Multi V vs Aircooled Chiller

BEHESHTE HASHTOM PROJECT

Simulation of Cost of Running cost

- Place : Iran Mashhad

	Building type	MALL	
1	Floor	15	F
2	Area	1650	m^2 / floor
3	Ratio of air conditioning area	85%	
4	Actual air conditioning area	1460	m^2 / floor
5	Unit cooling load	130	kcal/h / m^2
6	Unit heating load	140	kcal/h / m^2
7	Cooling load for each floor	190000	kcal/h
8	Heating load for each floor	200000	kcal/h
9	Total cooling load for building	2850000 / 950	kcal/h / RT
10	Total heating load for building	3000000 / 1000	kcal/h / RT

- Compared system

LG (Multi V III)

(Correction factor 120%)

Aircooled Chiller

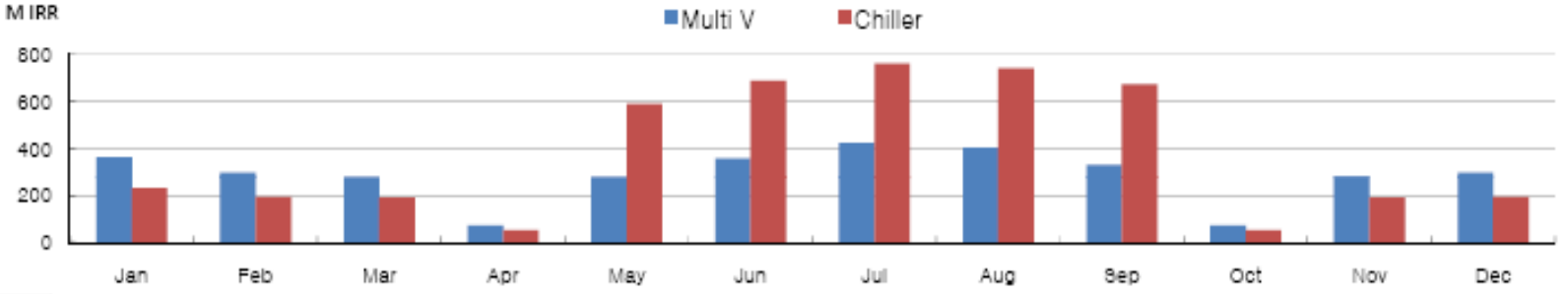
VRF system vs Aircooled Chiller

Comparison	**VRF system (Multi V)**	**Aircooled Chiller**
System	Using electric power / Cooling & Heating	Using Fuel gas / Heating & electric power / Cooling
Devices	Air cooled EHP ODU & IDU	Aircooled chiller, FCU, & Water pump
Piping	Refrigerant piping	Water piping
System diagram		
System cost	100%	100%~110%
Running cost	100%	132%
Installation time	Short-term	Long-term
Installation difficulty	Easy	Difficult
Energy Grade	A ++	B

Comparison of running cost between Multi V and chiller

Electricity fare	1KWh =	1,600	IRR
Gas fare	1Nm^3/h=	1,000	IRR
Exchange rate	1$ =	80,000	IRR

