CREDIT SM13 BUILDING USER MANUAL

BUILDING SYSTEM MANUAL

(ACTIVE GREEN FEATURES)

for Commissioning Specialist Works,

GBI (Green Building Index) Certification of

TROPICANA GARDENS MALL

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

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Date: 18 August 2022	

PROJECT DESCRIPTION

Tropicana Gardens Mall 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 midsized neighbourhood shopping mall is directly connected to the Surian MRT station and easily accessible from either Persiaran Surian or Persiaran Tropicana.

Tropicana Gardens Mall is equipped with a range of green building features and design strategies. The 7 storey mall consists of 4 levels of basement car park, 7 above ground levels of general retail, F&B, cinema, entertainment spaces, gymnasium and 50,000 sq. ft. convention centre.

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

PROJECT AREAS

GFA excld. Carpark	175,401 sqm
GLA	98,464 sqm

PROJECT TEAM

Owner / Developer	**Tropicana Indah Sdn. Bhd.**
Main Contractor	**GD Capital Holdings Sdn. Bhd.**
Architect	**GDP Architects 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 labeled 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 Mall 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).

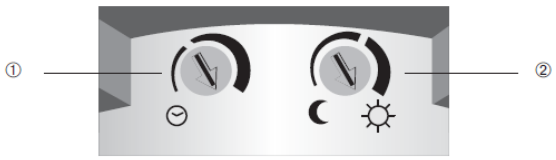
Level	Floor	Motion Sensor
L7	6th	
L6A	5A	-
L6	5th	-
L5A	4A	-
L5	4th	41
L4A	3A	-
L4	3rd	58
L3	2nd	56
L2	1st	83
L1	Ground	67
G	CC	67
LG	LG	1
B1	B1	-
B2	B2	1
B3	B3	11
B4	B4	9
Total Qty		**394**

Detector 360° flush mounted

EE805

Technical Properties	
Supply voltage	230 V +10% / -15%
Frequency	50 Hz
Protection class	isol.class II
Protection index IP	IP21
Type of contacts	1NC
Detection angle	360 °
Diameter of the floor detection area	6 m
Maximum Mounting Height	4 m
Width of installed product	19 mm
Length	74 mm
Mounting type	flush-mounted
Fixing mode	section make
Max. power with fluo uncompensated lamps	1000 VA
Halogen switching capacity 230V	0/1000 W
Incandescent bulb power	0/1000 W
Brightness measurement range	5/1000 Lux
Time delayed range	5s ; 15min
Operating temperature	0 to 45 °C
Storage temperature	-20 to 60 °C
Colour	white

Potentiometers EE804 and EE805



① Operating time setting potentiometer.
② Brightness level setting potentiometer.

Lighting output control

On power-on, the detector switches its circuit on for 30 seconds.
The lighting output is switched on when the brightness level set by potentiometer ② is considered too low and a movement is detected.
After detection, the light remains on for the time set by potentiometer ①.
The delay is reset after each movement detection occurrence.

Settings

It is possible to set potentiometers ① and ②, the operating time and the brightness level.
In order to facilitate set-up by the user, detectors are pre-set with a default setting suitable for standard installation: traffic area, corridor...

- Operating time: from 5 seconds to 15 minutes.
  Potentiometer ① is pre-set to a default value of approximately 3 min.
- Brightness level: from 5 to 1000 Lux.
  Potentiometer ② is pre-set to a default value of approximately 200 Lux.

Note:
These values can be changed using a screwdriver.

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
L7	6th	-
L6A	5A	-
L6	5th	-
L5A	4A	-
L5	4th	2
L4A	3A	-
L4	3rd	-
L3	2nd	18
L2	1st	15
L1	Ground	14
G	CC	9
LG	LG	-
B1	B1	-
B2	B2	-
B3	B3	-
B4	B4	-
Total Qty		**58**

Motion detector

HF 3360

V3 KNX - concealed, rd.
EAN 4007841 058241

STEINEL® PROFESSIONAL

high frequency sensor 360° | max. Ø 8 m | KNX | IP20 | 2 - 1000 lux | 5 sec - 15 min | ideal 2 - 2,8 m | Teach mode | energy saving | 5 JAHRE HERSTELLER GARANTIE manufacturer's warranty steinel-professional.de/garantie

Function description

Perfection through and through. High-frequency motion detector HF 3360, ideal for basement corridors, stairwells, multi-storey car parks, installation height 2.8 m, 360° angle of coverage, reach 1 – 8 m (radial), detection regardless of temperature, HF-sensor technology also detects movement through glass, wood and stud walls. Available either in round or square surface-mounted and concealed version.

Technical specifications

Type	Motion detectors
Dimensions (Ø x H)	124 x 64 mm
Sensor Technology	High frequency
Application, place	Indoors
Application, place, room	side room, stairwell, wc, washroom, multi-storey car park, underground car park, equipment room
Installation site	wall, ceiling, corner
Type of installation	Concealed wiring
HF-system	5,8 GHz
Mounting height	2,00 – 4,00 m
Optimum mounting height	2,8 m

Sneak-by guard	Yes
Twilight setting TEACH	Yes
Time setting	0 s – 1092 Min.
KNX functions	Photo-cell controller, Basic light level function, Light level, HVAC output, Constant-lighting control, Light output 2x, Presence output, Day / night function
With bus coupling	Yes
Material	Plastic
Colour	white
Colour, RAL	9003
Version	KNX - concealed, rd.
PU1, EAN	4007841058241

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 smaller.

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 MPs.

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	30
Main Switch Board (MSB & EMSB) - Landlord	100
Main Switch Board (MSB) - Tenant	26
Tenant Metering Panel (MP)	30
Sub-Switch Board (SSB) - Landlord	114
Total	**300**

EE5 ADVANCED EE PERFORMANCE

Achieve Building Energy Intensity (BEI) ***≤ 325 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 Mall shall be ***≤ 325 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 Mall can be an energy efficient low-rise commercial building.

The following main design strategies to reduce the energy consumption of Tropicana Gardens Mall 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 **241** 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.

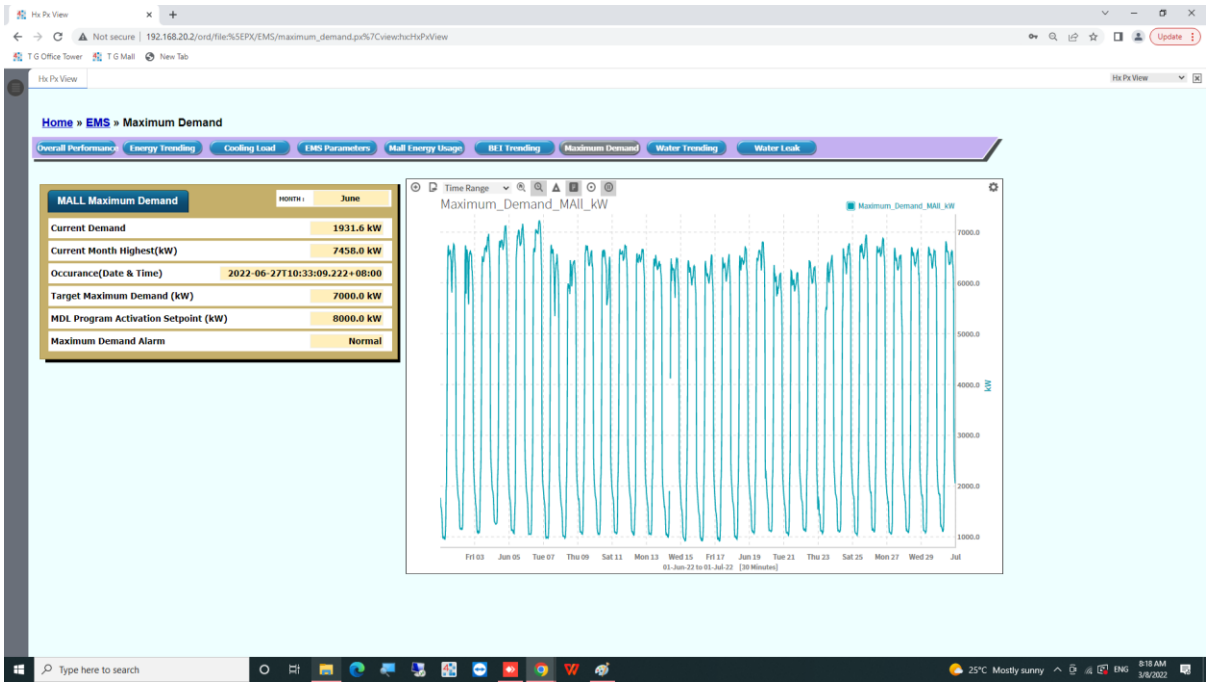
Energy Management System (EMS)

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**.

