Shin Fai Engineering Services Limited

MVAC System

(Mechanical Ventilation and Air Conditioning System)

This section will consist Three parts for the proposed commercial building

Air Conditioning



Air Conditioning and refrigeration are provided through the removal of heat. The definition of cold is the absence of heat and all air conditioning systems work on this basic principle. Provide from Central Chiller plant (water cool system)

(Office, Shopping Mail, Tanning Centre and fitness centre)

Chiller



The chiller can be water-cooled, air-cooled or evaporative cooled. The compressor types typically are reciprocating, scroll, screw or centrifugal. The evaporator can be remote from the condensing section on air-cooled units.

(Mechanical Ventilation and Air Conditioning System)

This section will consist Three parts for the proposed commercial building;

Heating



There are different types of standard heating systems. Central heating is often used in cold climates to heat private houses and public buildings.

(Office, Shopping Mail, Tanning Centre and fitness centre)

Ventilation



Ventilating is the process of "changing" or replacing air in any space to control temperature or remove moisture, odors, smoke, heat, dust and airborne bacteria. Provide Mechanical Ventilation (Car Park, Toilet and Plant Room)

(Mechanical Ventilation and Air Conditioning System)

Screw Chiller Plant

Water-cooled Chiller A chiller is a machine that removes heat from a liquid via a vapor-compression or absorption refrigeration cycle.
Chilled water pump (chilled water is often used to cool a building's air and equipment)

(Mechanical Ventilation and Air Conditioning System)

Chiller Plant

Condenser Water Pump (used to condense vapor into liquid)
Cooling Water Tower transfer process waste heat to the atmosphere

(Mechanical Ventilation and Air Conditioning System)

- The chiller machine operation Details information
 - Operation Voltage
 - Rate Current
 - Maximum Power
 - Cooling Valve

		DANCE		
RATED VOLTAGE		1110		
380	342 ***	410		
VOLT-AC	HZ PH R			
MOTOR 380	50 3 25	17 4		
FACTORY	CHARGE R134A	WITH 17		
FACTORY *	CHARGE 01148			
DESIGN PRESSURE PS	IG: HIGH 2000	LOW 266		
FIELD WIRING				
23094870	INSTALLATION, O	PERATION AND MA	INT	
LAYOUT AND SENSORS		ELE	CTRI	
COMPONENT LOCATION		P2	23	
SOMPORENT LOCATION				

(Mechanical Ventilation and Air Conditioning System)

Schematic Diagram for Chiller Plant



(Mechanical Ventilation and Air Conditioning System)

Chiller Plant Control



(Mechanical Ventilation and Air Conditioning System)

Considerations in Chiller Plant Control

- Reduced Risk
- Reliable Chilled water flow
- Operating Cost (Energy Efficiency)
- Reduce maintenance cost
- Flexible to accommodate a variety of plant designs
- Easy to understand user interface & operation

(Mechanical Ventilation and Air Conditioning System)

Design Criteria

Function Area	Summer Design	Winter Design	Min. Fresh Air	
	Temperature	Temperature	Provision	Type of HVAC System
	(±1°C)	(±1°C)	(1/s)	
Shop	23	-	5	Note (a)
Shopping Arcade	23	-	5	Note (a)
Tranning Centre	23	21	10	Note (c)
Office	23	21	10	Note (a)
Fitness Centre	22	-	10	Note (a)
F.S. Control Room	24	-		Note (b)
Main Switchroom	31	-		Note (b)
Lift Machine Room	31	-		Note (b)
BMS Room	23	-	7	Note (b)
Security Room	23	-	7	Note (b)
MCC Room	24	-		Note (b)
TBE Room	24	-		Note (b)
Other air conditioned space	To comply with local	& international stand	ards and Client's req	uirement
not listed above				

(Mechanical Ventilation and Air Conditioning System)

General Equipment

(Central system)

PAU –Primary Air Handling Unit
(Provide the conditioned outdoor air)services Area :Shopping Mall, Office and Fitness Centre

- AHU Air Handling Unit (Provide the conditioned air) services Area : Training Centre
- FCU –Fan Coil Unit (FCU)
(Provide the conditioned air)services Area :Shopping Mall, Office and Fitness Centre



AHU / PAU



FCU

(Mechanical Ventilation and Air Conditioning System)

General Equipment

(Terminal Unit)

VAV - Variable air volume (VAV) (Provide the conditioned air)



(Mechanical Ventilation and Air Conditioning System)

Individual System VRV - Spilt Unit

The innovative inverter technology ensures sufficient air conditioning in every stage of operation.