Running cost

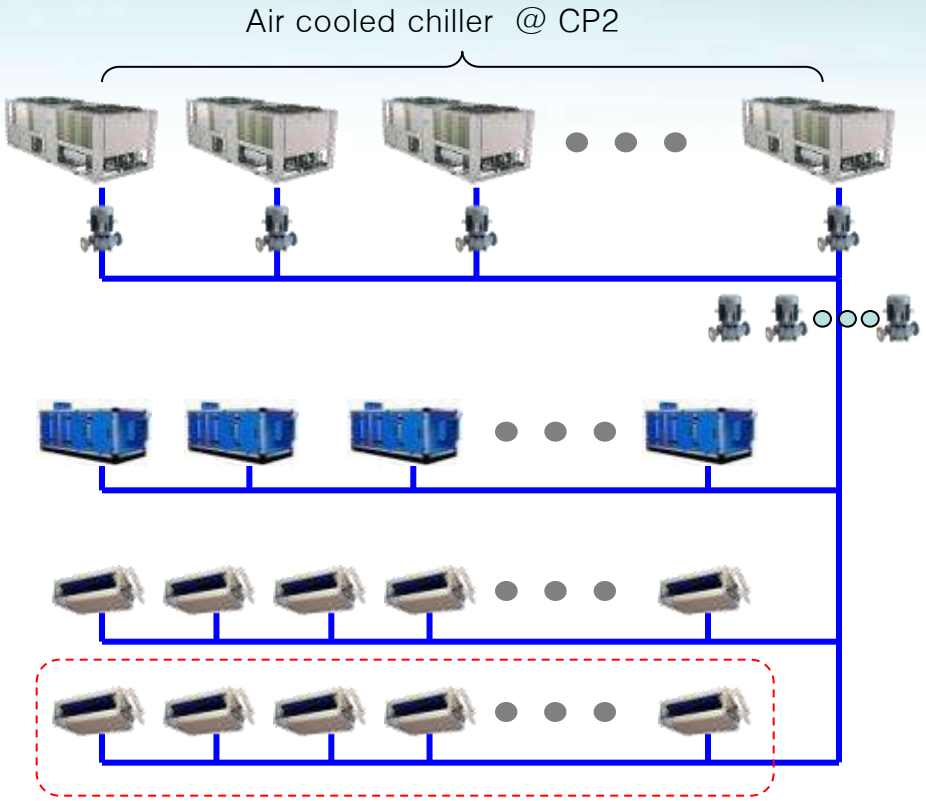


Ratio (Chiller 100%)			167%	164%	146%	187%	47%	52%	56%	64%	49%	189%	147%	164%	76%
			Heat	Heat	Heat	Heat	Cool	Cool	Cool	Cool	Cool	Heat	Heat	Heat	
Month			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
Multi V Energy consumption	MV Hp	kWh	182,968	107,166	96,186	23,617	131,985	180,239	219,668	206,766	161,222	24,408	98,217	107,166	1,459,486
	Boiler	Nm^3/h	60,925	42,525	42,000	11,550	-	-	-	-	-	11,550	42,000	42,525	243,075
	IDU	kWh	41,594	34,776	34,358	9,450	41,162	43,308	45,009	45,009	45,009	9,450	34,358	34,776	418,257
	Pump_Boiler	kWh	19,269	16,091	15,892	4,370	-	-	-	-	-	4,370	15,892	16,091	91,974
	Total	kWh	193,831	158,023	146,436	37,337	173,147	223,547	264,677	251,775	206,231	38,228	148,466	158,023	1,999,719
		Nm^3/h	60,925	42,525	42,000	11,550	-	-	-	-	-	11,550	42,000	42,525	243,075
	M IR for kWh		310	253	234	60	277	358	423	403	330	61	238	253	3,200
	M IR for Nm^3/h		61	43	42	12	-	-	-	-	-	12	42	43	243
	Total	M IR	**361**	**295**	**276**	**71**	**277**	**358**	**423**	**403**	**330**	**73**	**280**	**295**	3,443
		$	12,035	9,845	9,210	2,376	9,234	11,922	14,116	13,428	10,999	2,424	9,318	9,845	114,754
Chiller Energy consumption	Aircooled	kWh	-	-	-	-	289,288	345,922	388,556	376,479	332,576	-	-	-	1,732,764
	Boiler	Nm^3/h	101,850	85,050	84,000	23,100	-	-	-	-	-	23,100	84,000	85,050	486,150
	FCU	kWh	41,594	34,776	34,358	9,450	41,162	43,308	45,009	45,009	45,009	9,450	34,358	34,776	418,257
	Pump_All	kWh	38,638	32,181	31,784	8,741	38,141	40,127	41,716	41,716	41,716	8,741	31,784	32,181	387,366
	Total	kWh	80,131	66,957	66,141	18,191	368,585	429,357	475,281	463,204	419,301	18,191	66,141	66,957	2,538,386
		Nm^3/h	101,850	85,050	84,000	23,100	-	-	-	-	-	23,100	84,000	85,050	486,150
	M IR for kWh		128	107	106	29	590	687	760	741	671	29	106	107	4,061
	M IR for Nm^3/h		102	85	84	23	-	-	-	-	-	23	84	85	486
	Total	M IR	**230**	**192**	**190**	**52**	**590**	**687**	**760**	**741**	**671**	**52**	**190**	**192**	4,548
		$	7,669	6,406	6,328	1,740	19,665	22,899	25,348	24,704	22,363	1,740	6,328	6,406	151,586

System configuration comparison – Mechanical connection

Air cooled chiller

Total one system.