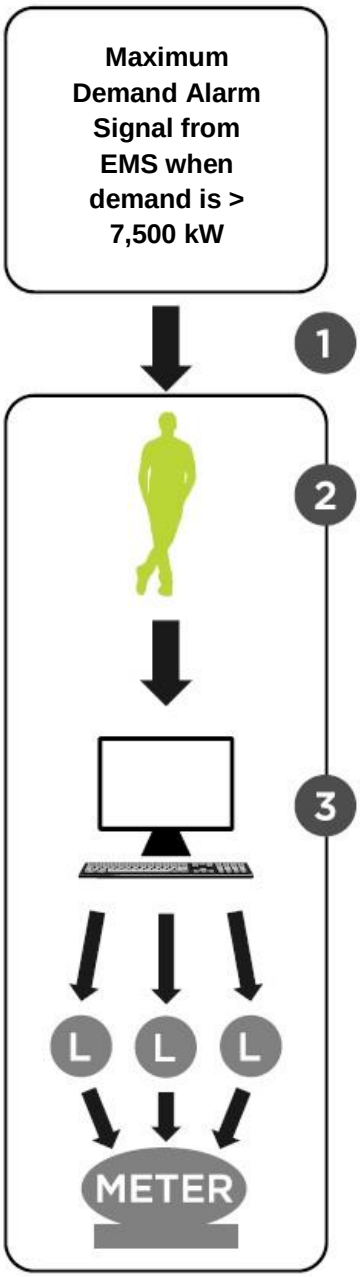
The EMS was supplemented with the building layout and system schematic to allow clear identification of location and system information that is provided by the EMS. For each DPM and DWM, a minimum logging interval shall be kept.

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 **7,500 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. Shed **Car Park Ventilation System**.

iii. Shed **Non-Critical Lightings** (basement carparks).

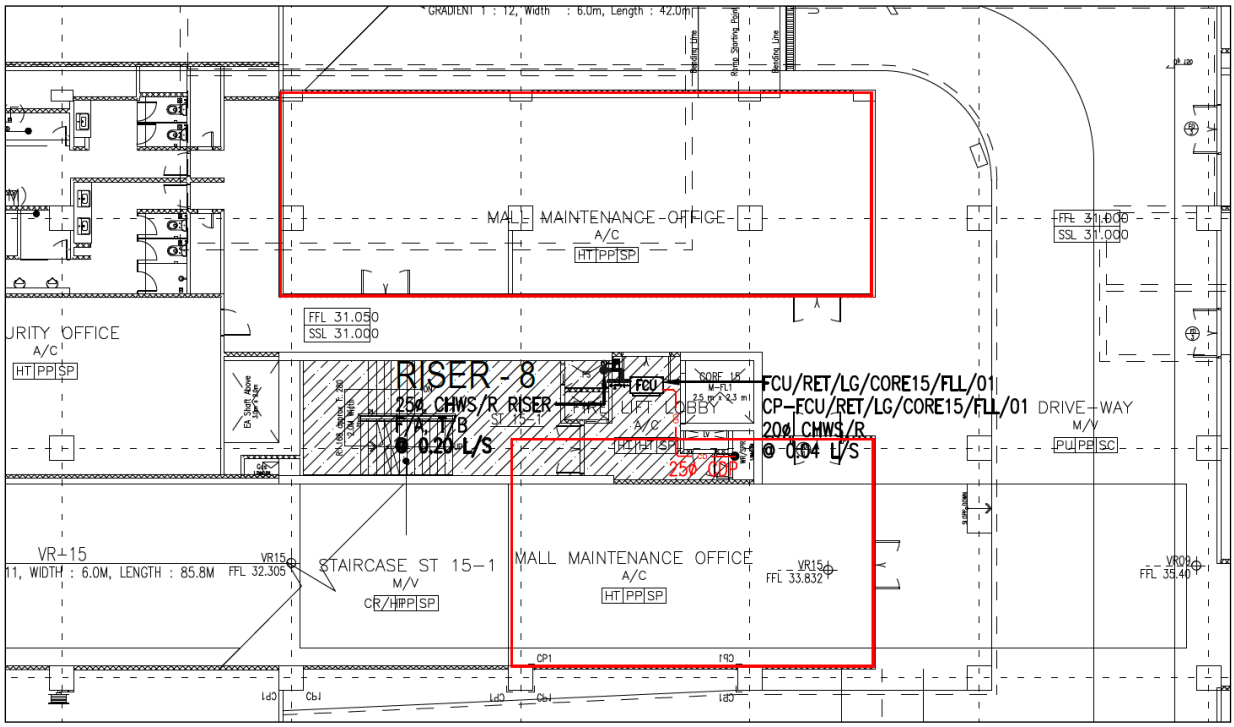
iv. Proper configuration of **secondary chilled water (SCHW) pump** speeds.

v. 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 Offices** at **LG** level that are fully equipped with facilities (including tools and instrumentation) and inventory storage are provided for the building maintenance team in the building. Both rooms shall be kept for sustainable maintenance.



Maintenance Offices 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.

The fresh air to the AHUs is supplied through Outdoor Air Fans. Additionally, the fresh air is supplied via duct work to each retail lot and to the tenants' fan coil unit (FCU).

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 Mall is as following:

Cinema	**= 2.5L/s per person + 0.3L/s per m^2**
Common Area	**= 3.8L/s per person + 0.3L/s per m^2**
Department Store	**= 3.8L/s per person + 0.3L/s per m^2**
Exhibition	**= 2.5L/s per person + 0.3L/s per m^2**
F&B	**= 3.8L/s per person + 0.9L/s per m^2**
F&B Kiosk	**= 3.8L/s per person + 0.3L/s per m^2**
Fashion	**= 2.5L/s per person + 0.6L/s per m^2**
Fashion Kiosk	**= 3.8L/s per person + 0.3L/s per m^2**
Fitness Centre	**= 10.0L/s per person + 0.3L/s per m^2**
Home	**= 3.8L/s per person + 0.6L/s per m^2**
Indoor Playroom	**= 10.0L/s per person + 0.3L/s per m^2**
Karaoke	**= 2.5L/s per person + 0.3L/s per m^2**
Leisure	**= 3.8L/s per person + 0.6L/s per m^2**
Retail	**= 3.8L/s per person + 0.6L/s per m^2**
Supermarket	**= 3.8L/s per person + 0.3L/s per m^2**

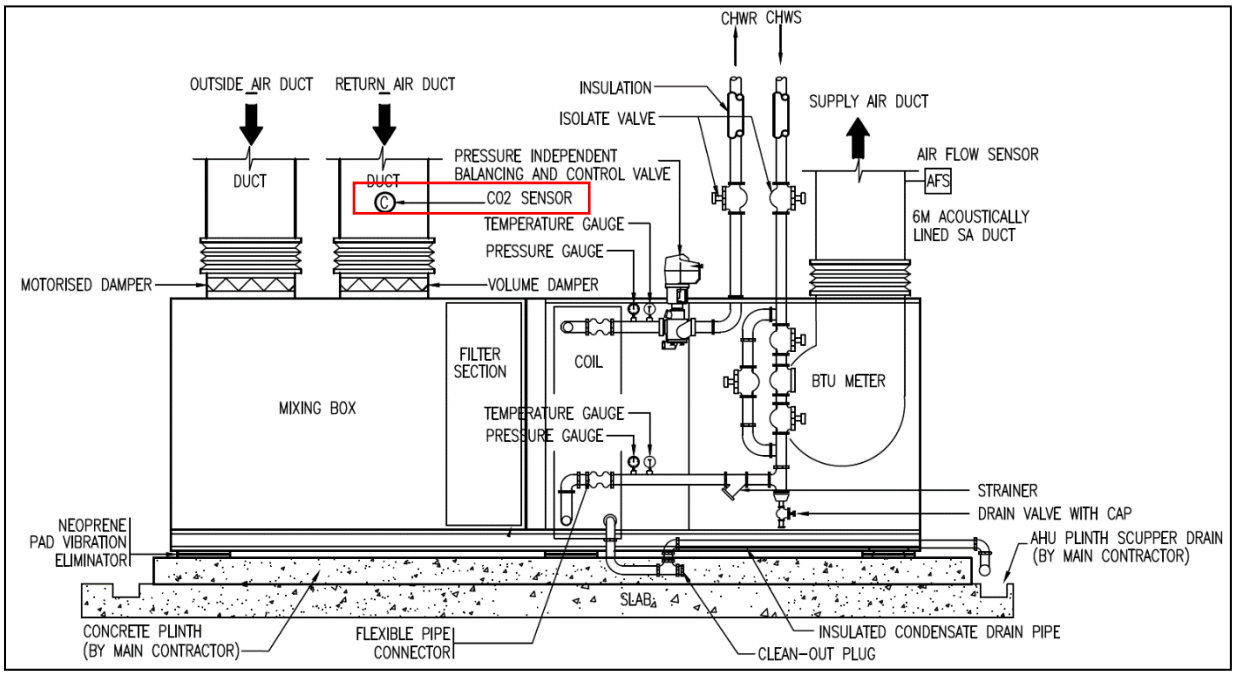
EQ3 CARBON DIOXIDE MONITORING AND CONTROL

