/SCH/201/ABD/00

The following is **catalogue** of installed $CO_2$ sensor:

Carbon Dioxide Transmitters

Scan here to watch product video

Duct




The **SERIES CDT** Carbon Dioxide and Temperature Transmitters accurately monitor the $CO_2$ concentration and temperature in indoor environments to help achieve energy savings. For increased sensor accuracy, a single beam dual wavelength non-dispersive infrared (NDIR) sensor is used to automatically correct the measurement in both occupied* and unoccupied buildings against light source aging effects. The single beam dual wavelength sensor technology provides the highest level of accuracy compared to Automatic Baseline Correction methods which can unintentionally shift the calibration based on $CO_2$ levels and barometric pressure conditions. In order to achieve a higher level of accuracy, the Series CDT includes digital barometric pressure adjustment and the ability to field-calibrate the sensor.
For applications that require visual indication, the wall mount configurations of the Series CDT can be ordered with an integral LCD display. Push buttons are standard on all configurations of the transmitters for access to the menu structure, but wall mount configurations can be ordered without the buttons. To prevent tampering, the action of the buttons can be locked out using an internal dip switch selection.

**FEATURES/BENEFITS**
- Single beam dual wavelength NDIR sensor eliminates draft due to light source aging
- Integral passive temperature outputs reduce number of devices mounted in the space
- Service display tool available for models without an integral LED
- Optional integral display and relay output

**APPLICATIONS**
- Demand control ventilation in schools, office buildings, hospitals, and other indoor environments
- LEED® certification

*For buildings occupied 24 hours per day, it is recommended that calibration be verified every 6 to 12 months depending on application.