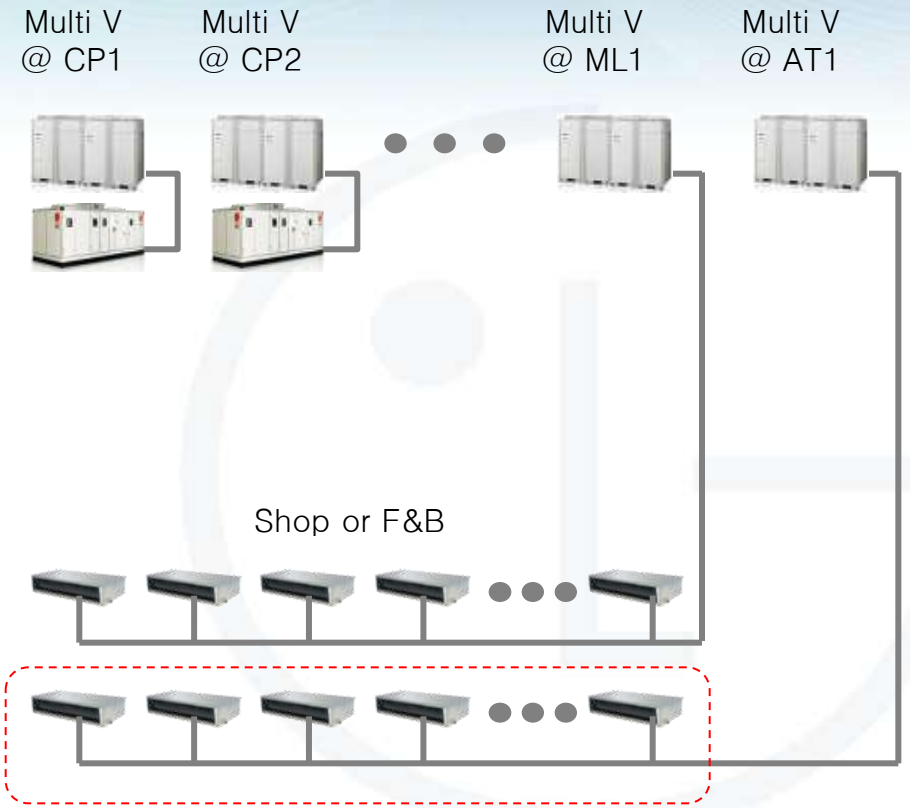


Independent zones like department :
Big size chiller and some pumps operates

Multi V

Economic, Easy

Modular system
– Individual operation



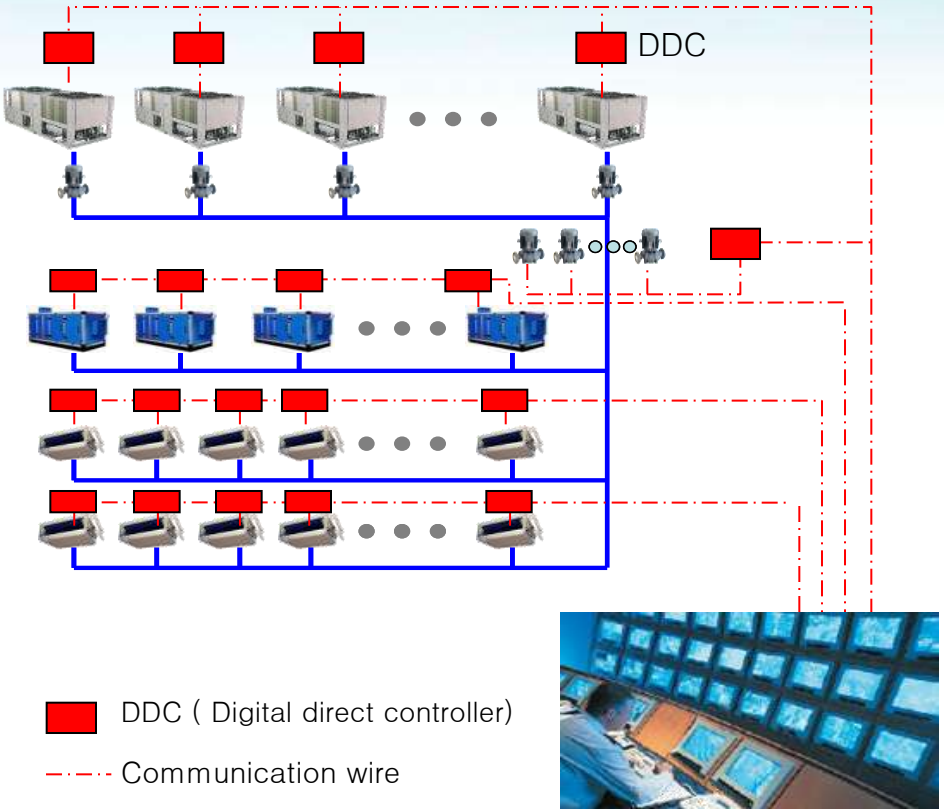
Independent zones like department :
only the connected system operates at anytime.

System configuration comparison – Central controlling with BMS

Except AHU damper, duct damper

Air cooled chiller

Too expensive control system
System integration by 3rd controller company



DDC (Digital direct controller)

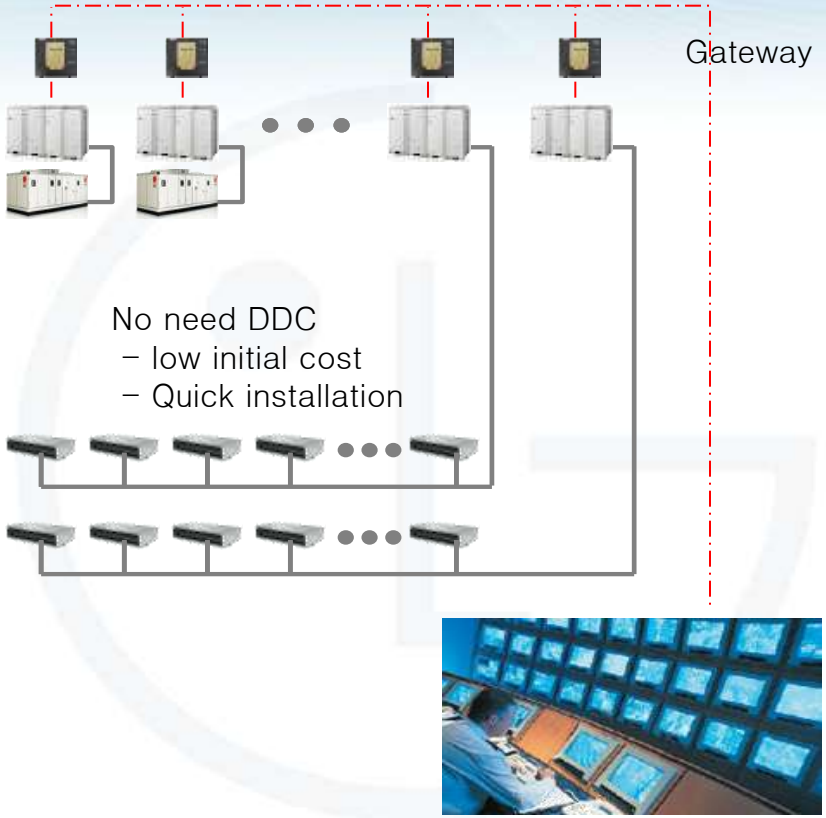
Communication wire

BMS
(Building management system)

