SS 553 - 2016

Energy Efficiency Optimisation of Air-Conditioning & Mechanical Ventilation Systems



http://www.straitstimes.com/politics/engineering-key-to-singapores-future-as-smart-nation-pm

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11-Aug-2016

Proprietary Information of Measurement & Verification Pte Ltd

Measurement & Verification Pte Ltd
An Accredited Energy Services Company

Agenda

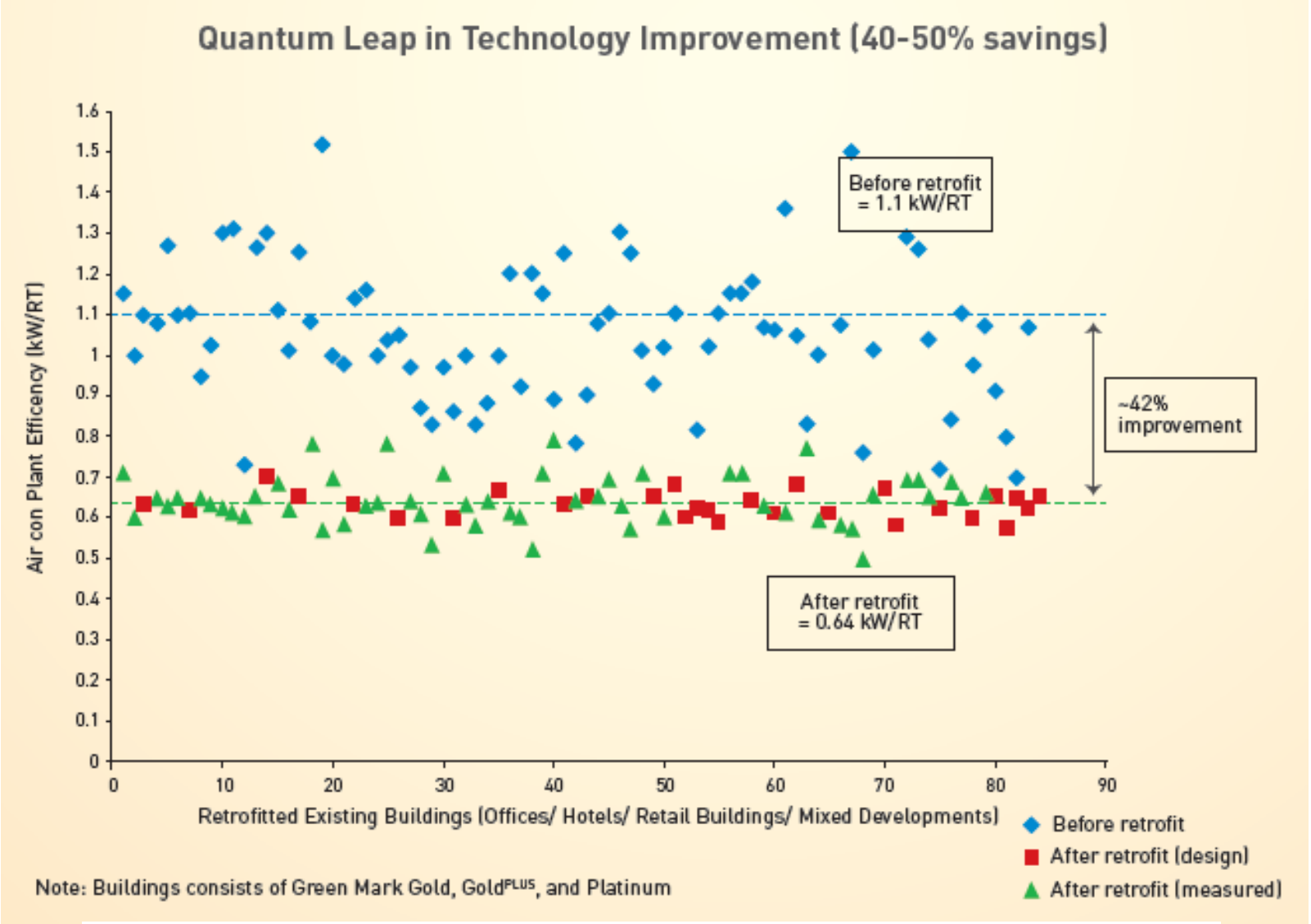
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1. Energy Efficiency Journey From Waterside Excellence to Airside + Mechanical Ventilation Excellence
2. Changes in SS553:2016
3. Pitfalls and Ideas for Airside Excellence
4. Pitfalls and Ideas for Mechanical Ventilation Excellence
5. Conclusions

Stock Take……

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Probably the highest concentration of high efficiency chiller plant in the world wide world.

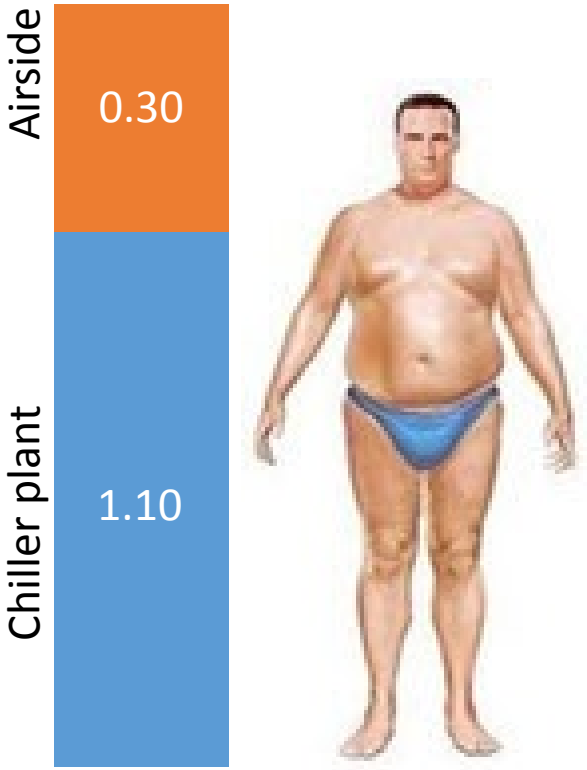


https://www.bca.gov.sg/GreenMark/others/BCA_BEBR_Abridged_FA_2015.pdf

The Modern History of Singapore ACMV Efficiency

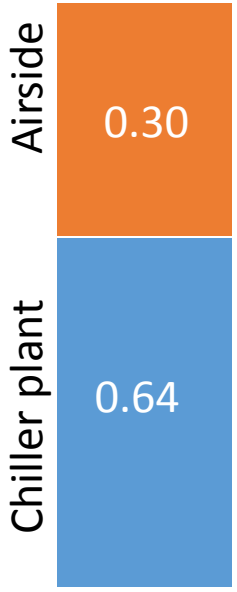
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1.40 KW/RT