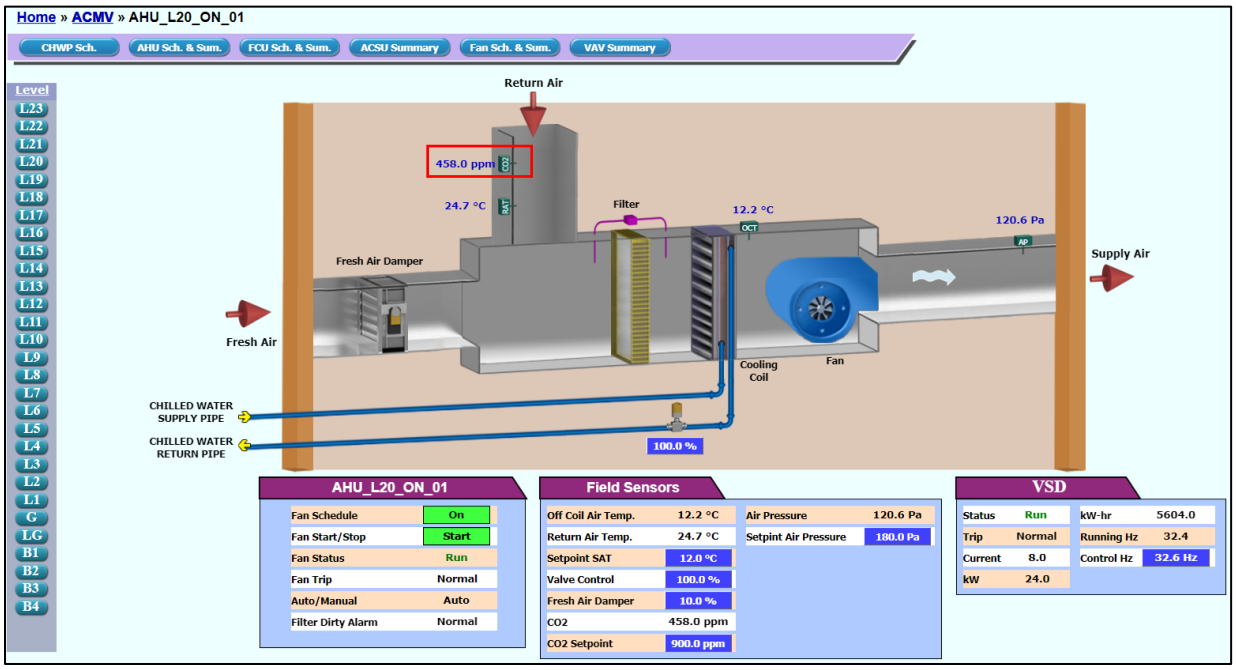
**SPECIFICATIONS**

**Sensor:** Single beam, dual wavelength NDIR.
**Range:** $CO_2$: 0 to 2000 or 0 to 5000 ppm (depending on model); Temperature: 32 to 122°F (0 to 50°C).
**Accuracy:** $CO_2$: ±40 ppm ±3% of reading; RH: ±2% (10 to 90% RH); **Temperature:** ±1°C @ 25°C.
**Temperature Dependence:** ±8 ppm/°C at 1100 ppm.
**Non-Linearity:** 16 ppm.
**Pressure Dependence:** 0.13% of reading per mm of Hg.
**Response Time:** 2 min for 99% step change.
**Duct Air Velocity Range:** 0-4000 FPM (20.32 m/s).
**Temperature Limits:** 32 to 122°F (0 to 50°C).
**Humidity Limits:** 10 to 95% RH (non-condensing).
**Power Requirements:** 16 to 35 VDC or 19 to 28 VAC.
**Power Consumption:** Average: 2 w; Peak: 3.75 w.
**Output:** Current: 4 to 20 mA (max. 500 Ω); Voltage: 0 to 5 VDC or 0 to 10 VDC (min. 500 Ω); Relay: SPST NO rated 2 A @ 30 VDC.
**Weight:** 4.4 oz (125 g).
**Agency Approvals:** CE.

**ACCESSORIES**

| Model | Description |
|---|---|
| GCK-200CO-2000CO2 | Calibration gas kit includes a 99.99% nitrogen |

The following is typical AHU system in BMS with installed $CO_2$ setpoint and level monitoring:



## EQ5 MOULD PREVENTION

*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.*
*Ensure that excessive moisture in building is controlled during the Design, Construction and Operation stages by the consideration and the control of the following:*

*1) Rainwater leakage through roof and walls*
*2) Infiltration of moist air*
*3) Diffusion of moisture through walls, roof and floors*
*4) Groundwater intrusion into basements and crawl spaces through walls and floors*
*5) Leaking or burst pipes*
*6) Indoor moisture sources*
*7) Construction moisture*

In general, there are a few factors that ensure mould growth in artificial environment such as buildings:

1) **Mould spores**
2) **Nutrients** such as dirt, dust cellulose and starch
3) **Relative Humidity** consistently above **70%**
4) **Oxygen**

To prevent mould growth, the main measure will be to prevent and manage moisture in the building. There are 2 broad areas of moisture to control and manage:

1) **Bulk Water Intrusion**
   This refers to uncontrolled water flow into the building. This could occur due to leaks or flooding after a huge rain event.

2) **Evaporation and Condensation**
   Evaporation and condensation can do a lot of damage.

The following strategies shall be adopted to prevent mould growth:

**<u>During Construction</u>**

(i) Building materials, especially those with moisture absorbing properties like wood, insulation, paper and fabric, should be kept dry to prevent the growth of mould and bacteria.

(ii) Water damaged materials should be dried within 24 hours. Due to the possibility of mould growth, materials that are damp or wet for more than 72 hours may need to be discarded.

(iii) Solvents, cleaners, gasoline, or other odorous or potentially toxic liquids that are spilled onto floor, they should be cleaned up immediately. If a spill occurs on an easily replaced building material, it may be safest it discards it and replace it with new material.

(iv) Seal all unnecessary openings in walls, floors and ceilings that separate external and internal spaces to minimize rainwater moisture leakage into occupied zone.

(v) As ductwork is being installed, all return and supply air vents and any open ductwork should be temporarily sealed to prevent the duct-work and air handling units from being contaminated with construction debris or dust.

(vi) Comprehensive visual inspection to be completed. Photographic evidence was collected to show that the activities during construction were acceptable and conformed to the defined Mould and Moisture Management Plan.

**Architectural & Structural**

(i) Ensure rainwater will not leak through the roofs and walls of the buildings. Roofs shall have proper joints and waterproofing to be carried out properly.

(ii) This building is designed to use waterproofed concrete and waterproofed paint for building material that allowed the mould prevention. Waterproofing works shall be carried out properly.

(iii) Prevent groundwater intrusion into basements and crawl spaces through walls and floors by ensuring good waterproofing concrete floor for basement and walls.

(iv) Structural design of substructure or building basement to be based on British Standard Code of Practice BS8007 – Design of concrete structures for retaining aqueous liquids.

(v) In the event of leakage, such leakage to be pressure grouted with appropriate and approved material such as epoxy grout or polyurethane grout.

**Mechanical & Electrical**

(i) The mechanical air-conditioned ventilation system shall be designed for Indoor Air Temperature of 23.0ºC DB ± 1.0ºC and Relative Humidity of 65 ± 5% RH for building spaces.

(ii) To prevent infiltration of moist air by maintaining positive pressure for indoor air.

(iii) Prevent leaking and burst pipes by having routine check on the pipe systems.