Spilt Unit-(To provide air conditional)





(Mechanical Ventilation and Air Conditioning System)

Comparison of MVAC Equipment

System	Advantage	Drawback
Air Cooled Chiller		
Water Cooled Chiller		-Refer water cooled package unit.
Water Cooled Package Unit	 -Water cooled system uses the ambient wet bulb temperature of the entering air as the heat sink, which is typically lower than the dry bulb and has better coefficient of performance as well as electricity consumption. -For instance, air cooled condensers require 600 to as much as 900 CFM per ton of heat rejection while a typical open cooling tower requires 250 CFM per ton with correspondingly lesser fan horsepower. -Cooling tower equips with lesser moving components, it reduces breakdown frequency and maintenance cost. 	 -Only one set of cooling tower as heat rejection equipment, the whole air conditioning system will be suspended in case of breakdown. -City water cost and sewer charge are necessary. -Supply of city water to cooling tower requires permission from the Statutory Department. -The risk of Legionnaires' Disease increases. -Less variety of equipment selection, the lowest cooling capacity for McQuay and Mitsubishi ducted equipment are 28,800 and 56,000 BTU/hr respectively. -All components such as cooling coils, compressor and blower fan(s) are assembled in a single unit, it requires a larger installation space and the operating noise is high.

(Mechanical Ventilation and Air Conditioning System)

Comparison of MVAC Equipment

System	Advantage	Drawback
Spilt Units	 -All indoor units equip with individual condenser, overall cooling capacity will not be drastically affected in case of any unit breakdown. -City water source does not require. -Equipment and all accessories comply with the Statutory Department's requirements. -Variety of suitable cooling capacity indoor equipment is available and the room temperature for different areas can be under desirable control. 	 -Condenser equips with several mechanical moving components such as condenser fan motors, it increases breakdown frequency and maintenance cost. -Air-cooled system has lesser coefficient of performance and the difference in summer is more obvious. -Annual energy consumption is about 35% higher than central plant.
VRV Spilt Units	 By integrating into one (1) refrigerant piping circuit, the installation of the piping work can be very quickly and the small bore refrigerant piping saves the installation space. No attachments such as strainers, isolating valves, control valves, gauges, flow switch are needed. Refrigerant piping system up to 100m in length in a single system enables a vertical level difference of 50m between the outdoor units and indoor unit(s) which is previously limited to 5 - 10 m in a traditional single spilt unit. Up to thirty (30) indoor units can be connected to one (1) refrigerant circuit. 	 -High investment cost than tradition spilt unit. -Only one refrigerant circuit, the whole system will be suspended in case of leakage. -Control system equips with several advance electronic components, it requires skillful workman for the maintenance and trouble shooting works.

(Mechanical Ventilation and Air Conditioning System)

Heating System

They can be used in stationary applications to provide heat, hot water, or steam for domestic use,



(Mechanical Ventilation and Air Conditioning System)

Electric heater

An electric heater is an electrical appliance that converts electrical energy into heat



(Mechanical Ventilation and Air Conditioning System)

Mechanical Ventilation

- (1) Natural ventilation occurs when the air in a space is changed with outdoor air without the use mechanical systems, such as a fan. Most often natural ventilation is assured through operable windows but it can also be achieved through temperature and pressure differences between spaces. Open windows or vents are not a good choice for ventilating a basement or other below ground structure. Allowing outside air into a cooler below ground space will cause problems with humidity and condensation.
- (2) Infiltrations separate from *ventilation*, but is often used to provide *ventilation air*



(Mechanical Ventilation and Air Conditioning System)

General Equipment

In- Line fan :

To exhaust the waste air to outdoor.(For Small Air Volume) Services Location : Toilet

Centrifugal Air Fan:

To exhaust the waste air to outdoor.(For Large Air Volume) Services Location : Car Park



In Line Fan



Centrifugal air fan

(Mechanical Ventilation and Air Conditioning System)

General Equipment

Axial air fan :

used in a wide variety of applications, ranging from small cooling fans for electronics to the giant fans used in wind tunnels.

