# Ohio Facility Construction Commission School Design

Greg Drensky
Vice President
Jacco & Associates

# Agenda:

- Who Is Jacco?
- What Is New At Jacco?
- Who Is OFCC
- Components Of Approved Systems
- Evaluation Of Systems

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# Who is Jacco

- Established 1968
  - Hudson, Ohio
  - Columbus, Ohio
  - Toledo, Ohio
- Focused on the Engineered Environment
  - Systems Knowledgeable
    - HVAC Systems
    - Service & Maintenance
    - Parts
- Full Circle Support
- 30 Minute Design


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# Who is Jacco

- Operations
  - –Brenda Homjak
  - –Mike Spangler
  - –Chad Russell
  - –Mike Mueller
- Contractor Owning Experience
  - –Maggie Sawicki
  - –Rick Baker
  - –Dan Duignan
- Engineering Owning Experience
  - –Greg Drensky
  - –Jerry Cohen
- Owning Experience
  - –Steve Leister
  - –Gloria Schwartz
  - –Jeff Watson

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# Purpose Statement

The purpose of our Company is to solve our customers problems, in the most economical way, at all times optimizing the owning experience.


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# Who is Jacco

- 30 Minute Design
  - Unit Performance
  - Drawing
  - Weights
  - Electrical
  - Specifications?
  - Sequence of Operation?
  - Cartoon?
  - Narrative?


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# Who is Jacco

## 2016 Seminars

| Seminars | Instructor | Date |
|---|---|---|
| Psychrometrics | Jerry Cohen | 13-Jan |
| The Refrigeration Cycle | Jerry Cohen | 10-Feb |
| Best Practices for VRF Systems - Design | Greg Drensky | 9-Mar |
| Best Practices for VRF Systems - Installation | Steve Leister | 13-Apr |
| Best Practices for Applied Rooftop Systems, Applications & Installation | Jerry Cohen | 11-May |
| Applying Energy Recovery Systems | Greg Drensky | 14-Sep |
| OFCC Applicable Systems - Pro's & Con's | Greg Drensky | 12-Oct |
| Applying Building Pressure & Air Flow Measurement Instrumentation | Greg Drensky | 9-Nov |
| Controlling HVAC Systems with Special Emphasis on Sequence of Operations | Jerry Cohen | 14-Dec |

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# Announcement!


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# RUUD:

- Established 1920
- 3-25 Ton RTUs, 6-20 Ton Split Systems
- Multiple Efficiency Levels
- Slide Out Drain Pan & Blower
- Copeland Scroll Compressors
- Microchannel Coils
- AL/SS Heat Exhangers
- VFDs
- Hot Gas Reheat
- Horizontal/Vertical Connections
- $10-12M Stock, 4 Week Standard Lead Time