(iv) Ensure the indoor moisture sources e.g., water tank room are well ventilated.

(v) The relative humidity (RH) of all areas served by air conditioning system shall not exceed 70% as required by MS1525:2007.

(vi) All pressure tests to be conducted properly for piping works for all services to ensure no leakages especially for pipes embedded in walls or through slabs.

**Maintenance**

(i) Building maintenance team is responsible to rectify pipe and building leakages. Practice regular maintenance around the building, especially for waterproofing repairs needed. It will likely to spot potential problems before it becomes a big problem.

(ii) All floor levels house-kept daily ensuring dry and clean environment.

(iii) The occupants of the building will be made aware to ensure that no unconditioned outdoor air is allowed into the space through open windows. This could lead to condensation of supply air outlets, window etc.

(iv) All air-filters will be cleaned regularly and replaced as per manufacturer's recommendations.

## EQ6 THERMAL COMFORT: DESIGN & CONTROLLABILITY OF SYSTEMS

*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.*

### Thermal Comfort Design

The design shall provide a thermal environment that is comfortable and supports the productivity and well-being of building occupants. This can be achieved by designing the thermal comfort system to **ASHRAE 55 standards** (which is affected by **air temperature**, **humidity**, **mean radiant temperature** and **air speed** in the space) in conjunction with the relevant localized parameters as listed in **MS1525:2014**. The summary of those parameters are as follows:

1. Outdoor design conditions
   (a) Outdoor air dry bulb temperature = **33.3 deg C**
   (b) Outdoor air wet bulb temperature = **27.2 deg C**

2. Indoor design conditions (air-conditioned space to provide thermal comfort)
   (a) Recommended design dry bulb temperature = **23 deg C to 26 deg C**
   (b) Minimum dry bulb temperature = **22 deg C**
   (c) Recommended design relative humidity = **55% to 70%**
   (d) Recommended air movement = **0.15 m/s to 0.50 m/s**
   (e) Maximum air movement = **0.70 m/s**

### Thermal Comfort Controllability

Conditions for thermal comfort include the primary factors of **air temperature**, **humidity**, **mean radiant temperature** and **air speed**. Comfort control for this purpose is defined as the provision of control over at least one of the primary factors in the occupants' local environment.

Below are the strategies to achieve individual thermal comfort > 50% of the building occupants to enable adjustment:

- Thermostat for each zone is placed at occupancy height and location in order to accurately measure and thus regulated the temperature of the respective zones.
- Constrain air flow rates in order to reduce noise level to the required rate.

## EQ10 ELECTRIC LIGHTING LEVELS

*Demonstrate that lighting design maintains a luminance level of no more than specified in MS1525:2007 for 90% of NLA.*

The illumination level will be selected to generally comply with MS1525 recommendation. The design of the illuminance levels for the various spaces in the building is generally in accordance with the recommendations from local Malaysian Code of Practice on Energy Efficiency and Renewable Energy for Non-Residential Building **MS1525: 2007**.

The illumination level shall not exceed the MS1525 guidelines to avoid unnecessary power consumption. The lux level is based on maintenance illuminance. Maintenance illuminance shall be calculated using the lamp light output lumens at an average **85%** of the specified initial lamps' lumens output. Maintenance factor shall be **0.85**.

| Task and applications | Illuminance (Lux) |
|---|---|
| a) Lighting for infrequently used area: | |
| - Minimum service illuminance | 20 |
| - Interior walkway and car-park | 100 |
| - Hotel bedroom | 100 |
| - Lift interior | 100 |
| - Corridor, passageways, stairs | 100 |
| - Escalator, travellator | 150 |
| - Entrance and exit | 100 |
| - Staff changing room, locker and cleaner room, cloak room, lavatories, stores. | 100 |
| - Entrance hall, lobbies, waiting room | 100 |
| - Inquiry desk | 300 |
| - Gate house | 200 |
| b) Lighting for working interiors | |
| - Infrequent reading and writing | 200 |
| - General offices, shops and stores, reading and writing | 300 - 400 |
| - Drawing office | 300 - 400 |
| - Restroom | 150 |
| - Restaurant, canteen, cafeteria | 200 |
| - Kitchen | 150 - 300 |
| - Lounge | 150 |
| - Bathroom | 150 |
| - Toilet | 100 |
| - Bedroom | 100 |
| - Class room, library | 300 - 500 |
| - Shop/supermarket/department store | 200 - 750 |
| - Museum and gallery | 300 |
| c) Localised lighting for exacting task | |
| - Proof reading | 500 |
| - Exacting drawing | 1 000 |
| - Detailed and precise work | 2 000 |

**EQ11 HIGH FREQUENCY BALLASTS**
*Install high frequency ballasts in fluorescent luminaries over a minimum of 90% of NLA.*

Conventional fluorescent lighting operates at a frequency of 50Hz (i.e., mains frequency) and this results in the light switching on and off **100 times per second** and may cause headache and eye strain. With the use of high frequency ballasts (in the range of 20 kHz and higher), **smoother** and **non-flickering** lamp operation is provided, and this flicker is totally undetectable at this high frequency. This will ensure better visual comfort for the occupants.