BEFORE GM

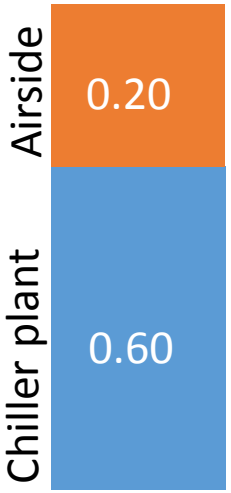
0.94 KW/RT





NOW

0.80 KW/RT



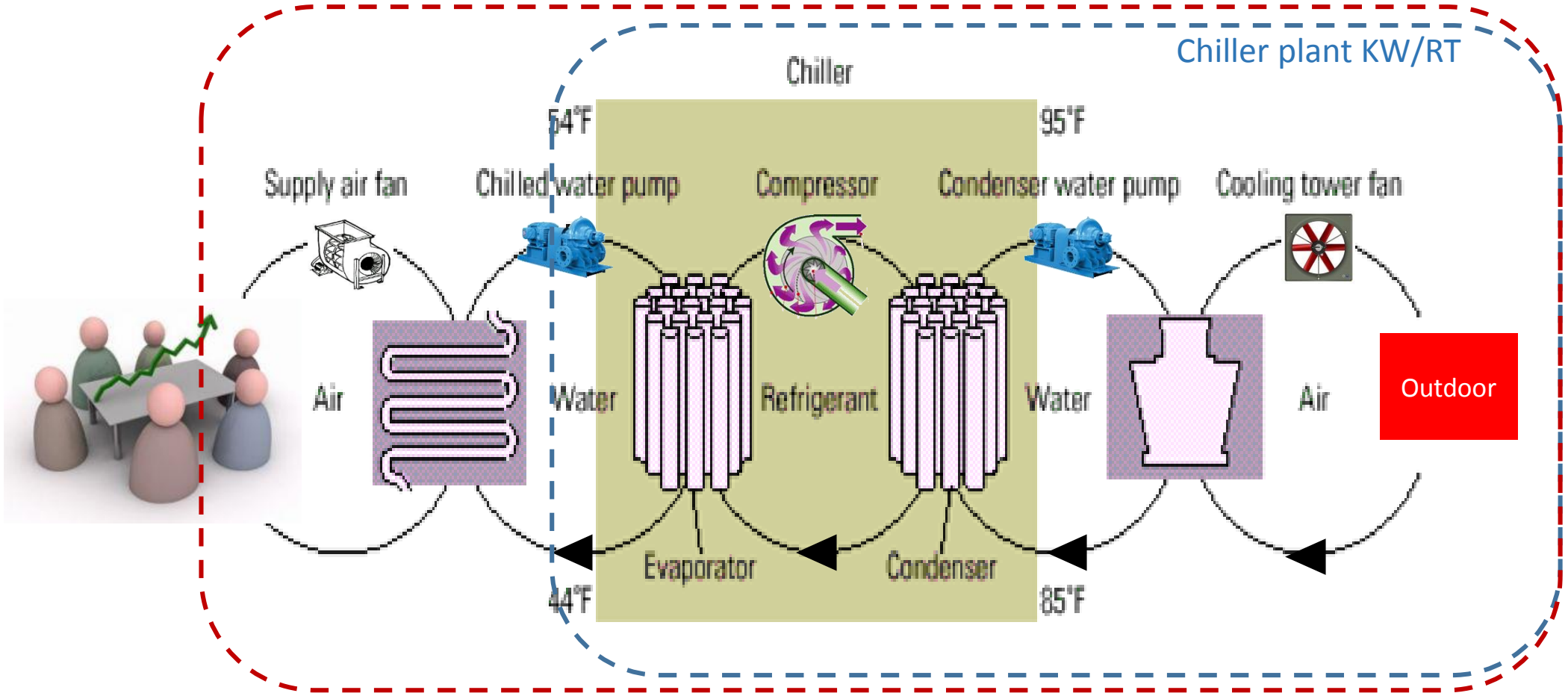


FUTURE

Green Mark 2015

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Whole system KW/RT Minimum Requirement for Gold^{plus} and Platinum: 0.90KW/RT or better.



Agenda

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Recommended Energy Efficiency Monitoring Points

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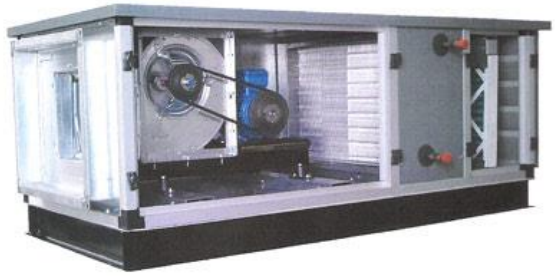
Table 14 - Recommended energy efficiency monitoring points and data recording interval

Metric	Units	Interval	Remarks
Bldg energy utilization Index	KW/m²	15 mins	M²: GFA
Cooling load intensity	W/m²	1 min	M²: Aircon area W: Cooling load
Chiller plant efficiency	KW/RT	1 min	Per SS 591
Airside efficiency	KW/ RT	1 min	As whole building
Receptacle Load Index	W/m²	15 mins	M²: GFA
Lighting power index	W/m²	15 mins	M²: GFA (Exclude carpark)
Car park ventilation fan power index	W/m²	15 mins	M²: Carpark area
Car park ventilation fan power index	W/m²	15 mins	M²: Carpark area
All others	W/m²	15 mins	M²: GFA

For non-single occupied buildings, the above points should be monitored for landlord(s) and all tenants.

Goals For Airside Efficiency

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$$\frac{W}{CMH} = \frac{\text{Total Pressure}}{3600 \times \eta_{fan} \times \eta_{motor}}$$

Types of air system	SS553-2016 (W/CMH)*	SS553-2016 (KW/RT)	Excellent class (W/CMH)	Excellent class (KW/RT)
Constant Volume AHU Motor ≥ 4KW	0.42 + A	0.29 + A	0.20	0.14
Variable Volume AHU Motor ≥ 4KW	0.58 + A	0.39 + A	0.20	0.14
AHU/FCU Motor < 4KW	0.17 + A	0.12+ A	0.10	0.07

Accurate and continuous measurement recommended

*: Based on power input method
A: Pressure Drop Adjustment Factor
KW/RT = W/CMH * 680 CMH/RT /1000

Goals For Mechanical Ventilation Efficiency

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$$\frac{W}{CMH} = \frac{\text{Total Pressure}}{3600 \times \eta_{fan} \times \eta_{motor}}$$



Types of air system	SS553-2009		SS553-2016		Excellent class
Power reference	Motor nameplate		Power input		Power input
W/CMH	CAV: 0.47	VAV: 0.67	0.35 + A	0.30 + A	0.18

A: Pressure Drop Adjustment Factor

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Creative but inefficient ways to move air

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Traffic lights needed



Patented



Creative but inappropriate way to save space for AHU

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Sorry,
we can’t hire
fat technicians

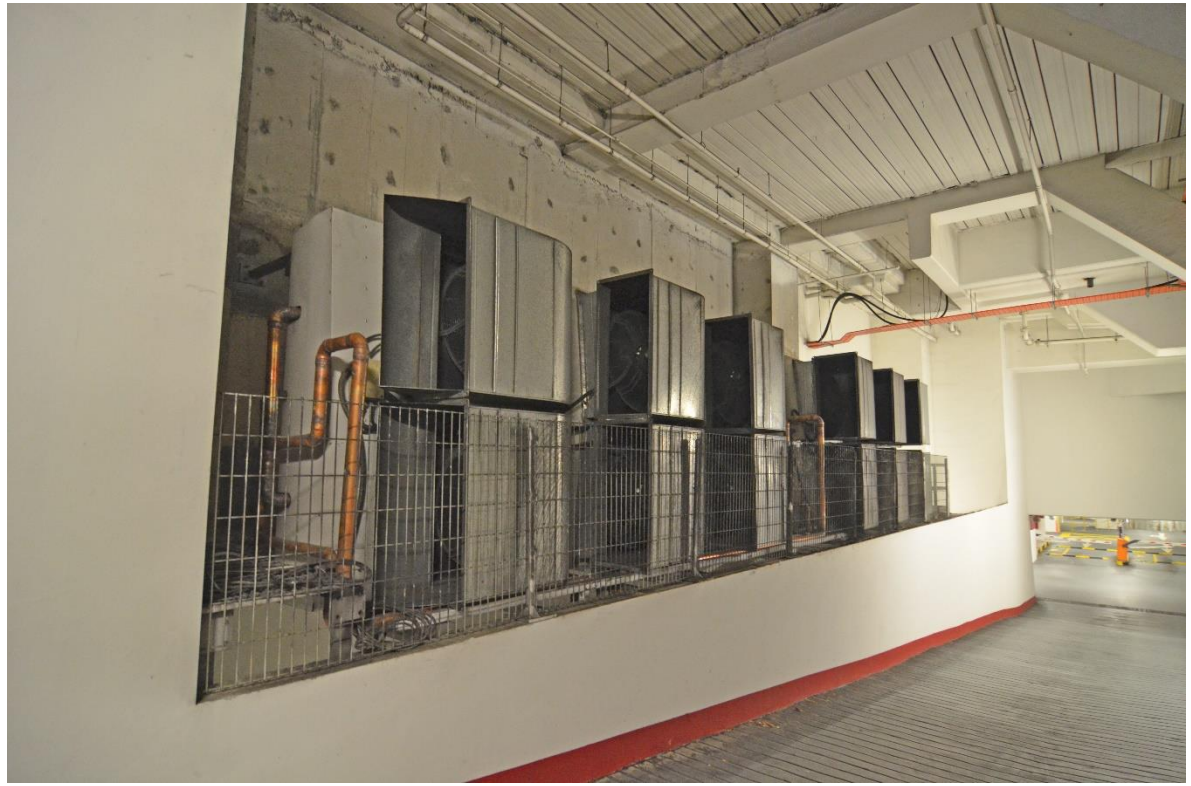




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Creative But Inefficient Condensing Units

