By your side
from concept to completion.
Fan technologies
Fans

• Belt driven Fans

• Direct driven Fans
Belt driven centrifugal fans

Forward curved centrifugal fan with belt drive

Backward curved centrifugal fan with belt drive

Aero foil Backward curved centrifugal fan with belt drive
Direct driven fans

Plug fan with direct drive

Plug EC fan

Axial flow fan
### Forward Curved Fans

- Efficient at low and medium pressure
- Low RPM
- Low sound level
- Using with frequency inverter is applicable with new automation equipments
**Backward Curved Fans**

- Efficient at medium and high pressure
- Medium-High RPM
- High sound level
- Non – overloading
- Using with frequency inverter is easy
Fans

Plug fan

- Efficient at medium and high pressure
- Medium-High RPM
- Laminar flow & optimum utilisation of pre & post components
- Using with frequency inverter is easy
Fans

Plug EC fan

- Constant Efficiency at part load
- Suitable for 0 – 100 % load variation
- Low sound level
- Built in frequency inverter
- Compatible with BMS / standalone control
Fans

High Efficient Axial fans
Belt Driven Fans - Components

Belt driven fans have many of components at work

- Fan* incl. the bearings
- 2 pulleys* with hubs for different shaft diameters (fan and motor)
- Number of belts*, often V-belts
- Standard motor*
- Optional VSD-controller*, if speed control
- Clamping slide for the motor (for belt tensions)
- Strong frame construction
- Optional belt guard*
Direct Drive Fans – Components

Plug Fan, only 3
- Impeller, especially composite material or C-Steel
- Standard motor (IE2 or better)
- VSD-Controller, external or on top

Plug EC Fan, only 2
- Impeller
- EC-Technology (motor and controller)
- Optimized fit of components
System Efficiency Comparison - With New Belt

- Forward curved fan – belt driven

\[ \eta_{VSD} \times \eta_{motor} \times \eta_{belt} \times \eta_{beltguard} \times \eta_{pulley} \times \eta_{fan} = \eta_{sFSys} \]
System Efficiency Comparison - With New Belt

- Backward curved fan – belt driven

\[ \eta_{\text{VSD}} \times \eta_{\text{motor}} \times \eta_{\text{belt}} \times \eta_{\text{beltguard}} \times \eta_{\text{pulley}} \times \eta_{\text{fan}} = \eta_{\text{sFSys}} \]

- VSD: 0.97%
- Motor: 85-91%
- Belt: 92-95%
- Belt guard: 97%
- Pulley / bearing cross: 92-96%
- Fan: 71-77%

Input: 100 %
Air power: 60 %
System Efficiency Comparison - No Belt system

- Plug fan – direct driven

\[ \eta_{faSys} = \eta_{VSD} \times \eta_{motor} \times \eta_{fan} \]

<table>
<thead>
<tr>
<th>Component</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSD</td>
<td>97%</td>
</tr>
<tr>
<td>Motor</td>
<td>85-91%</td>
</tr>
<tr>
<td>Fan</td>
<td>74%</td>
</tr>
</tbody>
</table>

Input: 100%  
Air Power: 65%
System Efficiency Comparison- No Belt system

- Plug EC fan – direct driven

\[ \eta_{\text{faSys}} = \eta_{\text{motor}} \times \eta_{\text{fan}} \]

- Motor efficiency: 92-97%
- Fan efficiency: 74%

Input: 100% → Air Power: 72%
System Efficiency Comparison - No Belt system

- Axial flow – direct driven

$$\eta_{faSys} = \eta_{VSD} \times \eta_{motor} \times \eta_{fan}$$

VSD
97 %

Motor
92-97 %

Fan
85 – 92 %

100 %

80% above
Direct driven Fans offer Better Value

Plug Fans have less number of components and offer high efficiency compared to the Belt driven fans:

- Belt driven fans: Total Efficiency =
  \[ \eta = \eta_{\text{VSD}} \times \eta_{\text{motor}} \times \eta_{\text{belt}} \times \eta_{\text{beltguard}} \times \eta_{\text{pulley}} \times \eta_{\text{fan}} \]

- Plug Fans & Axial Fans : Total Efficiency =
  \[ \eta = \eta_{\text{VSD}} \times \eta_{\text{motor}} \times \eta_{\text{fan}} \]

- EC Plug Fans: Total Efficiency =
  \[ \eta = \eta_{\text{EC motor}} \times \eta_{\text{fan}} \]
Comparison of consumed Power of FC / BC / Plug / Axial fans in AHU

- SFP in a typical unit with a air flow at 3.0 m3/s, only changed in the selection of fan and motor.