The purpose of having high frequency ballast is to provide a comfortable visual working environment for occupants. Electronic lamp ballast uses **solid state electronic circuitry** to provide the proper starting and operating electrical condition to power one or more fluorescent lamps. Electronic ballasts usually change the frequency of the power from the standard mains frequency of **50 – 60 Hz** to **20,000 Hz** or higher. Lamp **efficiency** increases sharply at about 10 kHz and continues to improve until approximately 20 kHz. By using high frequency ballasts, the **efficacy** of the lamp can be improved (lumen watt of the lamp output) as fluorescent lighting is sensitive to the operating frequency.

For fit-out retail space, all luminaires installed shall be either **T5 fluorescent tubes** with high frequency ballasts or **LED** lightings. For common area corridors, back of house areas and staircases, LED lamps and downlights shall be used.

**EQ13 INTERNAL NOISE LEVELS**
*Maintain internal noise levels at an appropriate level.*

The intent aims to highlight the precautionary measures that will be undertaken to maintain the internal noise level at an acceptable and tolerable level. The desired results will be to keep the sound level below or equal to **45 dBA** for open spaces and **40 dBA** for enclosed offices.

Acoustic control in ACMV installations is critical to prevent sound generated by the ACMV equipment and by air turbulence within the system (being transmitted via the network of ducts) from causing discomfort to the building occupants. Generally, the sources of noise generated by ACMV equipment include:

(i) AHUs
(ii) FCUs
(iii) Exhaust Fans

Acoustic control in ACMV installations can be addressed through a combination of careful system selection and an effective insulation solution. The strategies are:

(i) Design duct and fittings using good engineering practice (e.g., complying with **recommended air velocity** when designing ducting system).

(ii) Mount fans in Air Handling Units (AHUs) with properly designed **vibration isolators** / **inertia blocks**.

(iii) Isolate Fan Coil Units (FCUs) and the horizontal pipes and ducts run from soffit of ceiling slab with either **rubber grommet** or **spring isolators**.

(iv) Install a layer of **internal lining** in the air conditioning supply air duct at least six (6) meters from the AHUs / FCUs and in the **supply and return air duct**.

(v) Conduct a proper equipment selection so that **equipment with lower NC level** will be selected. For example, select a fan that operates as near as possible to its rated peak efficiency when handling the required airflow and static pressure.

(vi) Install **silencers** for fans and **flexible connector** at the inlet and outlet of fans to prevent vibration transmission from the fans to the adjacent ductworks.

(vii) Ensure all pipes, ducts and partition **penetrations are sealed** properly. If these penetrations are not properly treated, they provide a path for airborne noise, which can destroy the acoustical integrity of the occupied space.

(viii) Specify **acoustical ceilings** and **furniture with sound absorbing surfaces** on both sides if necessary.

**EQ14 IAQ BEFORE & DURING OCCUPANCY**
*Reduce indoor air quality problems resulting from the construction process in order to help sustain the comfort and well-being of building occupants.*

Building Flush Out

Building flush out could be categorised into 2 sections:

- Pre-occupancy air flushing – to provide not less than **10 airchanges/hour** (ACH) for at least **30 minutes** of operation.
- Post-occupancy air flushing – continuous minimum **1 ACH** during the initial **14 days** occupancy.

Pre-Occupancy Air Flushing - Office lots (after ID fit-out works)
Scheduled pre-occupancy air flushing via SSF and MAF systems has been conducted at the newly renovated office spaces in accordance with the flushing procedures/steps below. Please refer to Figures 1 and 2 for better illustration of flushing procedures.

i. Manually run SSF and MAF. Please refer to Figures 3 & 4.
ii. Bypass the fire mode at fire control panel in the AHU room. Please refer to Figure 5.
iii. Modulating fire dampers (normally close) at smoke spill ducts will be opened. Please refer to Figures 6 & 7.
iv. Manually open the modulating fire damper (normally close) at fresh air duct connected to the main return air duct. Please refer to Figures 8 & 9.
v. Manually close the modulating damper (normally open) at the AHU fresh air duct. Please refer to Figures 10 & 11.