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 are typical AHU schematic diagrams with installed CO_2 sensors:

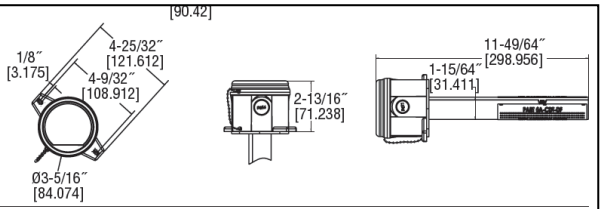


The following is **catalogue** of installed CO_2 sensor:

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

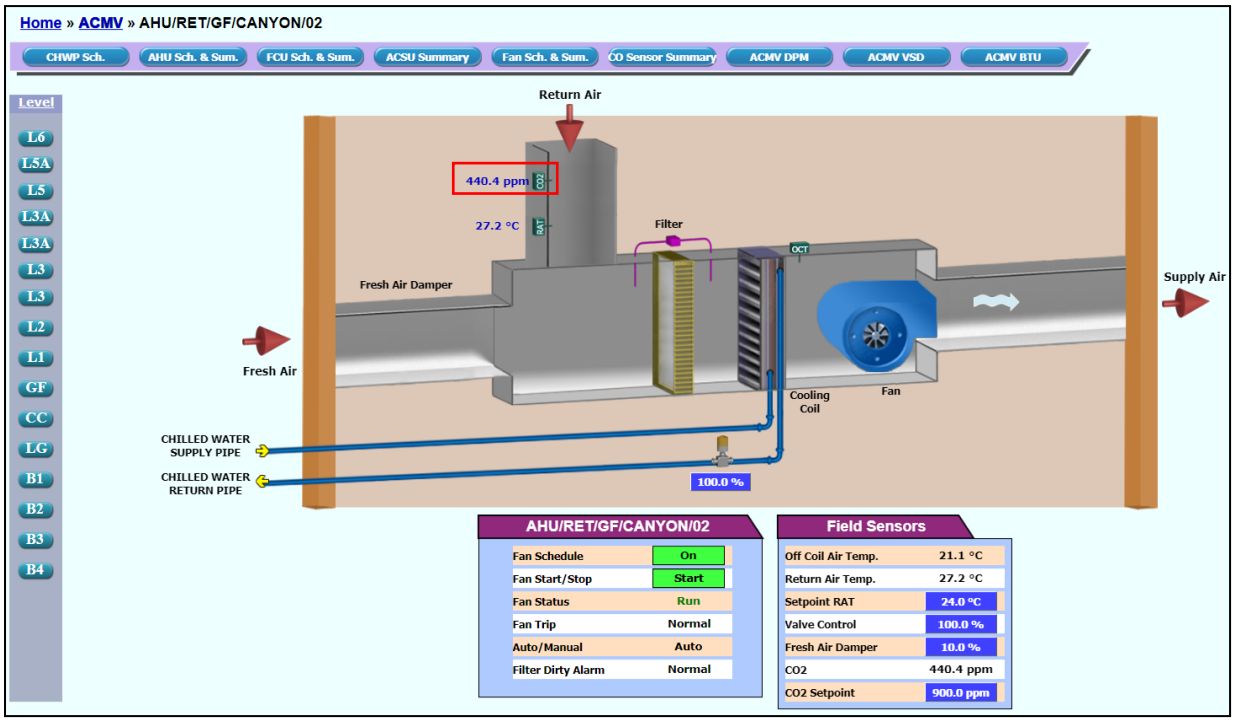
APPLICATIONS
- Demand control ventilation in schools, office buildings, hospitals, and other indoor environments
- LEED® certification

*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 **MS1525:2007**. 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 - Tenant lots (after ID fit-out works)

Pre-occupancy air flushing shall be conducted for the newly renovated retails lot. By using the base building smoke spill fans (SSF), make-up air fans (MAF), air handling units (AHU), or fan coil units (FCU), building flush out shall be performed by supplying fresh air to provide not less than **10 airchanges/hour** (ACH) for at least **30 minutes** of operation.

In addition, positive-negative approach could be implemented to ventilate the indoor air via main access doors. Outdoor air shall be supplied through the buildings' centralized AHUs into the space to provide make-up fresh air. AHU fresh air and supply dampers shall be fully opened whereas the AHU return dampers shall be fully closed or sealed off temporarily. After the air flushing is done, the dampers shall be set back to their normal positions and remove any seal off. The internal part of the AHU shall be cleaned and vacuumed prior to installation of temporary air filter before building flush out commences.

Pre-Occupancy Air Flushing – Mall (Covid-19 cleansing)

GAM has scheduled for Mall building flush out or Covid-19 cleansing between 27 May 2021 and 26 July 2021 (2 months) via SSF system. All 38 nos. of SSF were fire-alarm bypassed and manually run for 15 minutes from 8.30pm to 8.45pm. During the flushing period, fresh air was induced generally from the main entrances or openings from the perimeter of the building.

In future, similar method could be used to exhaust the foul air from mall space on schedule or case-by-case basis.

Post-Occupancy Air Flushing – Mall & Tenant lots

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. 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. 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. 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. 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. 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. 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 Mall 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 TNB HT Switch Room, TX, Genset Room, Consumer HT Rooms, LV rooms, Transformer Rooms, Chiller MSB & TX rooms, and Cinema MSB room is **CO_2** Gas Fire Extinguishing System.

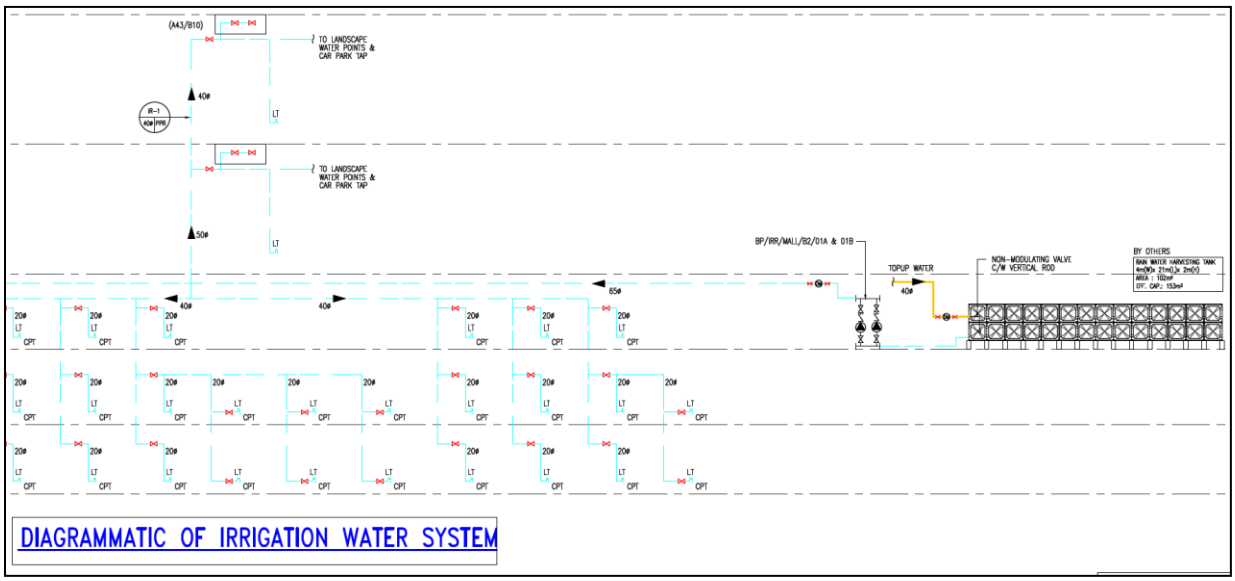
WE1 RAINWATER HARVESTING

Encourage rainwater harvesting that will lead to reduction in potable water consumption.