Multi V

Simple, Economic, Stable

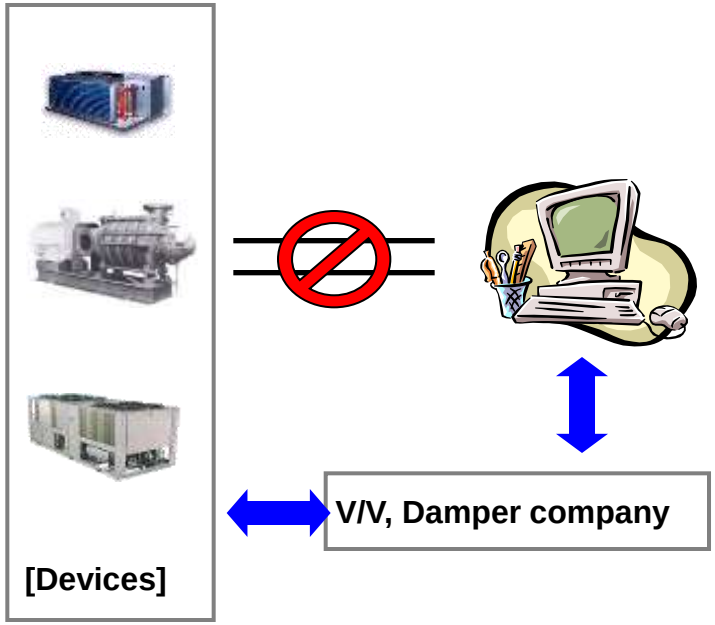
Simple & cheap control system
All air conditioners & controllers by LG.



BMS
(Building management system)

Control contents

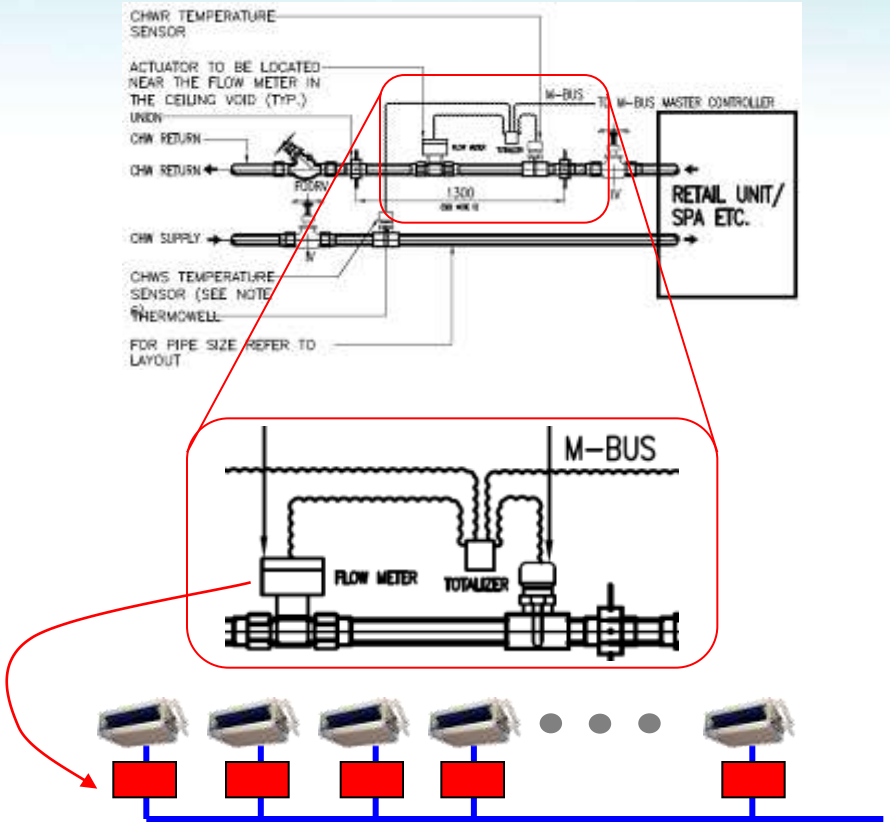
- Lower reliability due to different company ; Device company & Control company

	Aircooled Chiller	Multi V system
Control	- Lack of Standard Quality Control - Lower reliability due to different company 	- Securing Network Solution aligned System - 1 factory for system : Reliability 