Post-Occupancy Air Flushing – Office Space

Post-occupancy air flushing shall be carried out using fresh air supply from air-conditioning during business hours. The requirement of post-occupancy air flushing of **1 ACH** during the initial **14 days** shall be achieved by running the air-conditioning minimum 12 hours per day, 7 days per week.

## EQ15 POST OCCUPANCY COMFORT SURVEY: VERIFICATION

*Provide for the assessment of comfort of the building occupants.*

**Building occupants** represent a wealth of information about how well a building works. The challenge is to collect and analyse this input in a **systematic** and **meaningful** manner. Comfort survey of occupants' satisfaction allows designers, developers, owners, operators, and tenants to objectively gauge how well the building services and design features are working. This will help the employers to optimize employees' productivity and effectiveness.

Post occupancy comfort survey shall be carried out for **employees**. Online survey forms shall be utilized to determine occupants' reaction to:

1. **Thermal Comfort** – Temperature, relative humidity, air speed and mean radiant temperature.
2. **Lighting Quality** – Lighting level and glare problem.
3. **Acoustical Quality** – Background noise level.
4. **Indoor Air Quality** – Odour problem, $CO_2$ level, VOCs and particulate concentration.

The feedbacks by the occupants shall be summarized as the following:

| Description | Satisfaction | Neutral | Dissatisfaction |
|---|---|---|---|
| Thermal Comfort | % | % | % |
| Lighting Quality | % | % | % |
| Acoustical Quality | % | % | % |
| Indoor Air Quality | % | % | % |

**Corrective action plan** shall be developed if the survey results indicate that **more than 20%** of occupants are **dissatisfied** with the overall comfort in the building. This plan shall include **measurements** of relevant environmental variables in problem areas.

The following is sample of **Correction Action Plan**:

| IEQ Complaint | Corrective Actions |
|---|---|
| 1. Too cold or hot | Data-loggers will be placed at the problematic areas. The data-loggers will record and store measurements at max. 10 minute intervals for a 8 hour period over min. 2 working days.<br><br>If the air temperature reading falls outside the temperature range of 23 - 26ºC, the set point has to be re-set and/or the volume of airflow adjusted. |
| 2. Too dry or humid | Data-loggers will be placed at the problematic areas. The data-loggers will record and store measurements at max. 10 minute intervals for a 8 hour period over min. 2 working days.<br><br>If the relative humidity falls outside the recommended range of 55-70%, the set point has to be re-set, the off coil temperature adjusted and/or the volume of airflow adjusted to fall within the acceptable relative humidity range. |
| 3. Draughty/breezy | Spot measurement will be carried out using an anemometer to measure the air velocity of the problematic areas.<br><br>If the average air velocity falls outside the recommended 0.1-0.2m/s range, the volume of airflow has to be adjusted to still meet the temperature set-point but reduce the risk of draft.<br><br>The diffuser can be adjusted manually to suit the comfort range of the occupants. |
| 4. Stuffiness/odour | Carbon dioxide concentrations to be measured once every five minutes for a 10 hour period over 2 days.<br><br>If the carbon dioxide level in the space exceeds 1000ppm, it is an indication that the fresh air damper in the air handling unit is unable to provide sufficient fresh air to dilute the CO2 build up during peak occupancy.<br><br>Check the CO2 sensor set-point to ensure that the damper opening of the fresh air intake is properly regulated. |

## MR7 REFRIGERANTS & CLEAN AGENTS

*Use zero Ozone Depleting Potential (ODP) products: non-CFC and non-HCFC refrigerants/clean agents.*

The **refrigerants** & **clean agents** used shall be zero Ozone Depleting Potential (ODP) products: non-CFC and non-HCFC.

As an effort to demonstrate leadership in accelerating phase-out of all Ozone Depleting Substances, Tropicana Gardens Office Tower has employed the usage of environmentally friendly **Refrigerants** for the air-conditioning system.

The refrigerant used in the **chiller plant** is **HFC-134a** and **air-cooled split units** used **R-410a**. It contains no chlorine; **zero Ozone Depleting Potential (ODP)**, **non-CFC** and **non-HCFC** type.

The Fire Protection System for the whole building is designed in accordance with **NFPA** and complied with Jabatan Bomba dan Penyelamat (Fire and Rescue Department) Malaysia. The fire suppression system used in HT Room, Genset Room, LV Room, Transformer Room is **$CO_2$** Gas Fire Extinguishing System.