The rainwater harvesting system at Tropicana Gardens Mall is designed to collect rainwater from rainwater downpipes of building before entering the rainwater harvesting (RWH) tank. The RWH tank is located at **B2** level. The effective tank capacity is **153 m^3**. Rainwater is used for landscape irrigation or carpark water tap (general washing).

Whenever draught season or dry spell occurs and insufficient water for irrigation or toilet flushing, incoming potable water from water utility company (Air Selangor) will be used to fill in the RWH tank.

To maximize water savings, the top up electrode sensor shall be adjusted to provide backup supply of water in the event of demand exceeding rainwater supply whilst ensuring maximum rainwater storage at subsequent rainfalls.



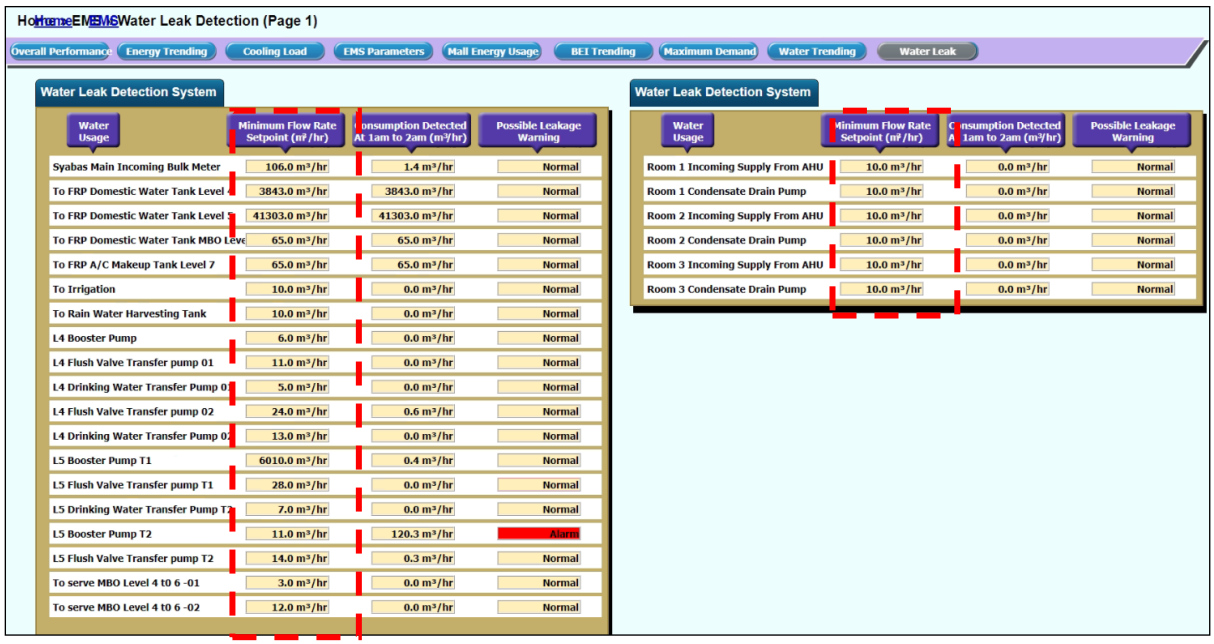
WE5 METERING & LEAK DETECTION SYSTEM

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 four (4) areas of major water usage:

i. **Domestic Water**
ii. **Rainwater**
iii. **AC Make-Up Water**
iv. **Drinking Water**

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**.

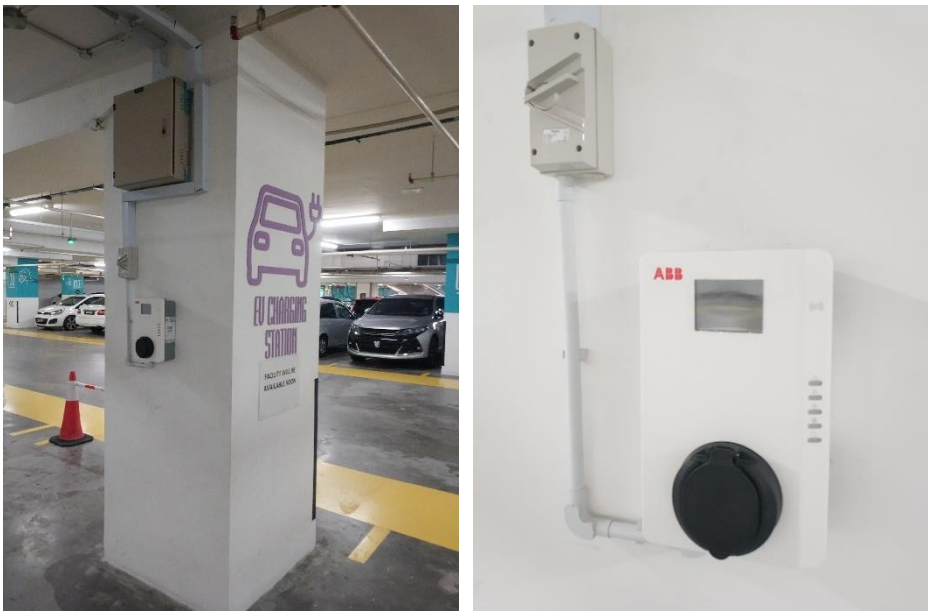
IN1 INNOVATION IN DESIGN & ENVIRONMENTAL DESIGN INITIATIVES

Charging Station for Hybrid or Electric Car

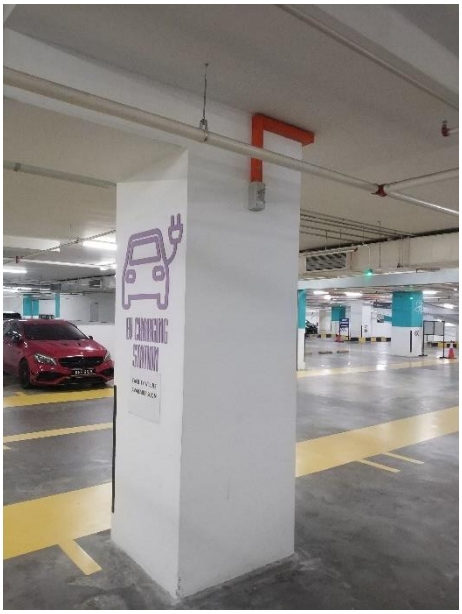
Ten (10) EV charging stations have been proposed to be installed in close proximity to the lift lobby at Basement 1 and Basement 2 respectively, and two (2) at Lower Ground for a total of twenty-two (22) installed EV chargers.

These 13 Amp charging points have been equipped with 240V conductive power supply or inductive charger, as the emerging market for electric vehicles is expected to require J-1772 compliant outlets, which need a 240V power supply.