<table>
<thead>
<tr>
<th></th>
<th>FC Belt Driven</th>
<th>BC Belt Driven</th>
<th>BC Direct driven</th>
<th>Plug Fan</th>
<th>Plug EC Fan</th>
<th>Axial Flow Fan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency fan</td>
<td>0.67</td>
<td>0.75</td>
<td>0.75</td>
<td>0.78</td>
<td>0.78</td>
<td>0.84</td>
</tr>
<tr>
<td>Efficiency transmission</td>
<td>0.95</td>
<td>0.95</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Efficiency motor</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.92</td>
<td>0.95</td>
</tr>
<tr>
<td>Efficiency control</td>
<td>0.95</td>
<td>0.95</td>
<td>0.95</td>
<td>0.95</td>
<td>1.00</td>
<td>0.95</td>
</tr>
<tr>
<td>Efficiency, total</td>
<td>0.54</td>
<td>0.61</td>
<td>0.64</td>
<td>0.63</td>
<td>0.72</td>
<td>0.75</td>
</tr>
<tr>
<td>SFP, value, kW/(m3/s)</td>
<td>2.85</td>
<td>2.40</td>
<td>2.35</td>
<td>2.34</td>
<td>2.05</td>
<td>1.96</td>
</tr>
<tr>
<td>Consumed Power, kW</td>
<td>8.54</td>
<td>7.20</td>
<td>7.05</td>
<td>7.03</td>
<td>6.15</td>
<td>5.88</td>
</tr>
<tr>
<td>11 h-kWh/year, 4015 h/year</td>
<td>34200</td>
<td>28809</td>
<td>28200</td>
<td>28120</td>
<td>24605</td>
<td>23520</td>
</tr>
<tr>
<td>24 h-kWh/year, 8760 h/year</td>
<td>74900</td>
<td>63091</td>
<td>61687</td>
<td>61583</td>
<td>53884</td>
<td>51508</td>
</tr>
</tbody>
</table>
EC Fan

Frequency regulator

Frequency regulator

EC fan

Buildings

Energy
Risk
Impeller
Motor

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EC fan – Efficiency vs speed
Power saving mainly on part load / demand control ventilation

Efficiency in %

Speed in min⁻¹
SMART Air Handling

Flow Diagram

Running mode: Normal operation

Flow Diagram

ASHRAE Qatar Oryx Chapter

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SMART AHU  Save energy upto 40%
BA plus
Next generation air handling

• Improved mechanical characteristics of current BA series
• Save upto 40% energy
• Plug and play with integrated controls and instrumentation
• High efficient EC fans
TYPICAL CONTROL SEQUENCE
AHU Controller System

- Fresh Air damper
- Pre Filter
- Chilled water Coil
- EC Fan
- Fine Filter
- Supply Air Damper
- Return Air Damper

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Static pressure Sensor

This logic helps in maintaining constant static pressure by ramping up/down the fan speed.

RS 485 Signal to Fan

Static pressure Sensor AI 1
Return Air Temperature Sensor

This logic regulates chilled water quantity by sensing the return air temperature.

Return Air Temperature sensor AI 2

Chilled water coil

Valve control AO 1

Output to valve
Valve feedback

This logic gives the feedback to controller on % age of valve opening.
Return Air CO2 Sensor

This logic regulates fresh air & return air dampers (in opposite directions) based on room CO2 level.
Return/ Fresh Air Damper feedback

This logic gives the feedback to controller on % age of FA/RA damper opening.
Supply air temperature sensor

This logic indicates supply air temperature on controller.
CHW In/Out Sensor

This logic indicates supply, return chilled water temperature on controller.
Pre Filter clog Alarm

This logic triggers an alarm when filter pressure drop exceeds the preset limit.
Fine Filter Clog Alarm

This logic triggers an alarm when filter pressure drop exceeds the preset limit.
Fire Alarm

This logic triggers an alarm on receiving signal from fire alarm system & switches off the fan.
Fan Data

- Speed
- Power consumption
- Line voltage
- Motor temperature
- Current
- Fan error status

RS 485 Signal from Fan

Fan Data sent to controller
# Overall control architecture

## CONTROLLER DATA POINT ALLOCATION

<table>
<thead>
<tr>
<th>AO1</th>
<th>Chilled water valve with actuator</th>
<th>Duct static pressure sensor</th>
<th>AI1</th>
</tr>
</thead>
<tbody>
<tr>
<td>AO2</td>
<td>FA/RA damper actuator</td>
<td>Return air temperature sensor</td>
<td>A12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chilled water valve feedback</td>
<td>A13</td>
</tr>
<tr>
<td>DO1</td>
<td></td>
<td>Return air CO2 sensor</td>
<td>A14</td>
</tr>
<tr>
<td>DO2</td>
<td></td>
<td>Fresh air damper feedback</td>
<td>A15</td>
</tr>
<tr>
<td>DO3</td>
<td></td>
<td>Return air damper feedback</td>
<td>A16</td>
</tr>
<tr>
<td>DO4</td>
<td></td>
<td>Supply air temperature sensor</td>
<td>A17</td>
</tr>
<tr>
<td>DO5</td>
<td></td>
<td>Chilled water IN temperature</td>
<td>A18</td>
</tr>
<tr>
<td>DO6</td>
<td></td>
<td>Chilled water OUT temperature</td>
<td>A19</td>
</tr>
<tr>
<td>RS 485</td>
<td>Between controller &amp; Fan</td>
<td>Differential pressure switch - Pre filter</td>
<td>D11</td>
</tr>
<tr>
<td>RS 485</td>
<td>Between controller &amp; BMS</td>
<td>Differential pressure switch - Fine filter</td>
<td>D12</td>
</tr>
<tr>
<td>TCP/IP</td>
<td>For connecting to Network</td>
<td>Signal from fire alarm system</td>
<td>D13</td>
</tr>
</tbody>
</table>

## OUTPUTS

- RS 485
- TCP/IP

## INPUTS

- RS 485
- DO1
- DO2
- DO3
- DO4
- DO5
- DO6
- AO1
- AO2
- AI1
- AI2
- AI3
- AI4
- AI5
- AI6
- AI7
- AI8
- AI9
- DI1
- DI2
- DI3

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**BMS SYSTEM**

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Conclusions

• Energy saving with Direct Driven Fan with EC motors with IE5 efficiency
• Energy saving upto 40% with demand control ventilation
• PLUG and Play Solution
• Sustainable and maintenance free
• Redundancy against failure for critical operation
QUESTIONS?

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