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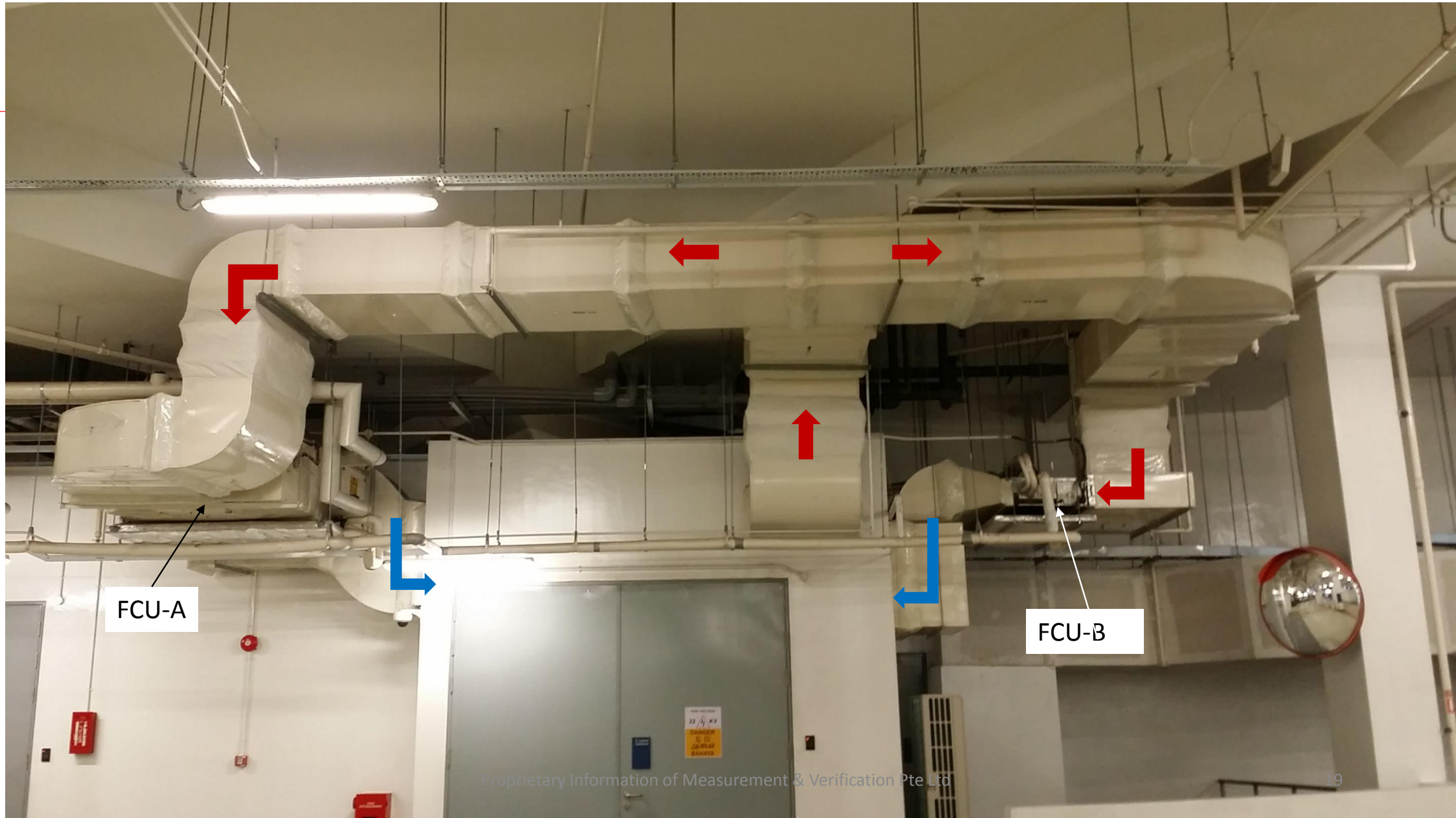
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Highly Unique But Also Highly Inefficiency FCU

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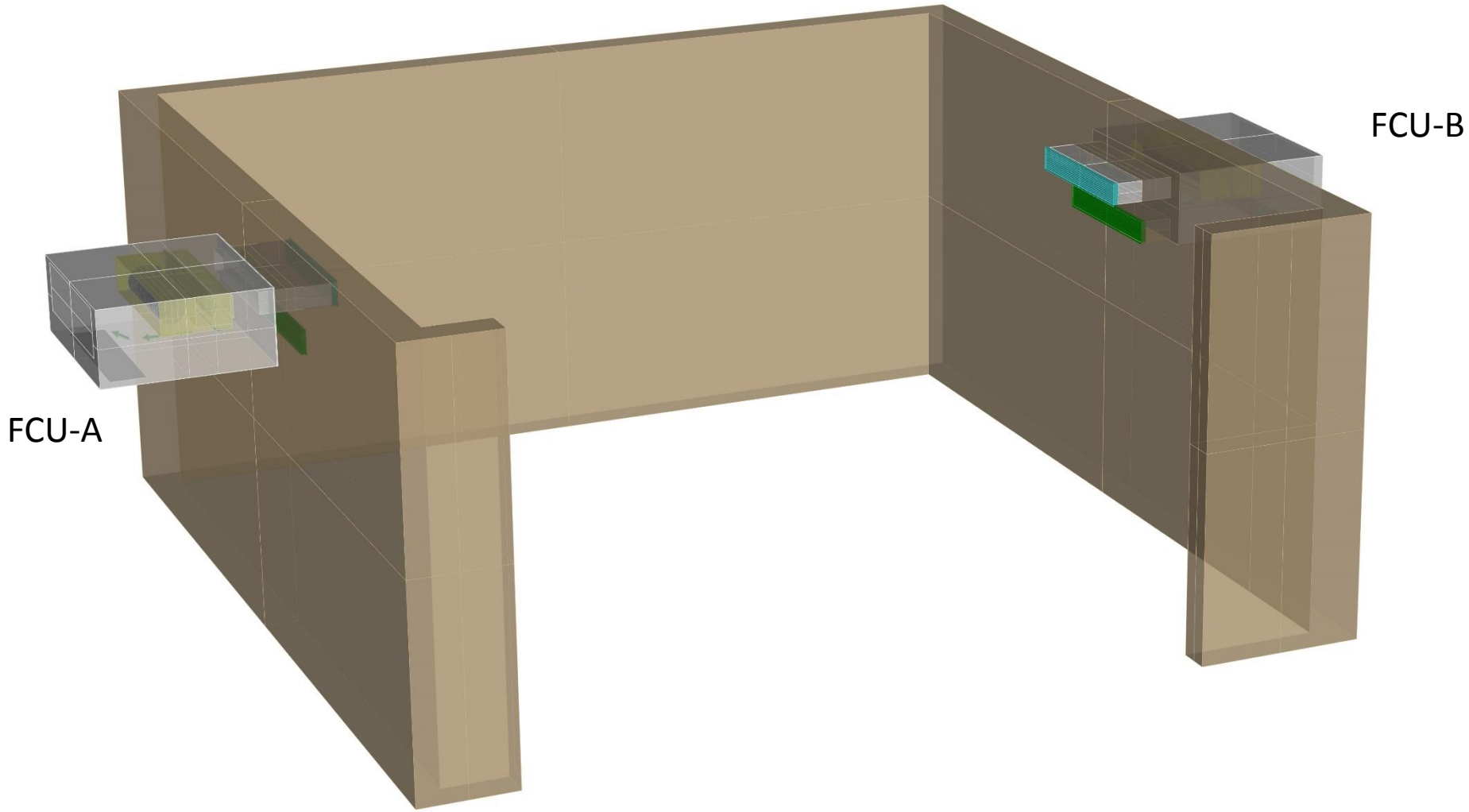