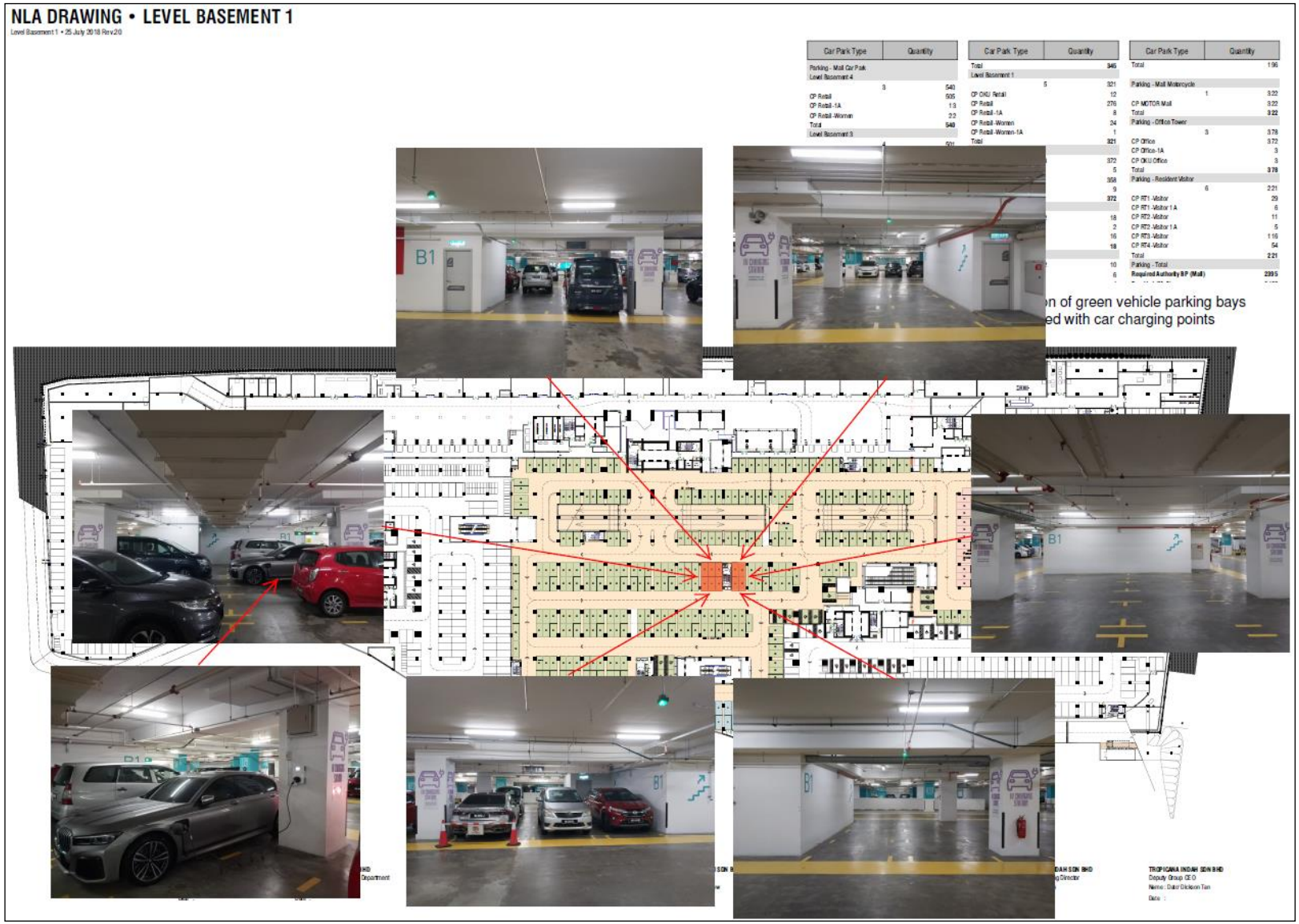
Total installed EV chargers: **1 (Basement 1)**