Comparison – Individual billing system

Air cooled chiller

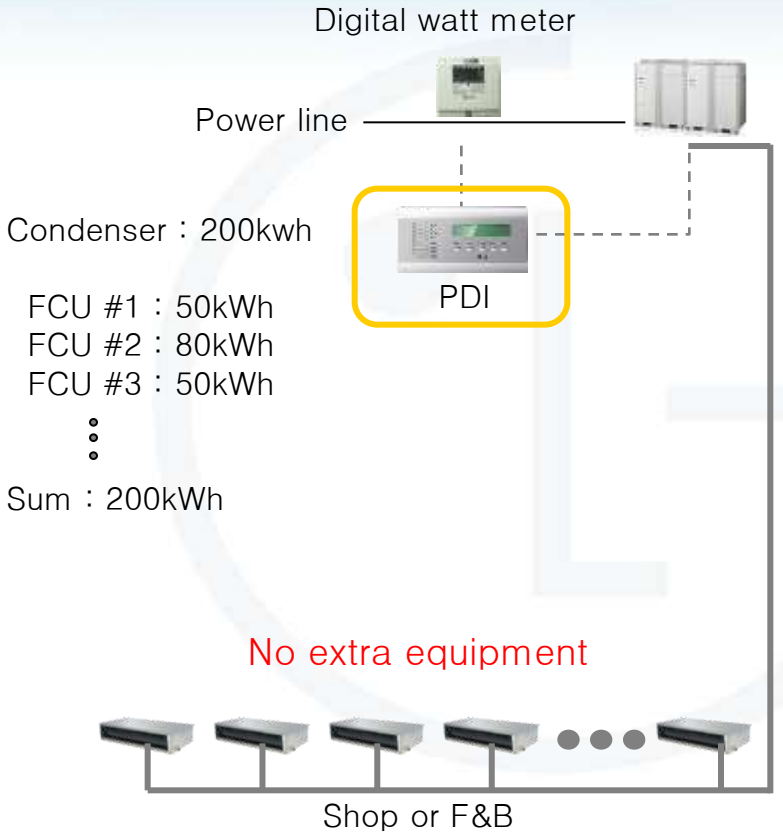
Measure water flow rate and covert it.
Flow meter (heat meter) by each FCU & Totalizer to BMS. Expensive and complicated method.



Multi V

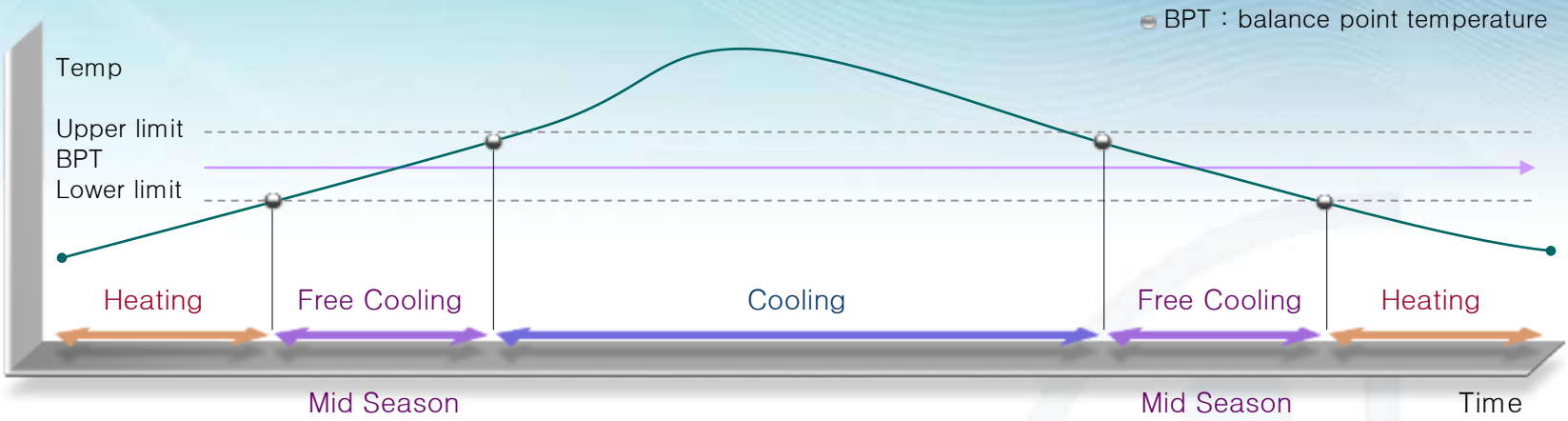
Simple, Economic, Convenient

Measure electric power consumption exactly and distribute it to each FCU.
Simple connection and exact calculation.