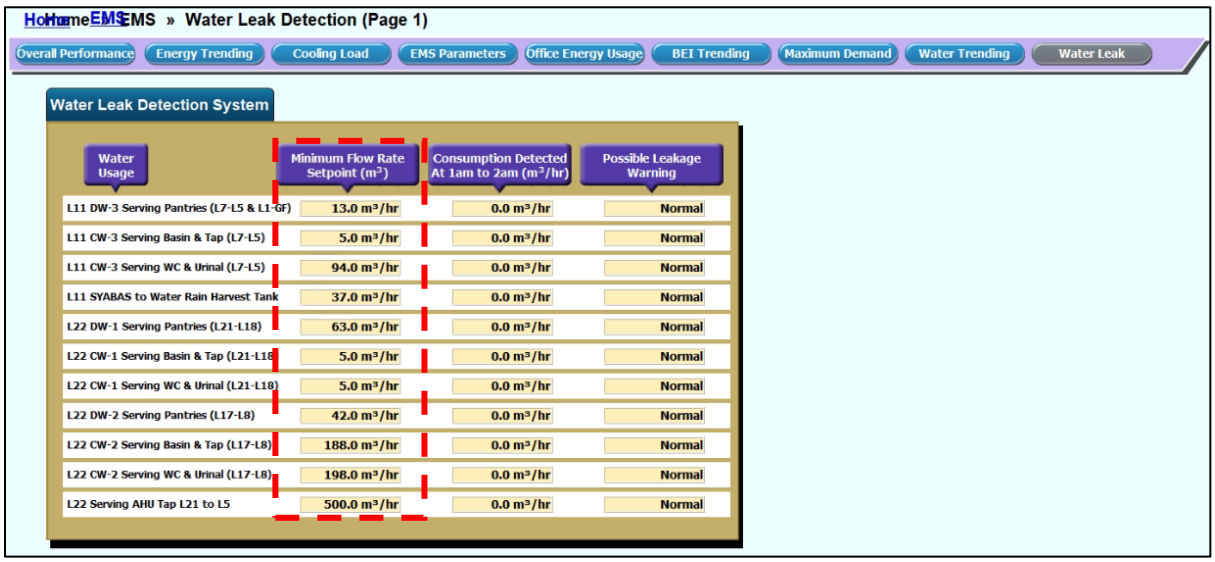
## WE5 METERING & LEAK DETECTION SYSTEM

*Use of sub-meters to monitor and manage major water usage for cooling towers, irrigation, kitchens and tenancy use. Link all water sub-meters to EMS to facilitate early detection of water leakage.*

Generally, DWMs are provided for three (3) areas of major water usage:

i. **Domestic Water**
ii. **Rainwater**
iii. **Toilets & Pantries**

All the digital water meters (DWMs) are linked to the **Energy Management System (EMS)**.




By linking the reading to BMS, water usage trends can be recorded. An alarm/warning can be activated if there is a sudden increase in water consumption or a new pattern in water consumption as this could be an indication of a possible water leak. With the use of digital water meter (DWM), any deviation from normal water consumption treads can be detected and investigated to determine events of water leakages.

Notification on excess water consumption would be available from the building BMS. Threshold will be established. Water leakages will be assumed to have occurred if the detected water consumption exceeds the established threshold. The threshold is monitored and further fine-tuned to avoid **false alarms**.

## IN1 INNOVATION IN DESIGN & ENVIRONMENTAL DESIGN INITIATIVES

***Pressure Independent Balancing Control Valve System***

Pressure Independent Balancing Control valves (PIBCV) always ensure a well distributed balanced flow throughout the entire chilled water piping system, from partial load up to full load conditions. By eliminating over-flow even at partial load conditions, it saves on chiller and pump operating energy and at the same time able to control temperature at all load conditions.

It lowers the pumping head and operating power requirement because by using this valve, there is no need to have additional branch balancing valves or pressure differential control valves.