EXIT
Fresh
Air
CAUTION
Door Swings
Outwards



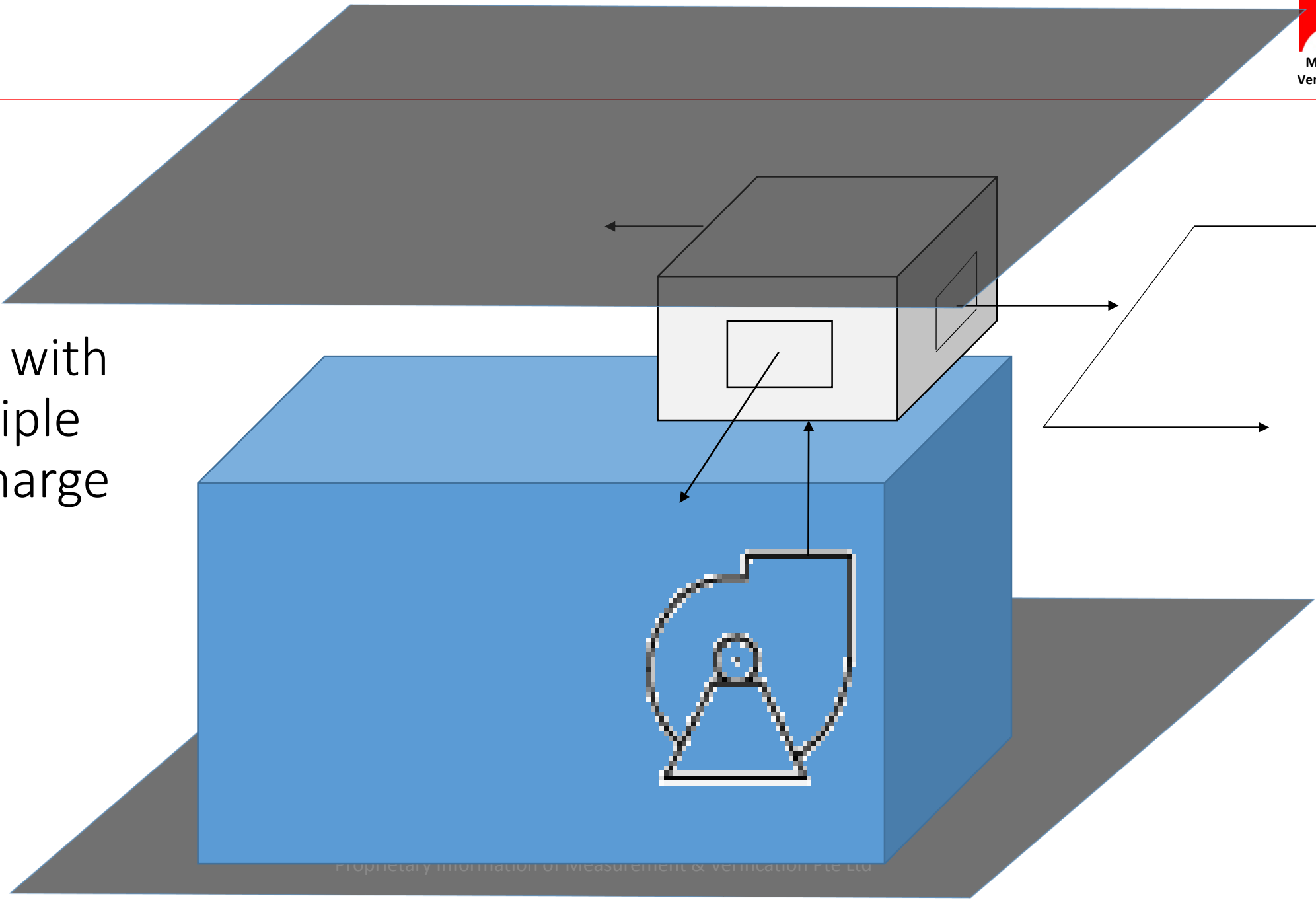
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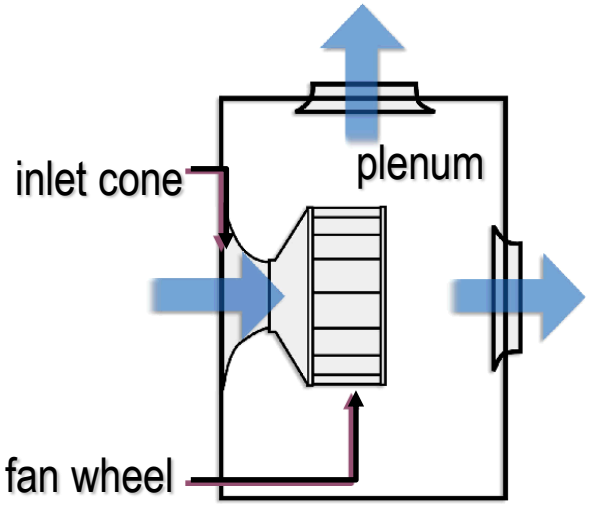
AHU with multiple discharge