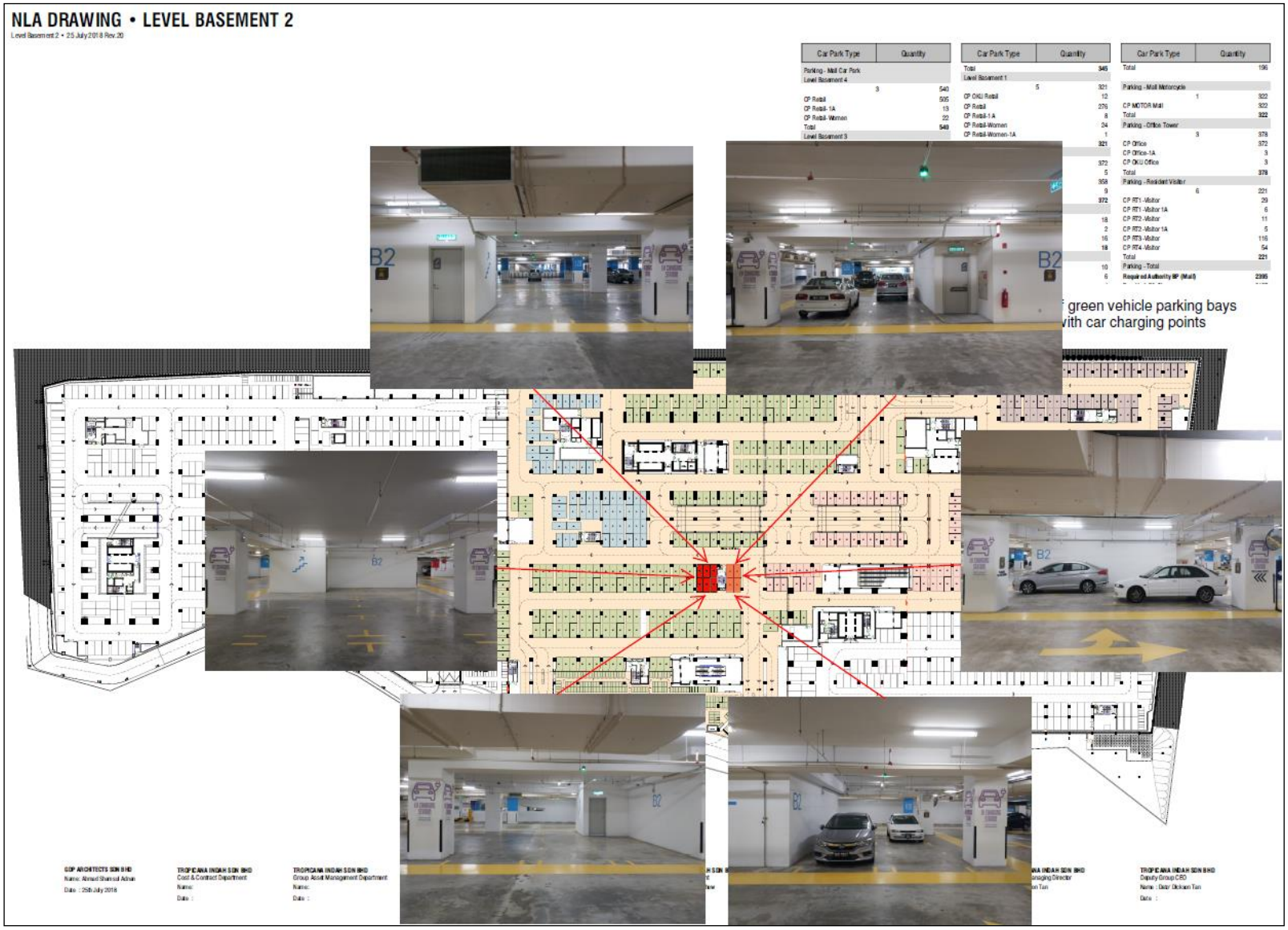
Installed EV charger



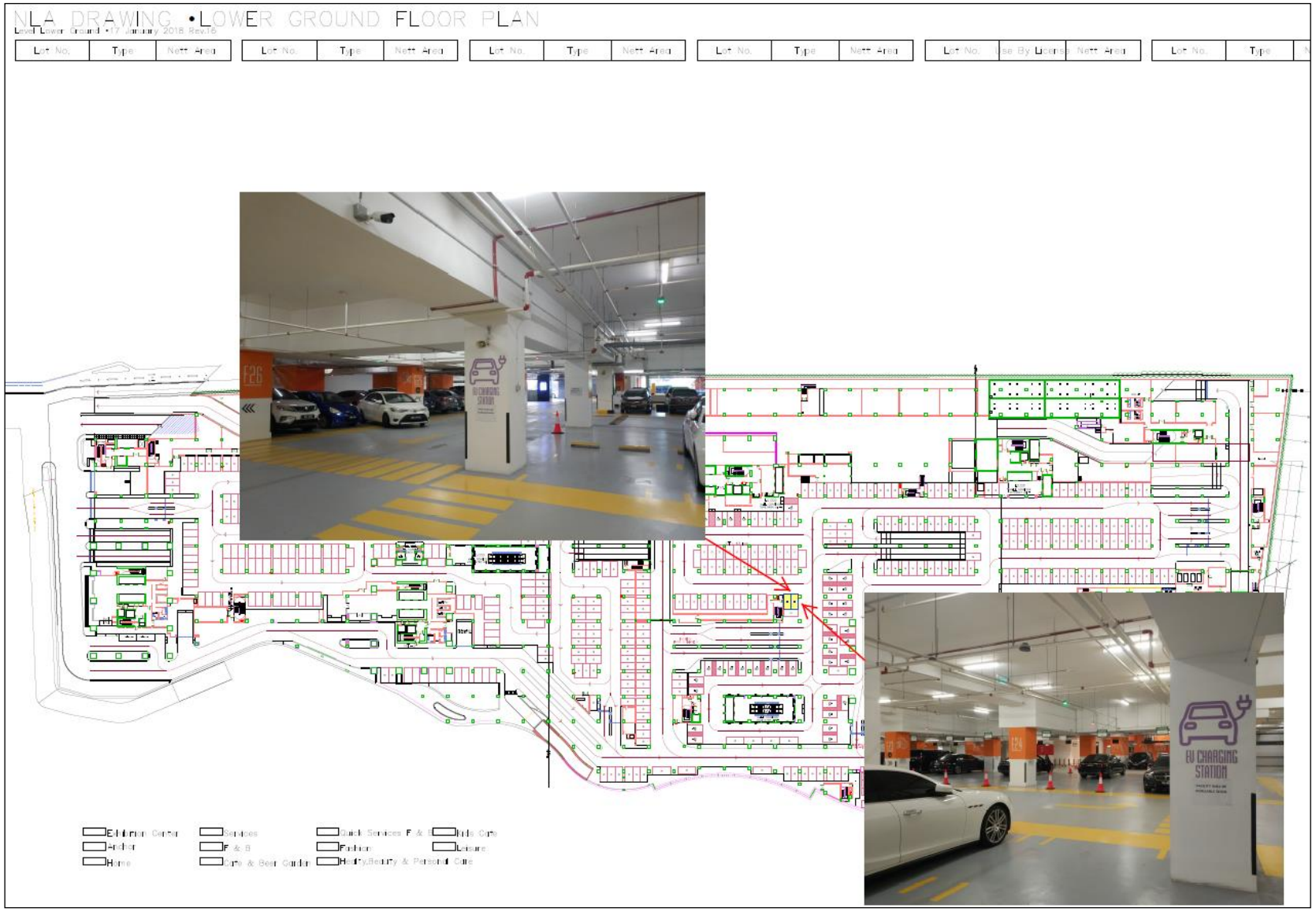
Installed 13 Amp with 240V charging outlet



Basement 1 – 10 nos. charging points



Basement 2 – 10 nos. charging points



LG – 2 nos. charging points

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.

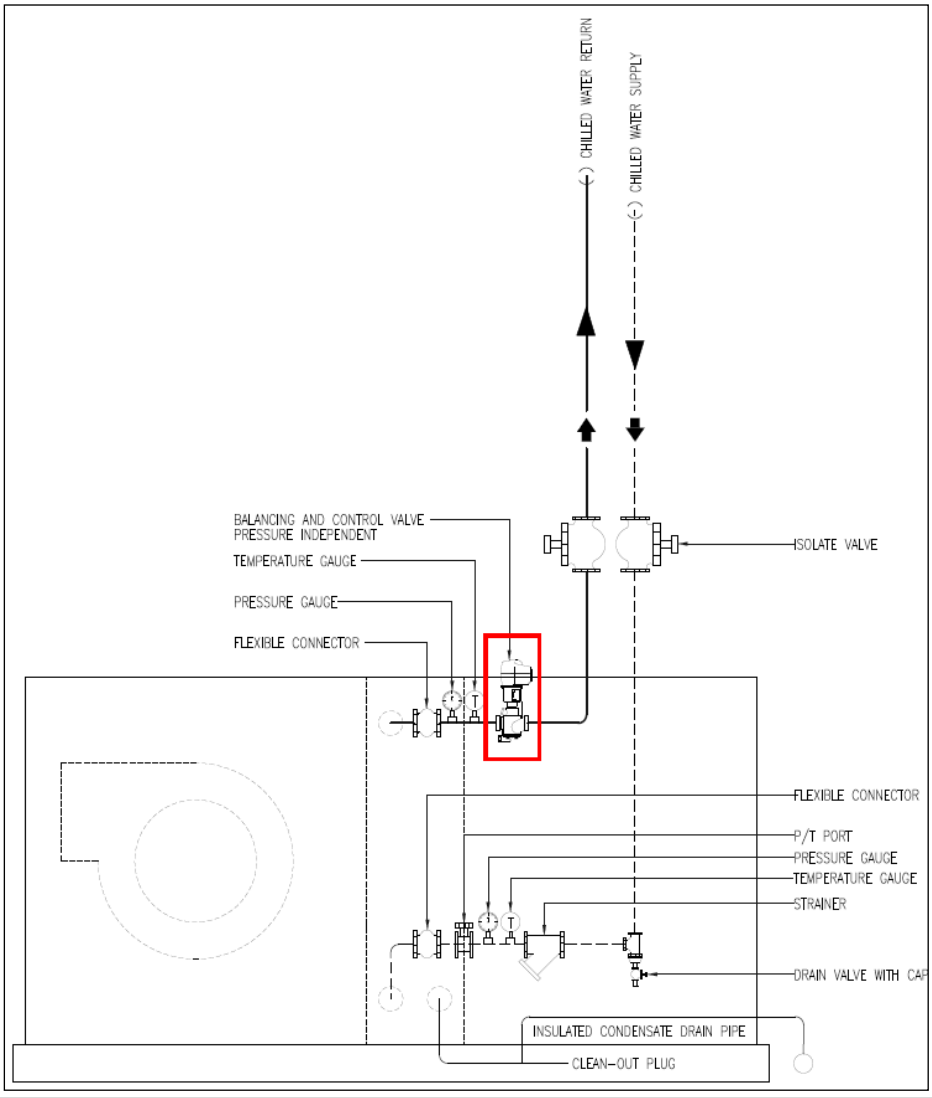
Some benefits of PIBCV including: -

i) Lower commissioning time.

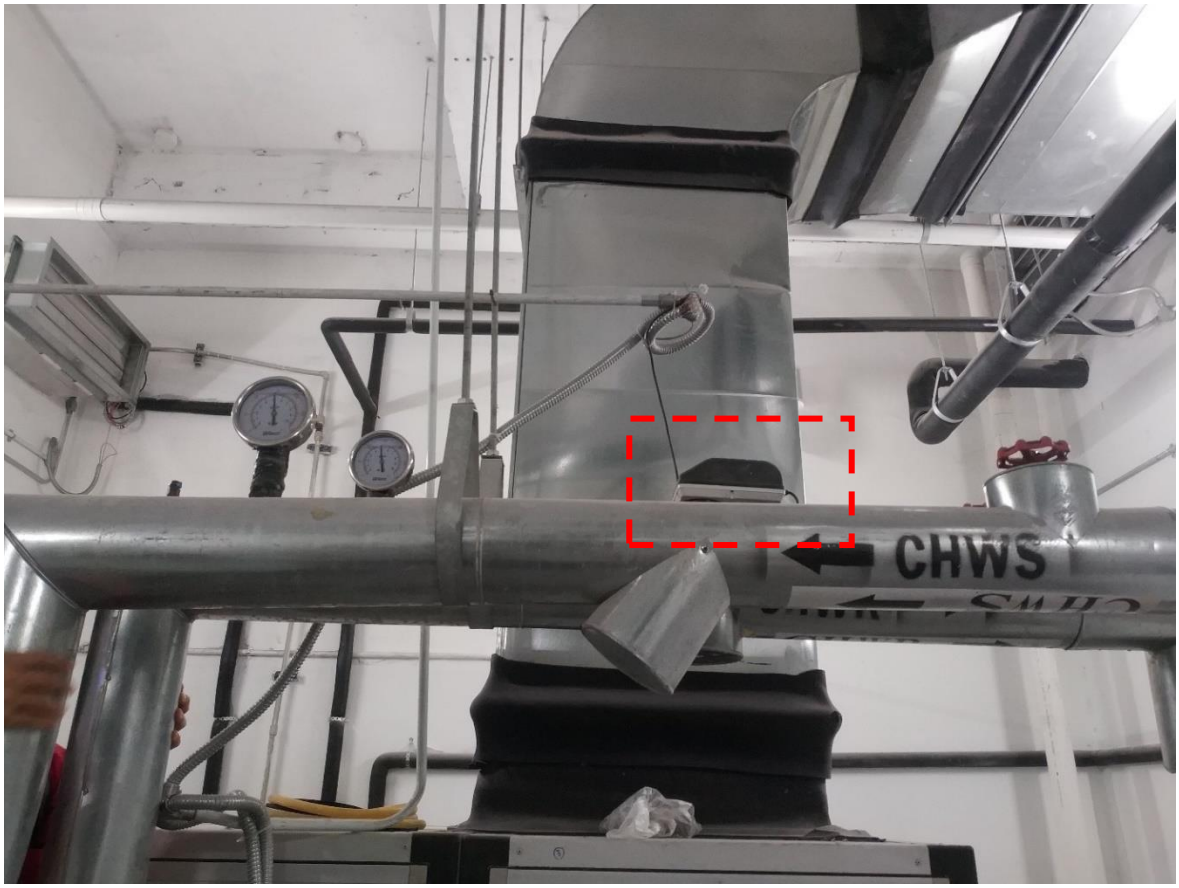
ii) Offers automatic balancing, temperature control, differential pressure regulation, flow monitoring as well as allowing feedback to the BMS system.