Some benefits of PIBCV including: -

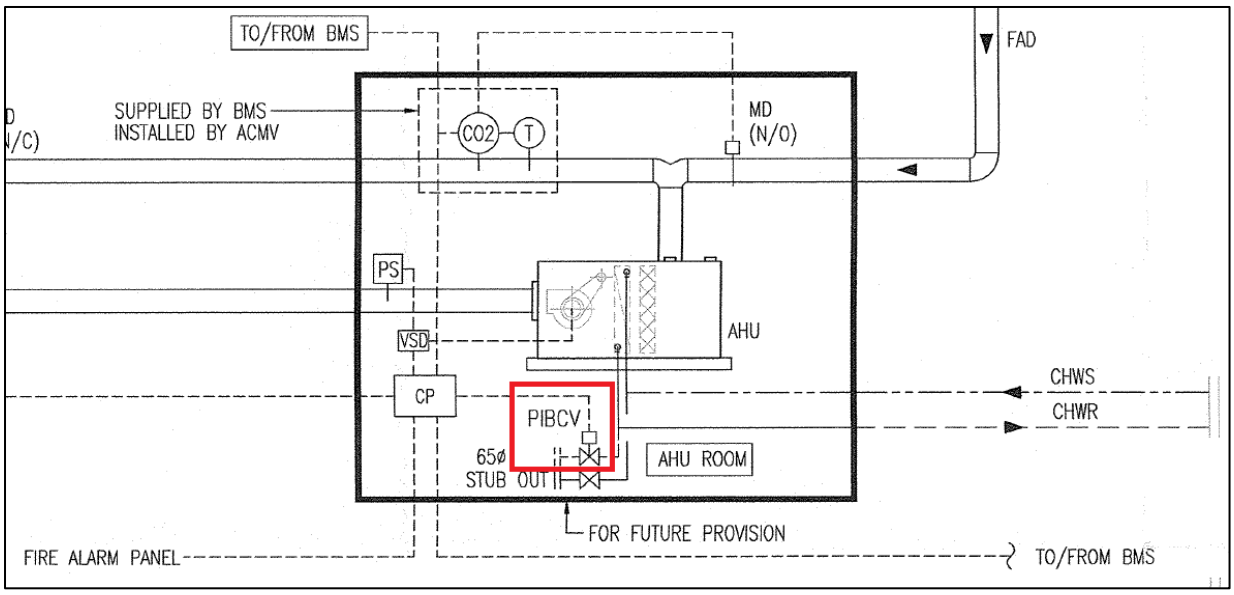
i) Lower commissioning time.

ii) Offers automatic balancing, temperature control, differential pressure regulation, flow monitoring as well as allowing feedback to the BMS system.

iii) Promotes building maintenance because it uses ONE standard actuator for all various sizes of valves, hence possible to have less backup actuators for the building.

iv) More efficient chilled water system.