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Direct Drive Plenum Fan





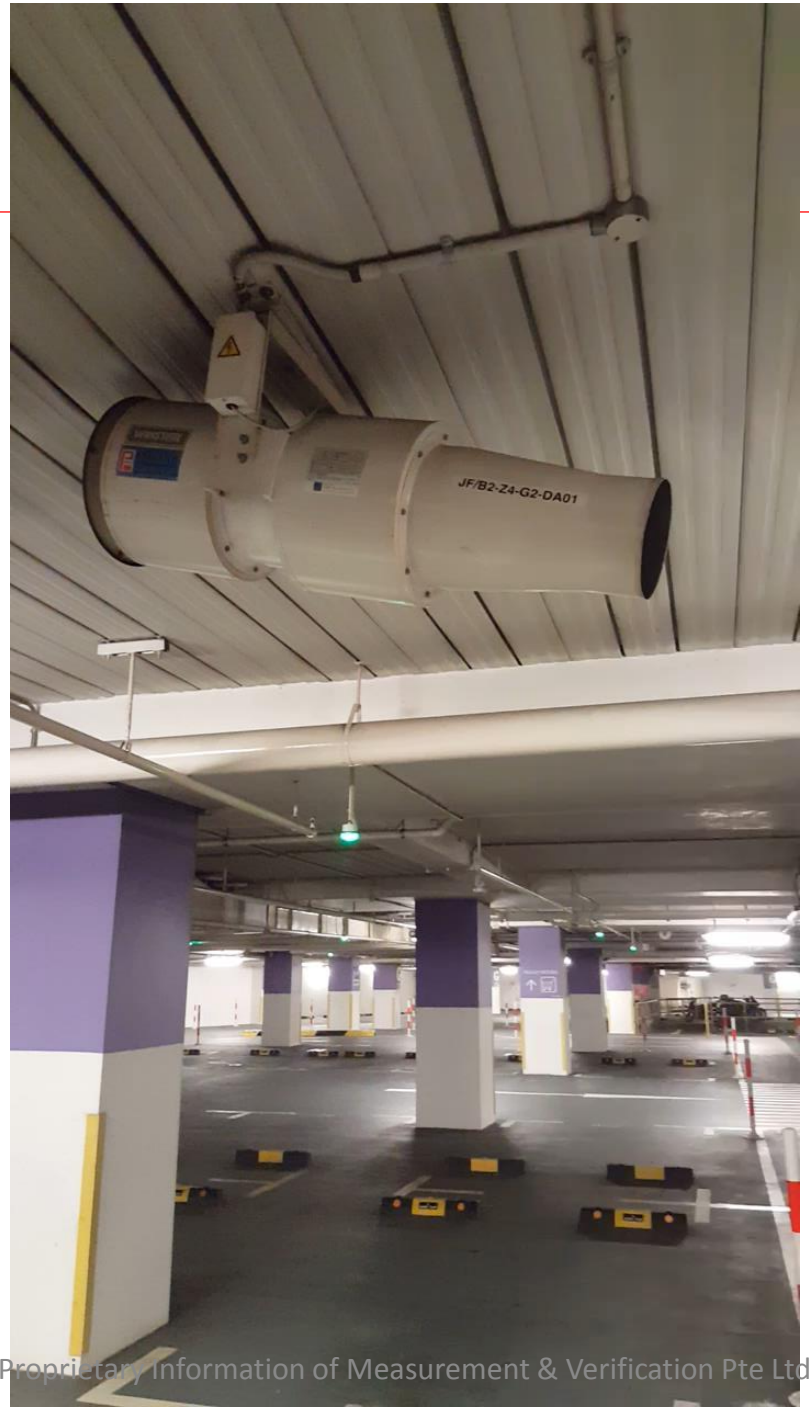


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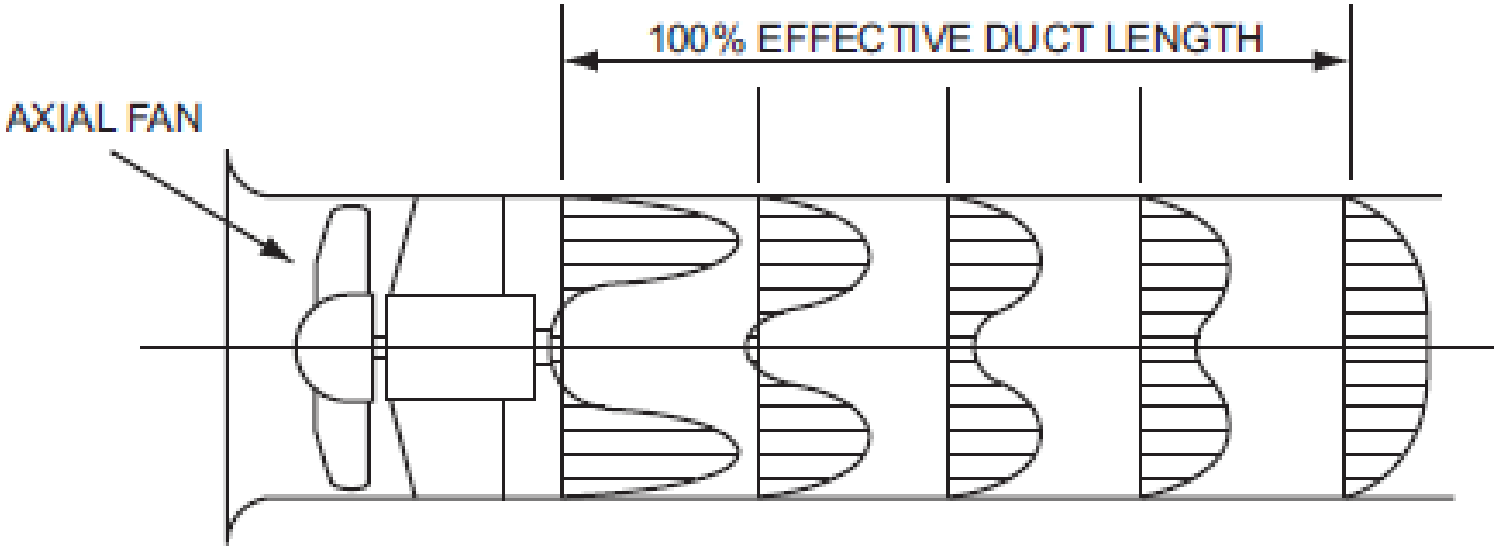


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AMCA 203 Recommendation for Air Intake & Discharge

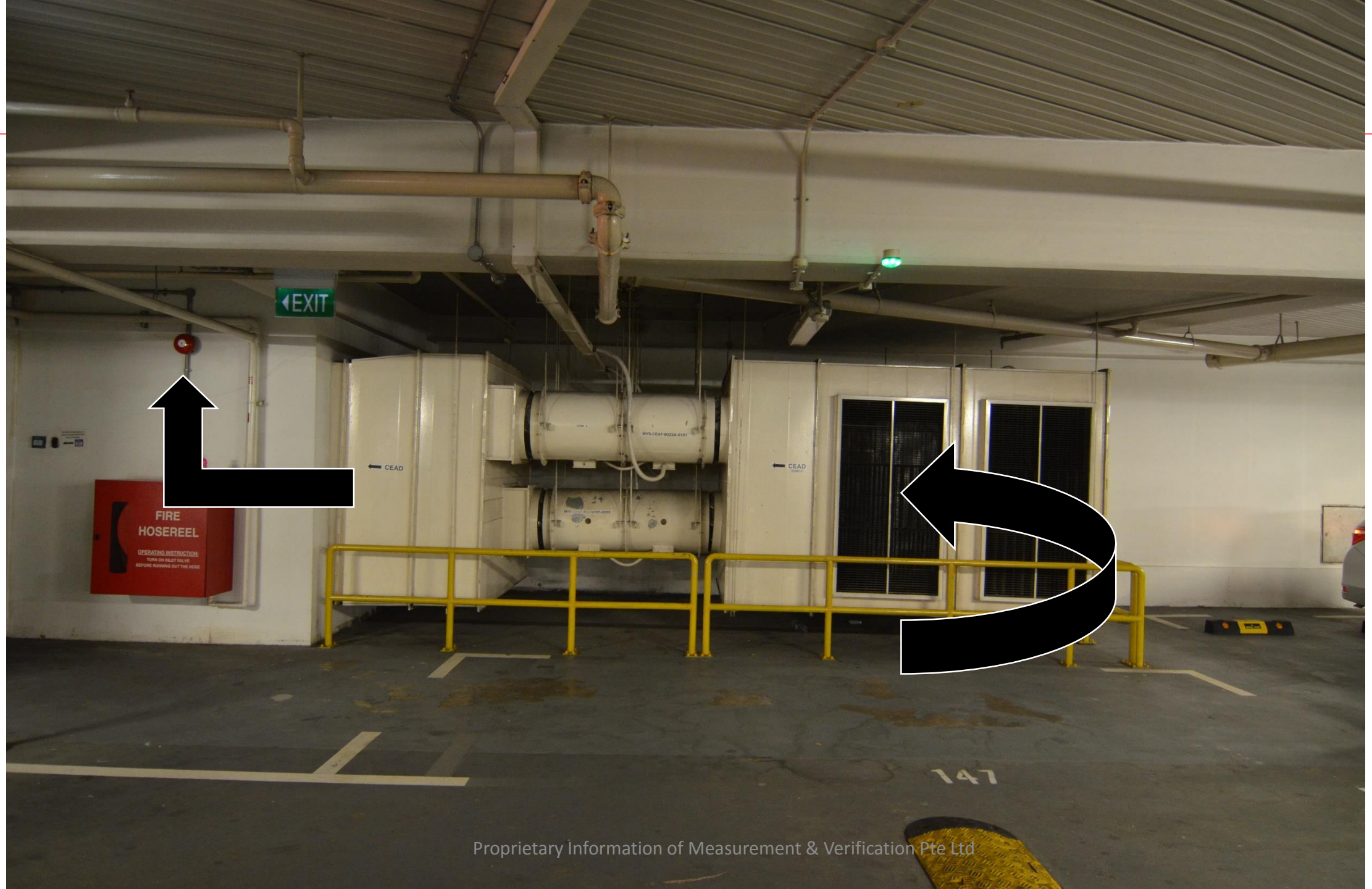
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To calculate 100% effective duct length, assume a minimum of 2½ duct diameters for 2500 fpm or less. Add 1 duct diameter for each additional 1000 fpm.