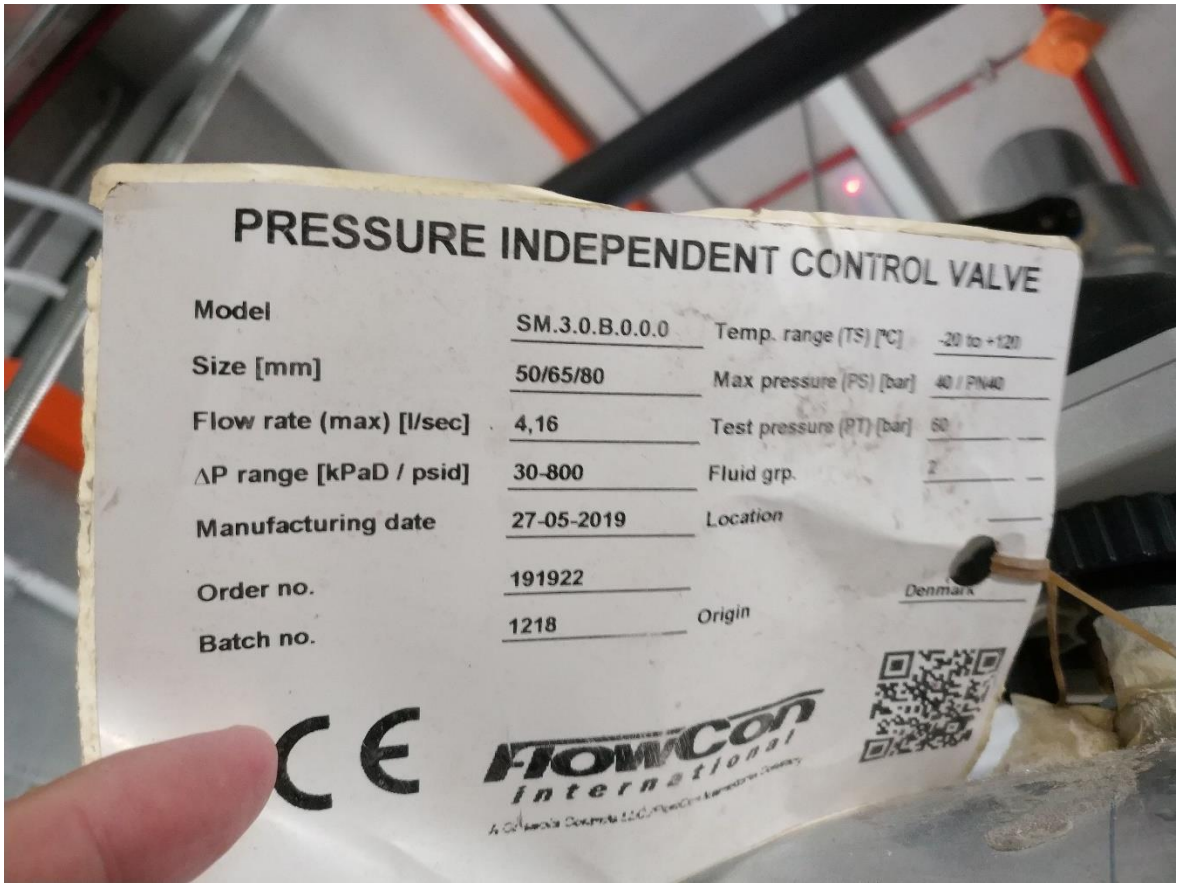
iii) Promotes building maintenance because it uses ONE standard actuator for all various sizes of valves, hence possible to have less backup actuators for the building.

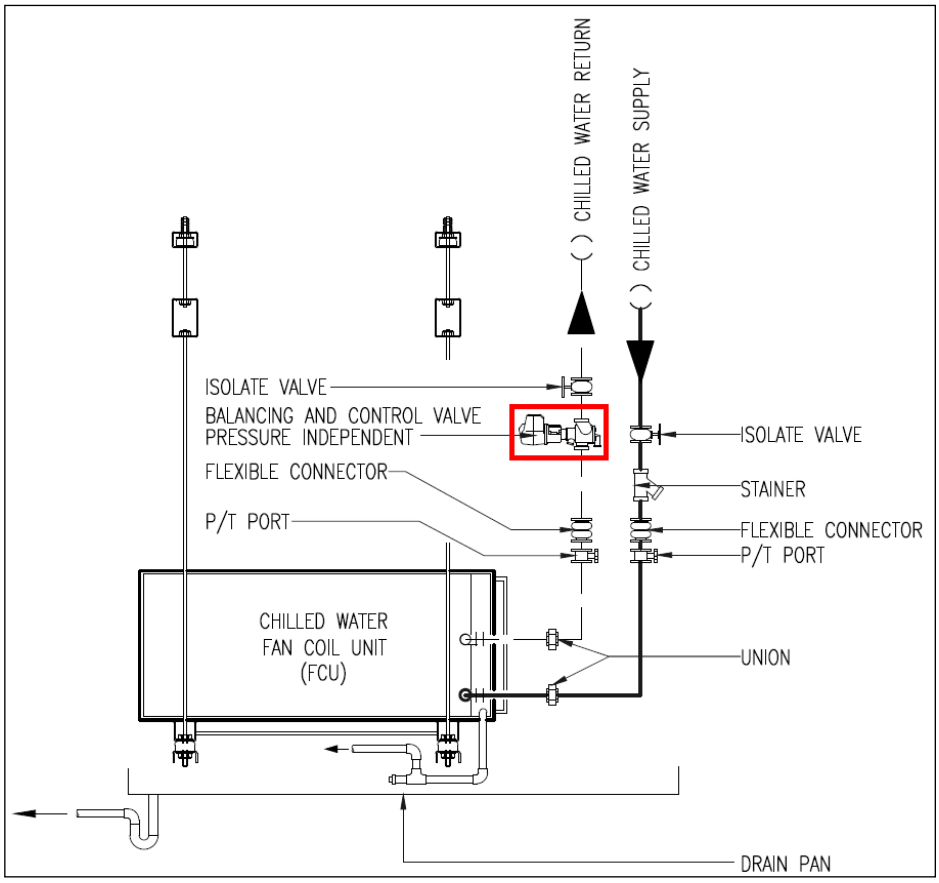
iv) More efficient chilled water system.



Typical Installation of PIBCV at AHU







Typical Installation of PIBCV at FCU

Condensate Water Recovery and Use

With the huge capacity of air-conditioning system in Tropicana Gardens Mall, the amount of condensate produced can be quite significant. Condensate from 50% of AHUs for the retail are used to top-up the air-conditioning make-up water tank located on Level 7 (rooftop).

Condensate water recovery system has been incorporated into the chilled water system to enhance the system performance. The main purpose of recovering the condensates from the terminal units (AHUs / FCUs) are to conserve water or reduce the building operating costs. Apart from supplementing the amount of make-up water that the chilled water system requires on a daily basis, the condensates also enable the chillers to run more efficiently due to lower compressor lift.

Although there are several methods of using the recovered condensates, this building opts for the condensate to be channelled back to the cooling towers' sump. As mentioned above, this option will effectively lower the average condenser water temperature (reducing the compressor lift) and enable the compressor to run at a lower electrical ikW/ton.

The drainpipes from identical AHUs have been connected to a common vertical waste pipe leading the condensates to a dedicated condensate recovery tank, which is located at the condensate recovery rooms in LG. A set of transfer pump (1 duty and 1 standby) have been installed in the same room to pump the collected condensates from the tank straight into the cooling tower make-up tank located at the roof level of Mall. In order to optimize the benefits of this system, adequate insulation has been provided for the pipes and tank to maintain the 'coolness' of the condensates.