**Typical Installation of PIBCV at AHU**

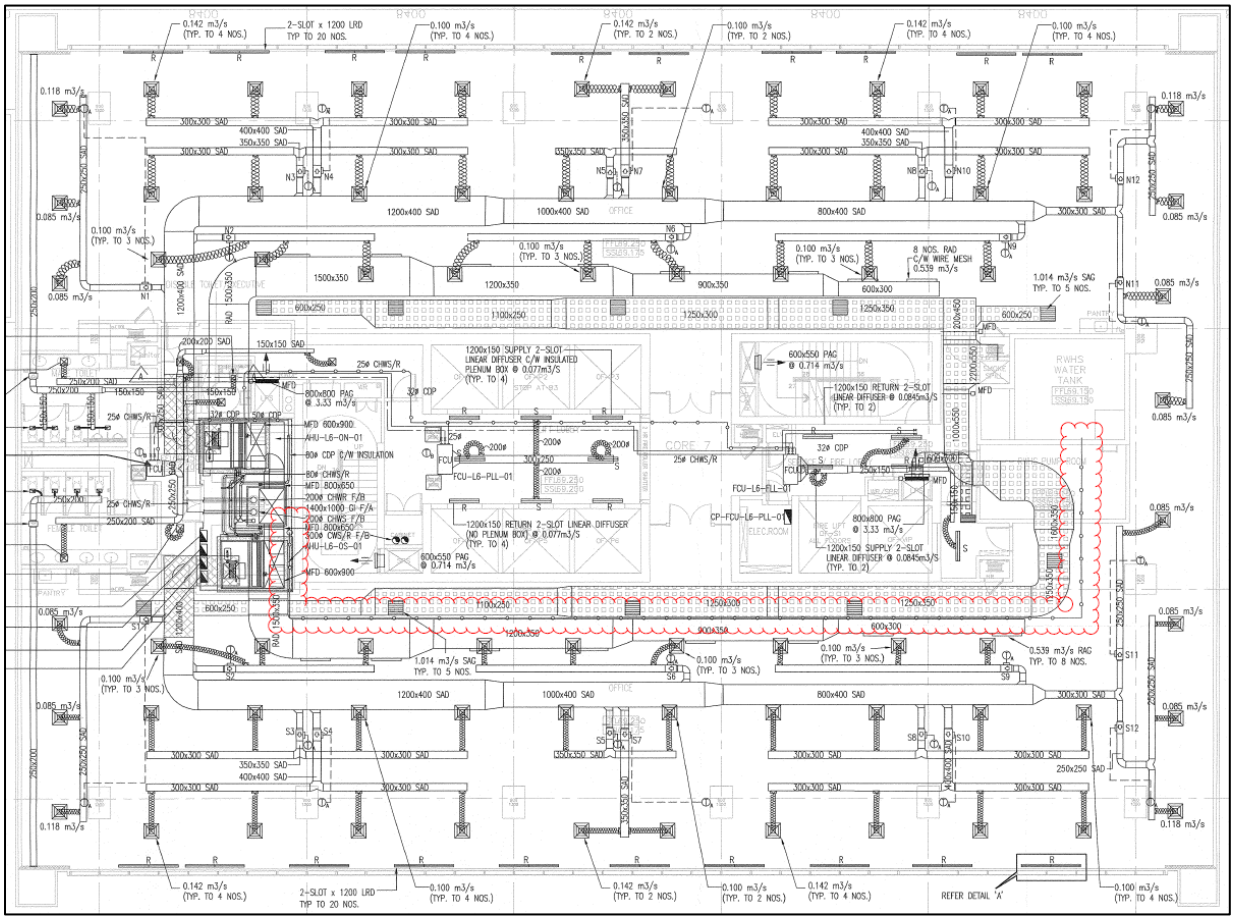


***Condensate Water Recovery and Use***

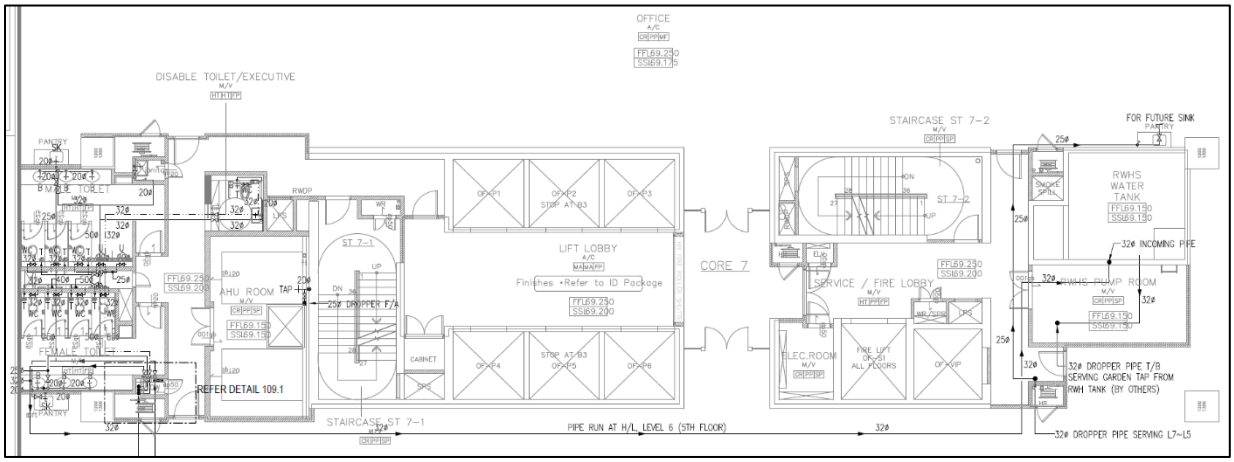
With the high capacity of air-conditioning system in Tropicana Gardens Office Tower, the amount of condensate produced can be quite significant. Condensate from more than 50% of AHUs and FCUs are gravity fed for landscape irrigation on Level 5 (4th Floor) and Ground Floor.

The main purpose of recovering the condensates from the terminal units (AHUs / FCUs) are to conserve water or reduce the building operating costs. The drainpipes of AHUs and FCUs from Level 6 and above have been connected to a common vertical drainpipe leading the condensates to a shared rainwater harvesting/condensate water tank, which is located at the rainwater harvesting tank room in Level 6 (5th Floor).

**Condensate Drainpipe to Condensate Water Storage Tank at Level 6 (5th Floor)**



**Outgoing from Condensate Water Tank for Landscape Irrigation**



**SOFTCOPY OF OPERATION & MAINTANENANCE MANUAL AND AS BUILT DRAWINGS:**

As the volumes of O&M Manual are huge, they will be presented in softcopy in DVD format instead of print-out hard copies:

1. ACMV Services O&M Manual and As Built Drawings
2. Cold Water and Sanitary Plumbing Services O&M Manual and As Built Drawings
3. Electrical & ELV O&M Manual and As Built Drawings
4. Fire Protection System O&M Manual and As Built Drawings
5. BMS O&M Manual and As Built Drawings
6. Lift O&M Manual and As Built Drawings
7. Façade Lighting O&M Manual and As Built Drawings
8. ELV Security System O&M Manual and As Built Drawings