Example: 5000 fpm = 5 equivalent duct diameters



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Example of inefficiencies

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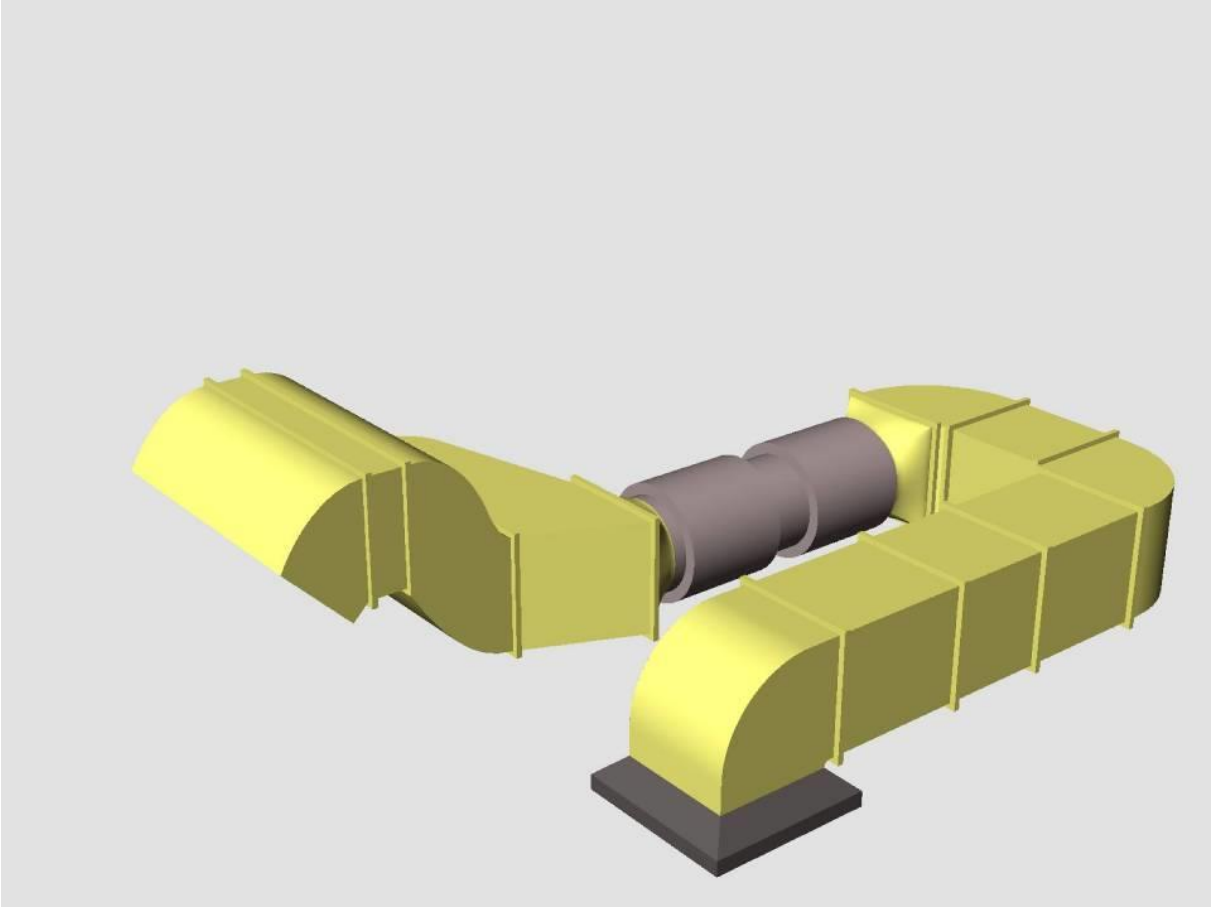


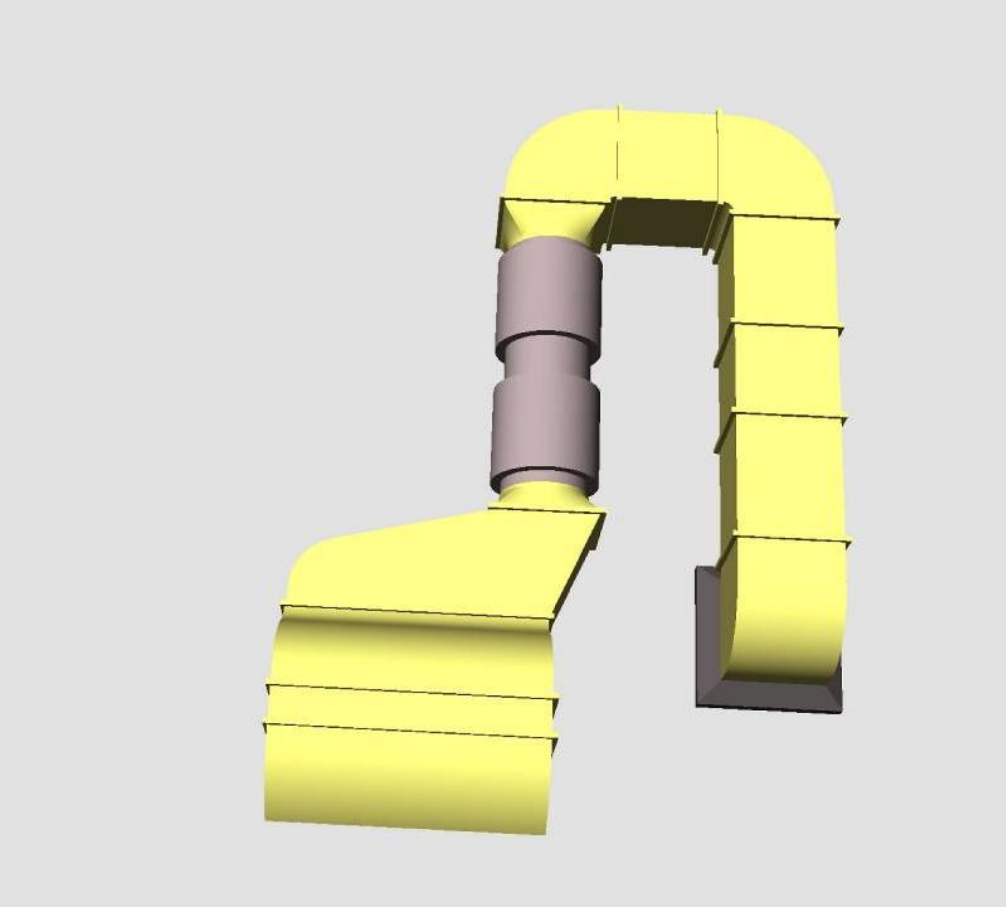


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Example of inefficiencies

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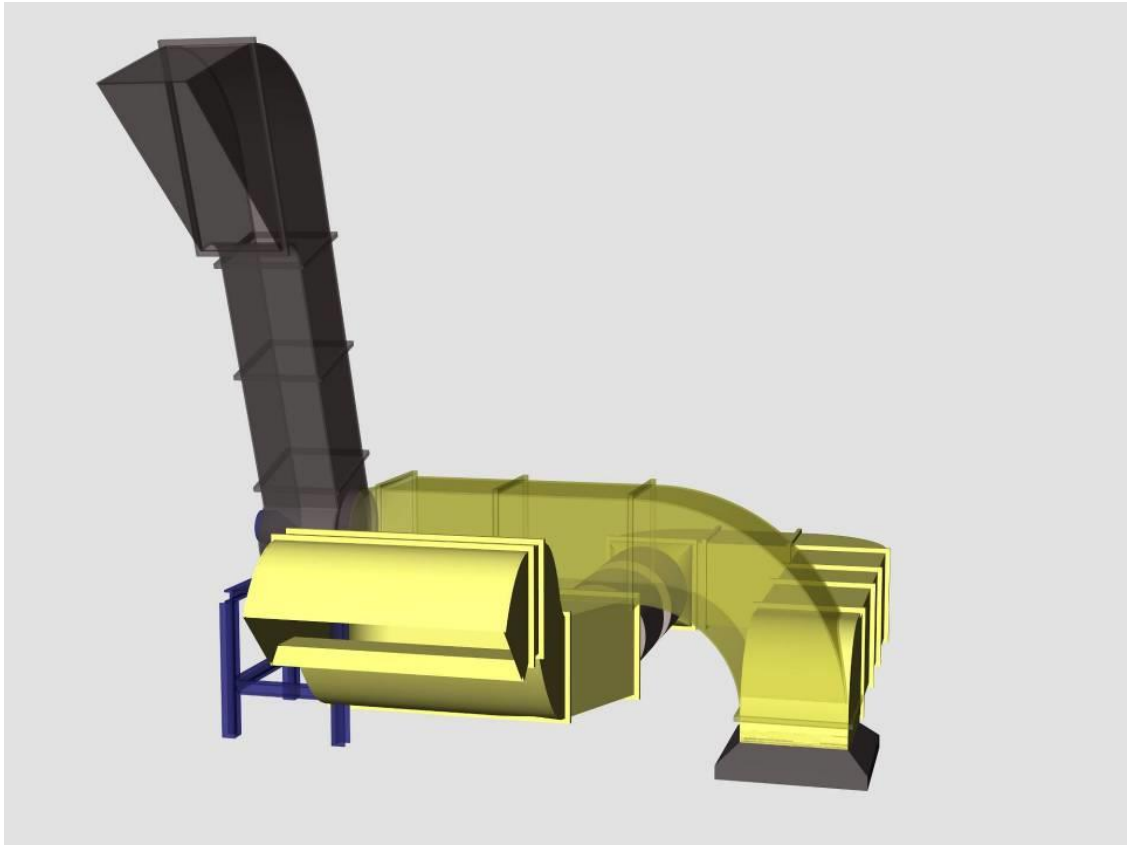