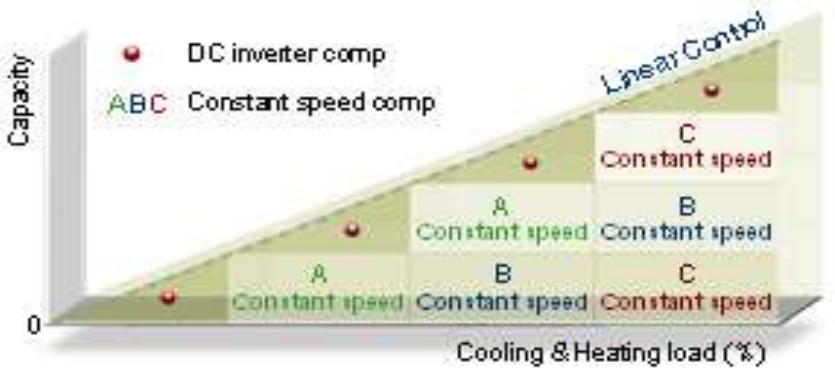


Multi V AHU _ Energy saving control

Energy saving function control compared enthalpy of outdoor air with indoor air



- Linear control of heat load with ODU inverter control

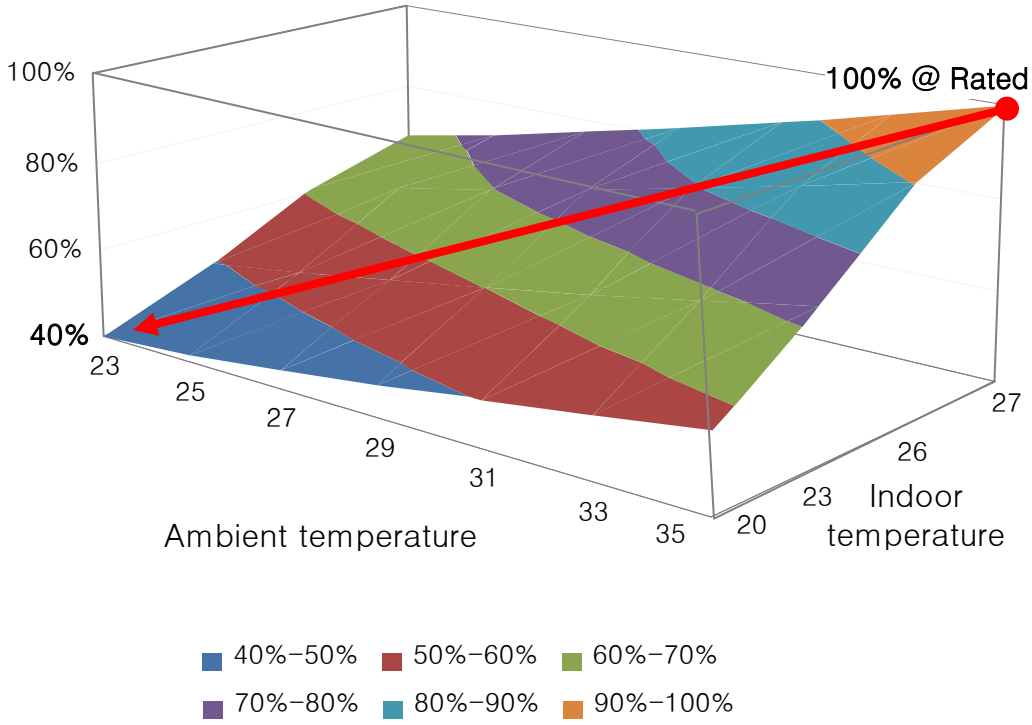


Multi V AHU _ Energy saving control

Thanks to inverter technology and compressor, Multi V can save energy.

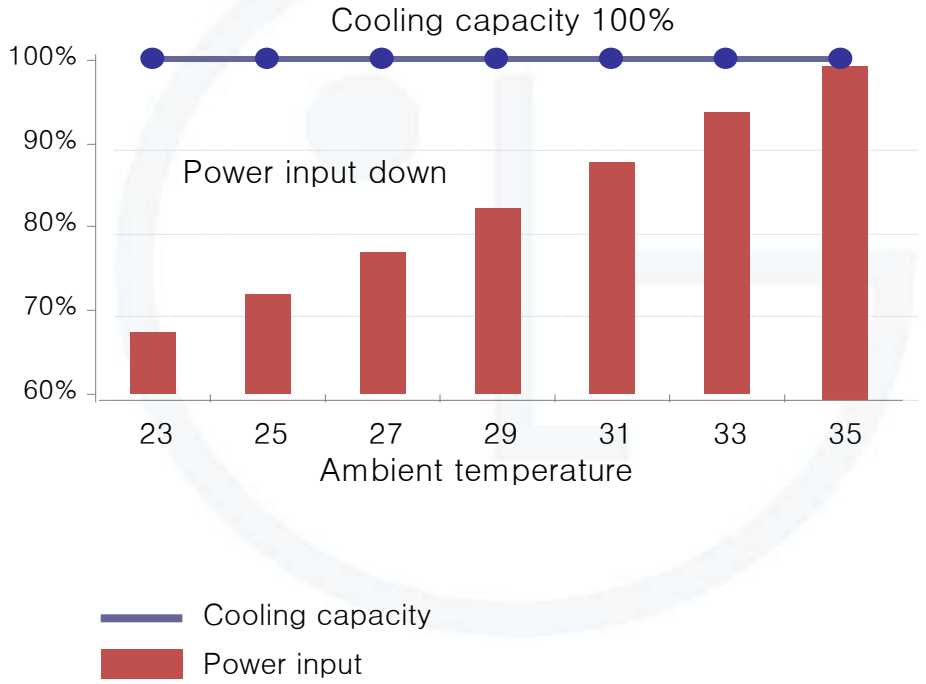
Multi V power input change

Even a full operation like shopping mall, power input can vary from 100% to 40% according to ambient temp. & Indoor temp. thanks to inverter technology.