Propeller :

It can be used to drive an aircraft, ship, or the fluid within a pump. It consists of one or more blades about a central shaft and operates like a rotating screw or wing.(For Large Air Volume) Services Location : Plant Room



Axial air fan



Propeller air fan

(Mechanical Ventilation and Air Conditioning System)

Туре	<u>Efficiency</u>	<u>Advantage</u>	<u>Disadvantage</u>	<u>User</u>
Propeller	<40%	Easy installationLow install free	Low static	No air duct
Centrifugal multi-blade forward curved	50-60%	Low speedSmall size	 Motor more trip Motor more into stand by mode 	Low or medium static
Centrifugal limit load backward curved	70-75%	 High efficiency Motor more trip 	 High speed Noise high than forward curved 	 Medium or high static
Axial	60-65%	 Small size 	 High speed Noise high than forward curved 	Low static

(Mechanical Ventilation and Air Conditioning System)

Fan Sizing:

 By air change per hour (as per CIBSE design Guide)

Static pressure calculation:

Calculate by Equal Friction Method and select a critical path to calculate the pressure drop.

Proposed commercial and office delevopment at 223-231 Tong Yin Street, Tseung Kwan O Pressure Loss Calcualtion Sheet (By Equal Friction Method)

|--|

-1-7													20 1101 01
	Air Flow	Size	Size	(1)	Aspect	Radius	$(2) = 0.602 x(1)^2$	(3)	(4)	(5)	(6) = (3) x (5)	(7) = (2) x (4)	(8) = (6) +(7)
Duct Element	Rate	(W)	(H)	Velocity	Ratio	Ratio	Velocity	Equivelent	Loss	P.D. Per Length	Duct Pressure	Fitting Pressure	Total Pressure
	(m ³ /s)			(m/s)	(H/W)	(R/W)	Pressure (Pa)	Length (m)	Coefficient	(Pa/m)	Loss (Pa)	Loss (Pa)	Loss (Pa)
Weather Proof													
Lourve											-		50.00
FAD	1.17	400	350	7	0.88	1	29.50	4.00		1	4.00		4.00
Elbow	1.17	400	350	7	0.88	1	29.50	-	0.67			19.76	19.76
FAD	1.17	400	350	7	0.88	1	29.50	2.20		1	2.20		2.20
Filter								-		-	-		
Fan								-		-	-		
PAD	1.7	400	350	7	0.88	1	29.50	1.60		1	1.60		1.60
Elbow	1.17	400	350	7	0.88	1	29.50	-	0.67	-		19.76	19.76
PAD	1.17	400	350	7	0.88	1	29.50	1.20		1	1.20		1.20
F.D.								-			-		30.00
Elbow	0.2	250	200	7	0.80	1	29.50	-	0.45	-		13.27	13.27
PAD	0.2	250	350	7	1.40	1	29.50	16.10		1	16.10		16.10
VCD													20.00
												Total:	177.90
													111120

Safety Factor x 1.15 204.59 Total Calculated PD: 204.59

Date : 25.Nov.07

(Mechanical Ventilation and Air Conditioning System)

Air Conditioning Area :



General Office

Different location air-condition request

•Quiet High Effective High Cooling Capacity

•Adjust Temperature & air flow



Fitness Centre •Quiet High Effective Humidity Control

(Mechanical Ventilation and Air Conditioning System)



Different location air-condition request

High Cooling CapacityQuietHigh Effective



•Quiet •Adjust Temperature Training Centre

(Mechanical Ventilation and Air Conditioning System)

Mechanical Ventilation Services Area :



Ventilation rate is around 15 to 20 air change per hour.

Car Park



Ventilation rate for toilet is around 6 to 10 air changes per hour.

Toilet

(Mechanical Ventilation and Air Conditioning System)

Mechanical Ventilation Services Area :



Ventilation rate for toilet is around 5 to 7 air changes per hour.

Plant Room

(Mechanical Ventilation and Air Conditioning System)

Design Criteria (Ventilation)

The Ventilation design were based on the CIBSE Design Guide to make sure the air quality were at good condition.

- Toilet -Each toilet have a indicial exhaust air fan toExhaust the waste air from Lav. to outdoor.
- Car Park Provide a Exhaust air fan to exhaust the waste air from Lav. to outdoor. (Have CO Sensor to sense the concentration and control the speed for the exhaust air fan.)



(Mechanical Ventilation and Air Conditioning System)

THE END