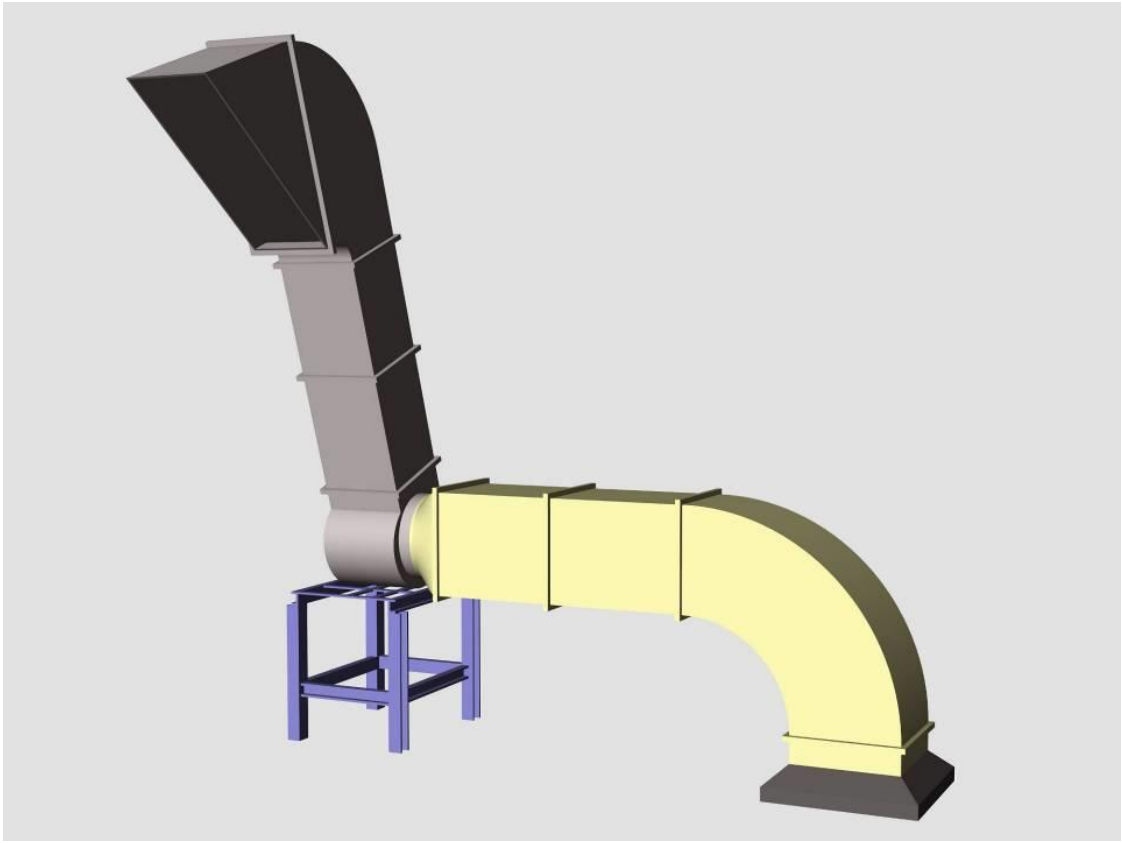


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Ideas to improve

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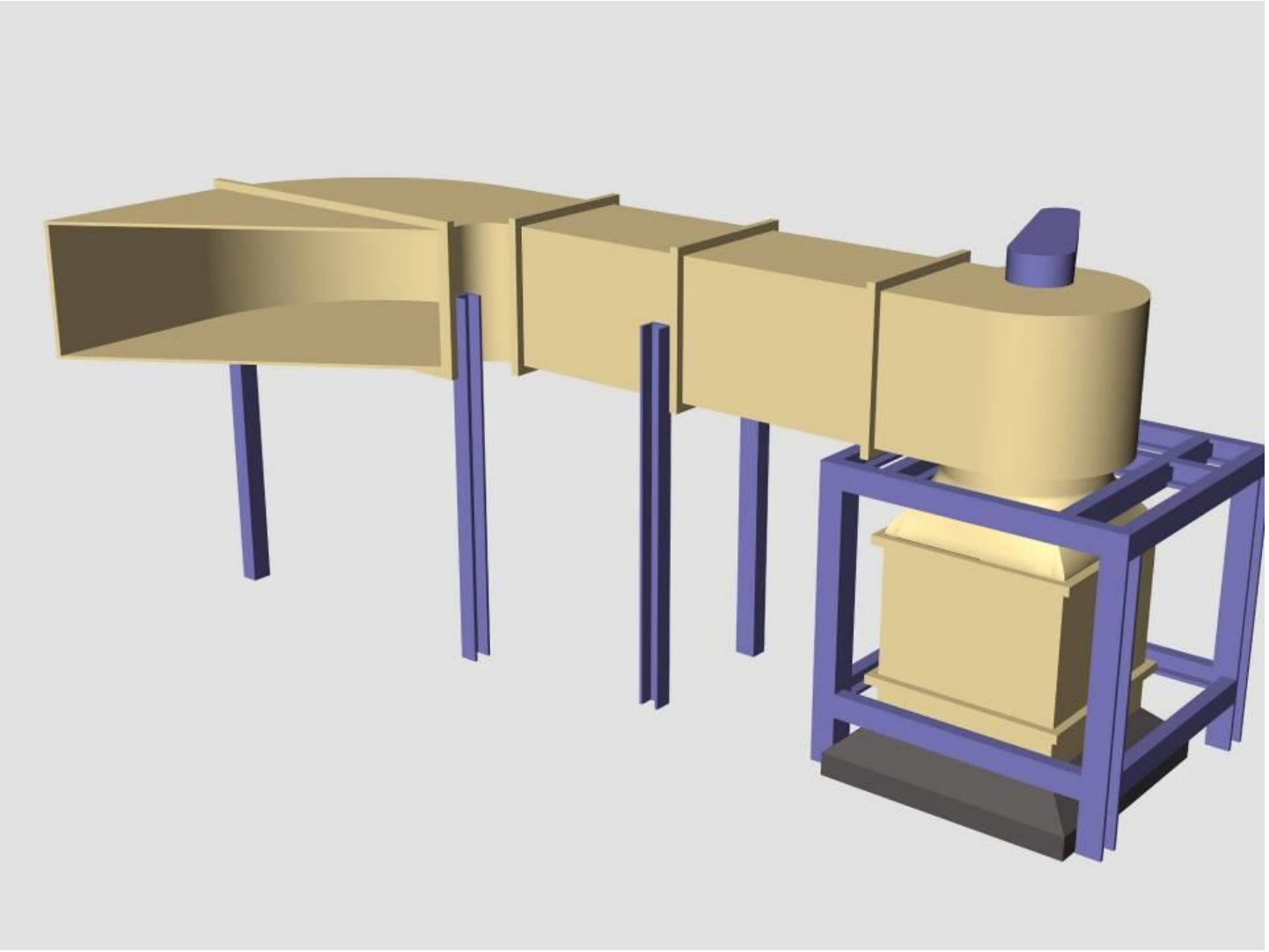