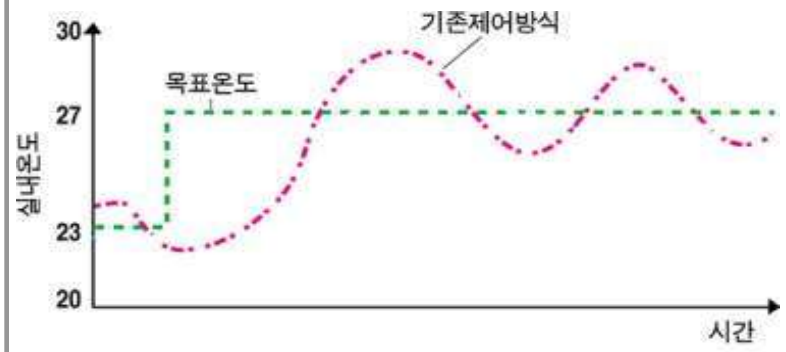
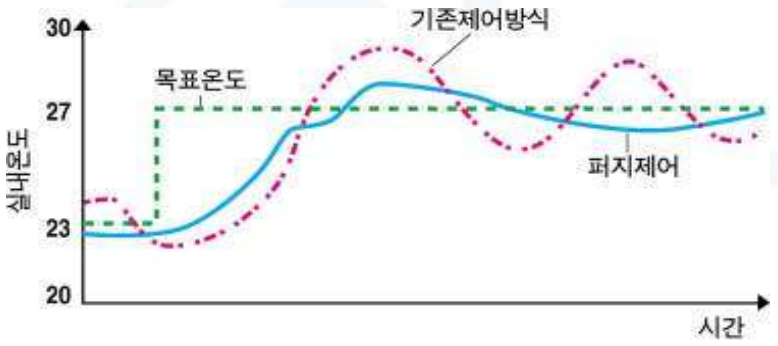
Multi V cooling capacity vs. Power input

When ambient temperature goes down, Cooling capacity keeps 100% performance. But power input reduce.



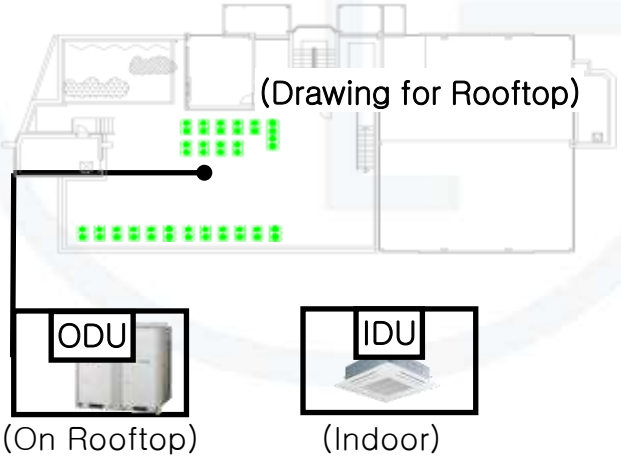
Indoor temp control

- Impossible to indoor temp. control Aircooled Chiller

	Aircooled Chiller	Multi V system
Control	- Impossible exact indoor temp control  **<Basic Control>**	**- Exact indoor temp control with Fuzzy control** **- Control error with ±0.5℃**  **<Artificial Intelligence>**

No need of Machine room

- More Parking lots for Multi V

	Aircooled Chiller	Multi V system
Space utilizing	- Additional Machine room  <Water Pump>  <Boiler>  <Machine room>  <Thermal Storage>	- No need of Machine room - Better Space utilizing  < Space utilizing for Parking lots > 

Comparison – Maintenance, Staff

Air cooled chiller

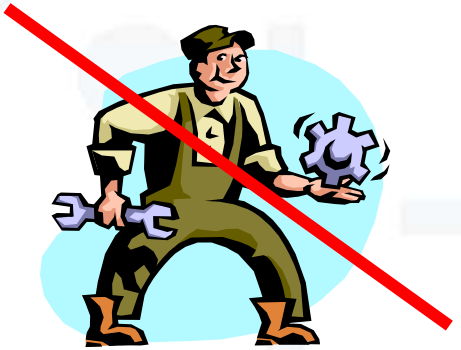
The system requires certified maintenance and operating staff not only for chillers but also pumps, boilers, cooling towers etc.

→ More expensive maintenance cost.