Condensate from different AHU risers will flow by gravity to the respective **condensate recovery tanks** located in the condensate collection room 1 to 3 at **Basement 1** as per schedule below:

Riser	AHU (qty)	Condensate Collection Room
1	14	1
2	13	1
3 & 4	11	2
5	9	3
AHU with condensate collection	**47**	-
	50%	-
Total Installed	94	-

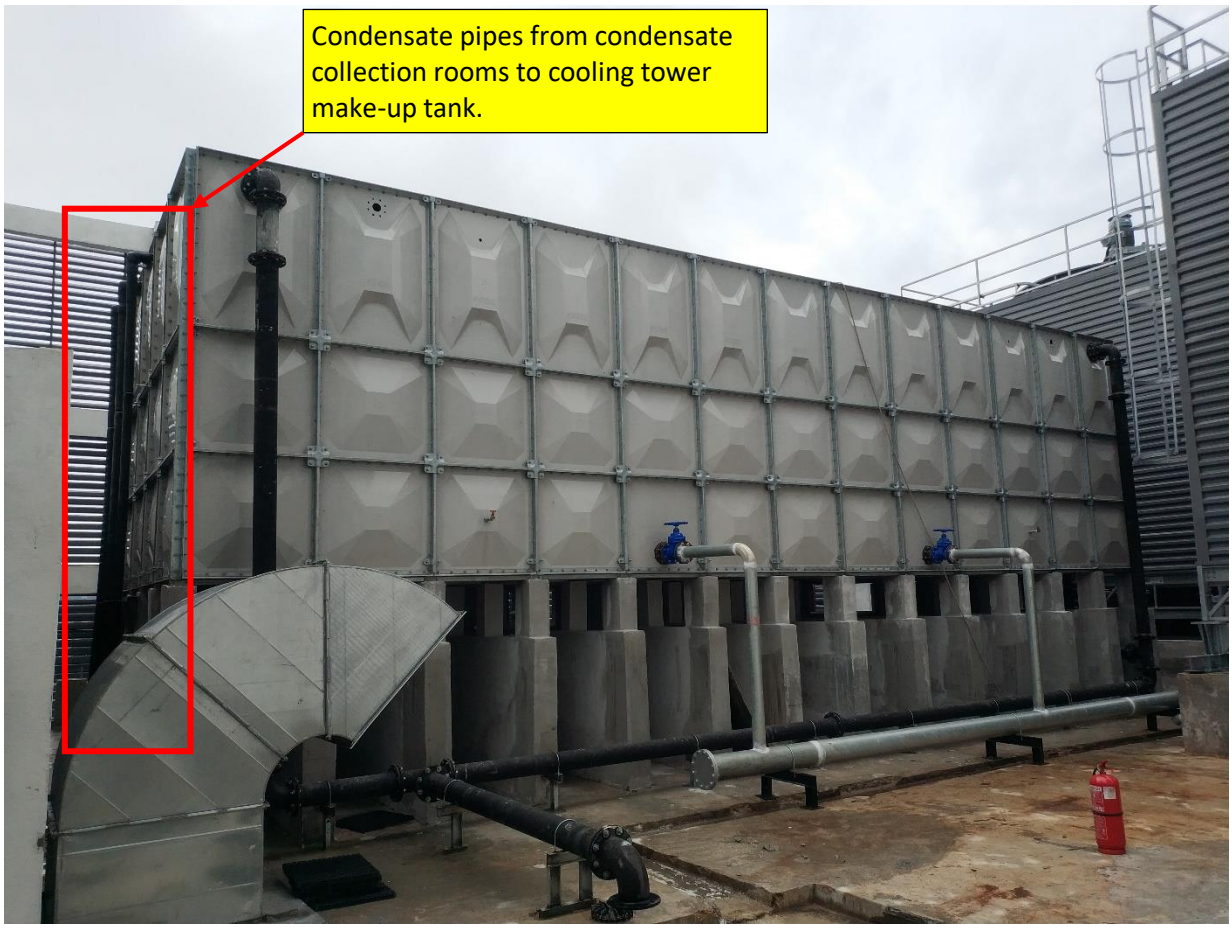
All the collected condensates will be pumped up to the **cooling tower make up tank**.

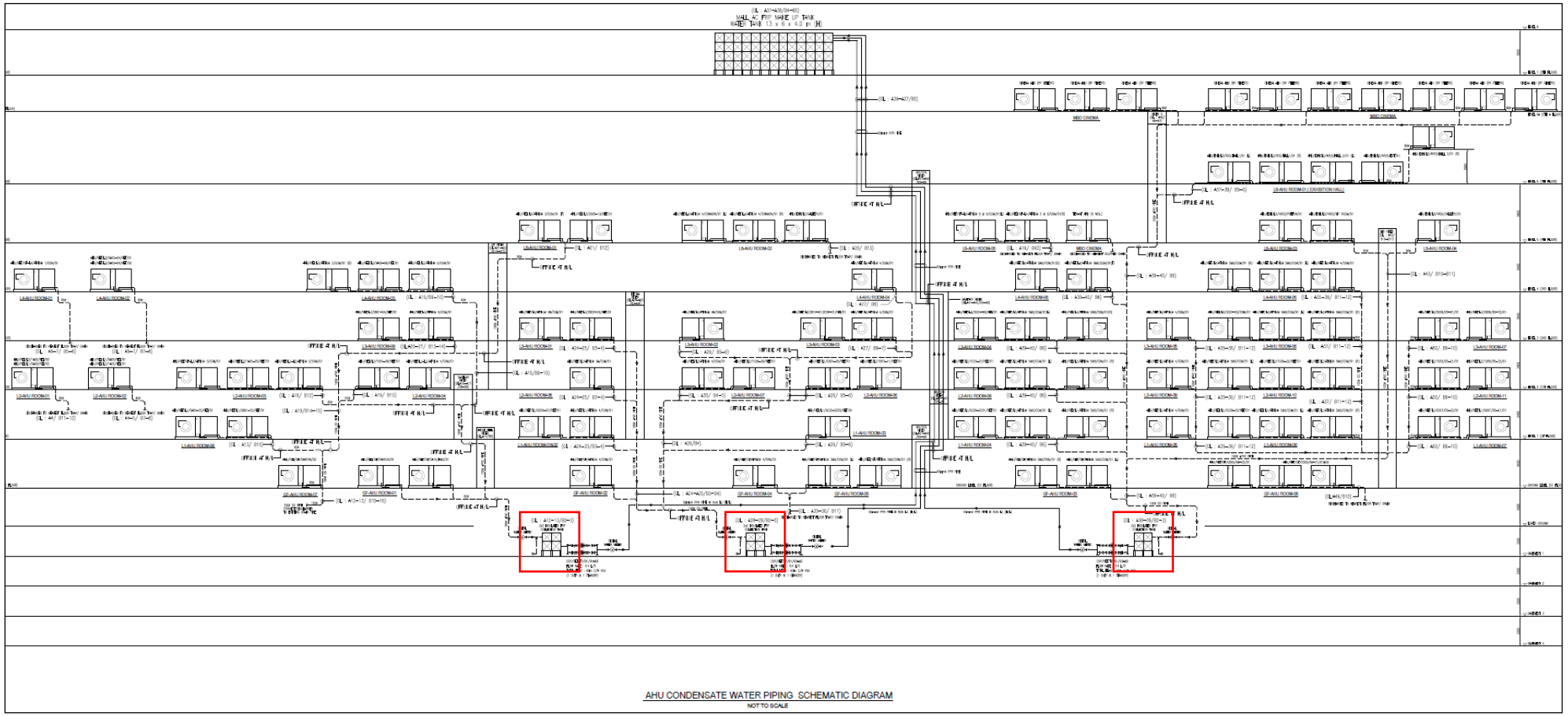
Condensate Collection Room 1

Condensate Collection Room 2

Condensate Collection Room 3

Cooling Tower Make-up Tank





AHU Condensate Water Piping Schematic Diagram

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. Escalator & Autowalk O&M Manual and As Built Drawings
8. Carpark Management System O&M Manual and As Built Drawings
9. Natural Gas (NG) Services O&M Manual and As Built Drawings
10. ELV Security System O&M Manual and As Built Drawings