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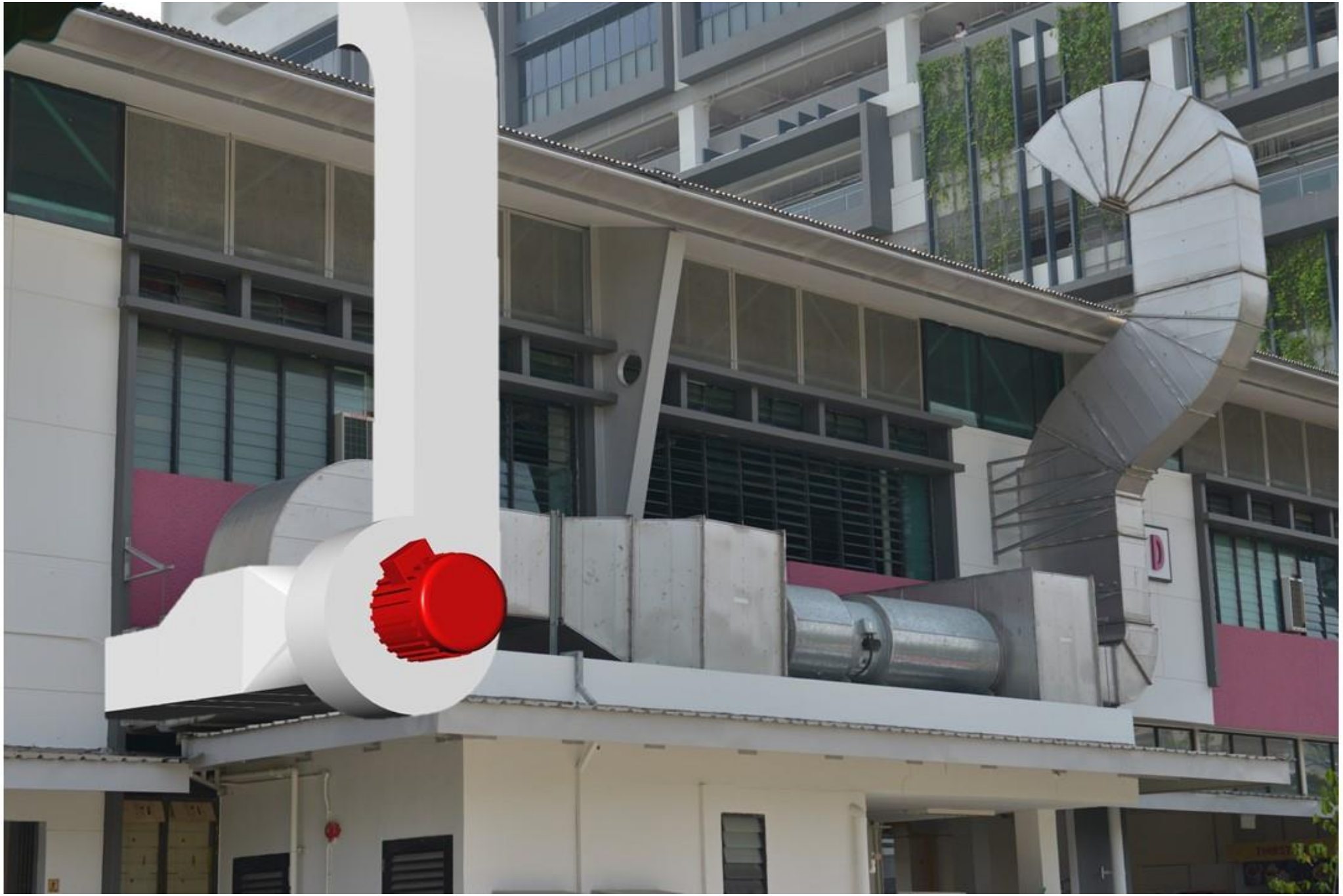
Ideas to improve

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D



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Measuring Airside KW/RT

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Belimo Energy Valve - Five Functions in One Valve

Dynamic Balancing



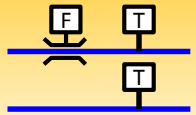
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Modulating & Shut-off Control



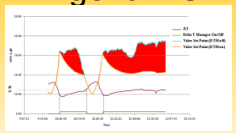
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Flow & Temp Measurement



+

Delta T Manager & Power Control Algorithms



+

Live Monitoring, Data Logging, BACnet Interface





DN15…50



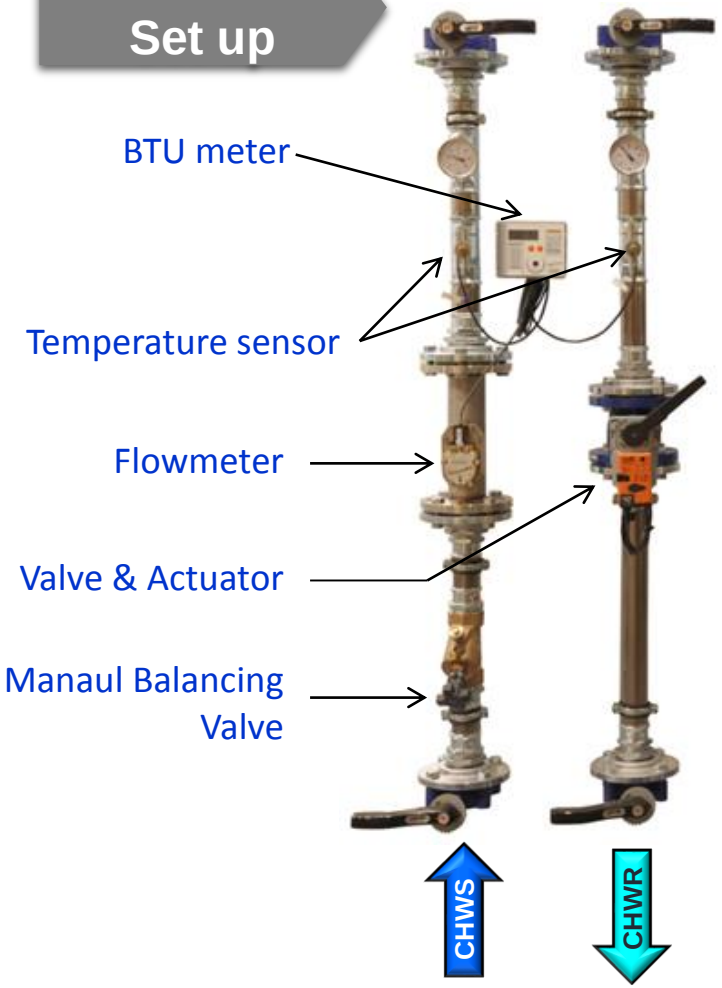
DN65…150

Key element for improvement

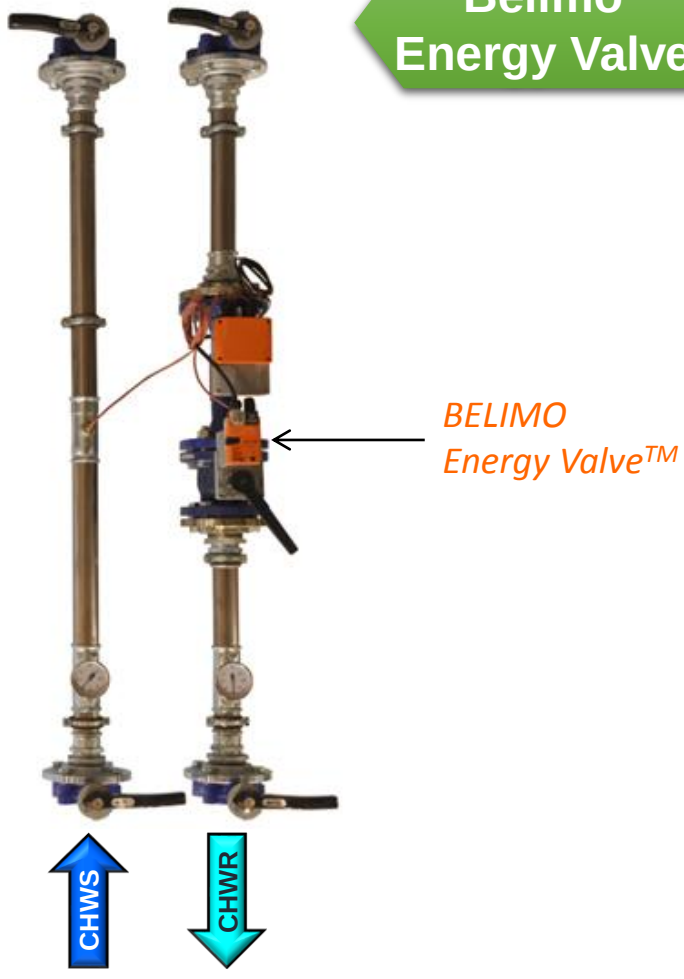
Measuring Airside KW/RT

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Conventional Set up



Belimo Energy Valve



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Conclusions



Measurement and Goals are vital for improvement



Optimize the entire system (Water + Airside + MV) and adopt continuous optimization and M&V

Make Singapore own the highest concentration of high efficiency Waterside + Airside + MV plant in the whole wide world.

Thank you for your attention

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