→ Maintenance Staff is required

Multi V

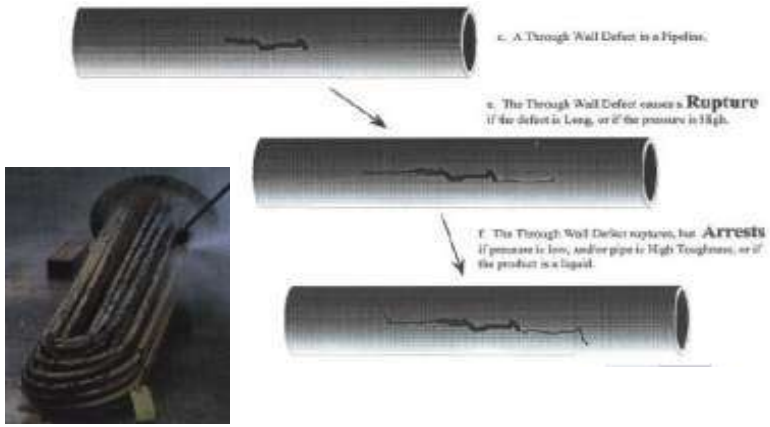
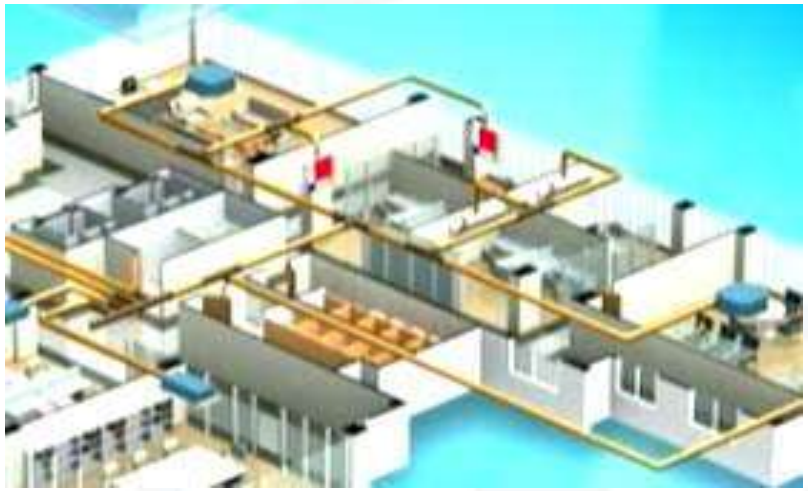
No need special maintenance staff.
Economic and easy maintenance



→ No need Maintenance Staff

Corruption in Water Pipe

- Capacity dropping & danger of Leakage

	Aircooled Chiller	Multi V system
Corruption	**- Capacity dropping & Danger of Leakage** By using Anti-Freezing liquid, corruption increasing in Pipe 	**- No Corruption in Refrigerant Pipe**  **< Copper Pipe for connection between IDU and ODU>**

Comparison – Maintenance, Scale

Air cooled chiller

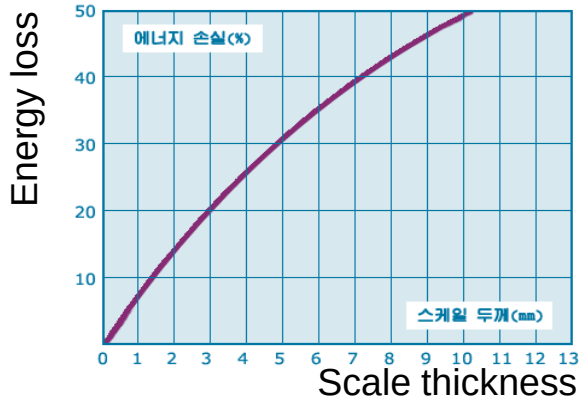
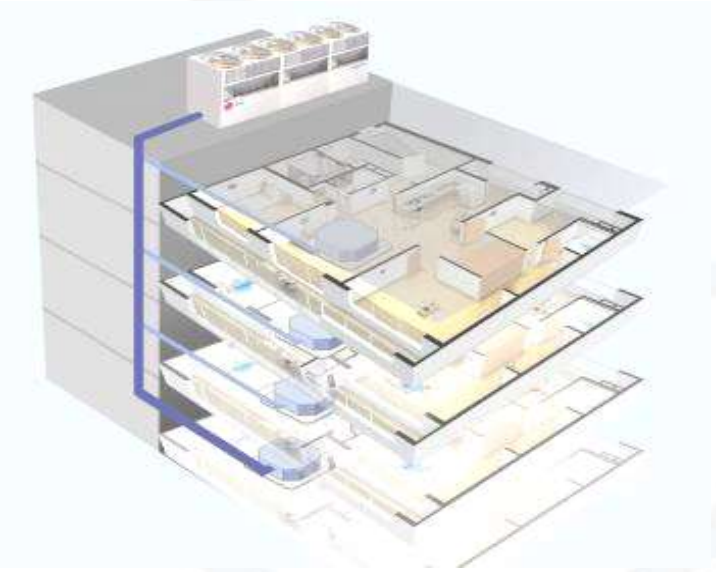
→ Regular maintenance required.

Multi V

→ No need maintenance for refrigerant pipe

Water Pipe management

- Regular checking and Cleaning by specialized company ▶ Hard to make maintenance

	Aircooled Chiller	Multi V system
Maintenance	**- Needs to clean Water Pipe in FCU** System capacity dropping by Water scale and rust, and causes virus appearance  **< Energy loss per scale thickness >**  2~3 years 5~6 years 7~8 years	**- No Water Pipe : No scale**  **< All refrigerant Pipe >**

Comparison – Commissioning

Air cooled chiller

1. 3rd party TAB (Water balance, Air balance)
 * TAB (Testing, Adjusting, Balancing)
2. Commissioning for each machine.
3. Matching commission between all machine
 (Pump, Chiller, AHU, FCU, BMS, etc)

1 week

Multi V



1. PC Connect to Outdoor unit.
2. Running the LGMV Program.
 * LGMV (Testing and checking program)

→ Making Report

2 hours

http://www.lge.com