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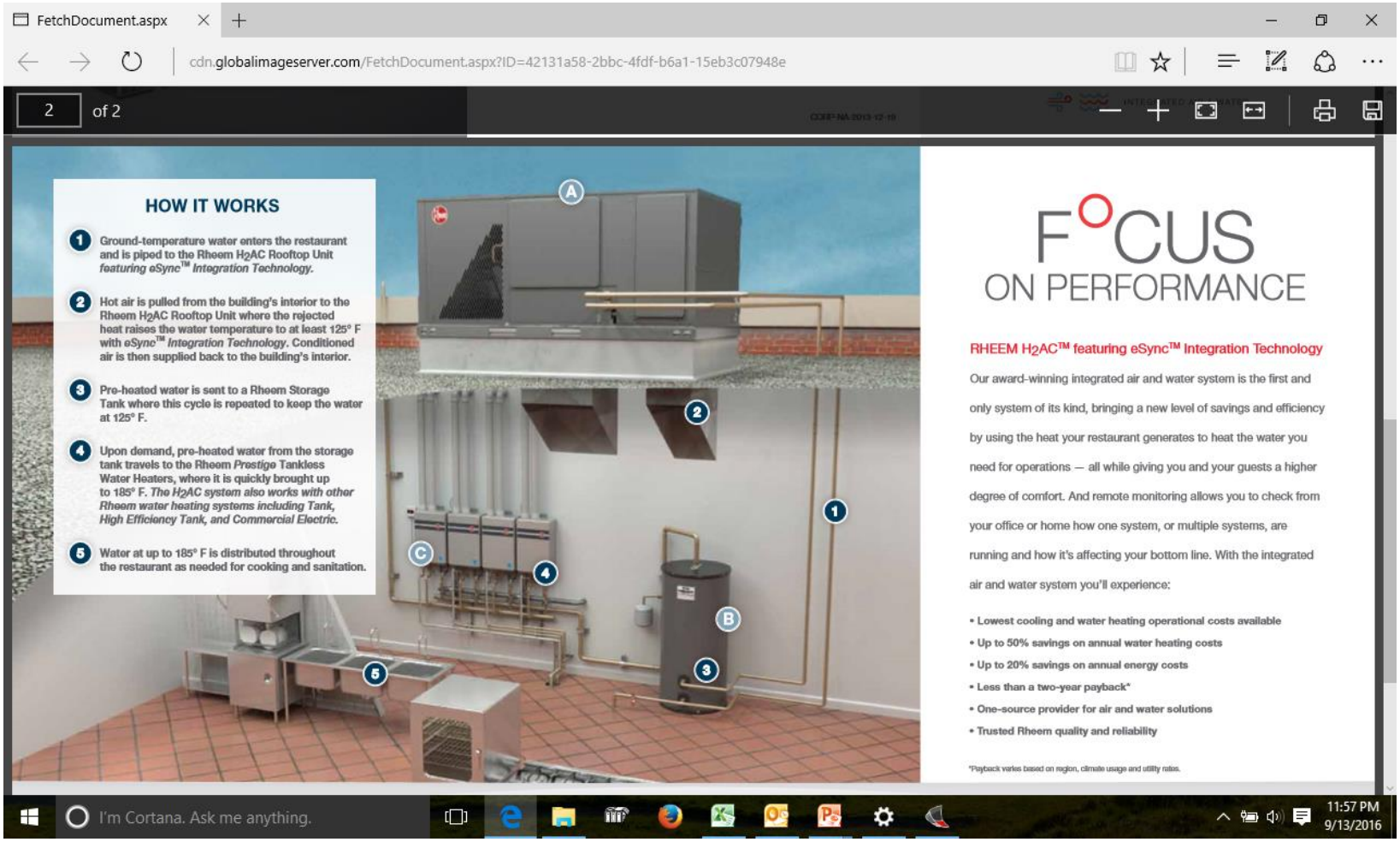
# RUUD: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2 of 2
HOW IT WORKS
1 Ground-temperature water enters the restaurant and is piped to the Rheem H2AC Rooftop Unit featuring eSync™ Integration Technology.
2 Hot air is pulled from the building's interior to the Rheem H2AC Rooftop Unit where the rejected heat raises the water temperature to at least 125° F with eSync™ Integration Technology. Conditioned air is then supplied back to the building's interior.
3 Pre-heated water is sent to a Rheem Storage Tank where this cycle is repeated to keep the water at 125° F.
4 Upon demand, pre-heated water from the storage tank travels to the Rheem Prestige Tankless Water Heaters, where it is quickly brought up to 185° F. The H2AC system also works with other Rheem water heating systems including Tank, High Efficiency Tank, and Commercial Electric.
5 Water at up to 185° F is distributed throughout the restaurant as needed for cooking and sanitation.
A
B
C
1
2
3
4
5
FOCUS ON PERFORMANCE
RHEEM H2AC™ featuring eSync™ Integration Technology
Our award-winning integrated air and water system is the first and only system of its kind, bringing a new level of savings and efficiency by using the heat your restaurant generates to heat the water you need for operations — all while giving you and your guests a higher degree of comfort. And remote monitoring allows you to check from your office or home how one system, or multiple systems, are running and how it's affecting your bottom line. With the integrated air and water system you'll experience:
• Lowest cooling and water heating operational costs available
• Up to 50% savings on annual water heating costs
• Up to 20% savings on annual energy costs
• Less than a two-year payback*
• One-source provider for air and water solutions
• Trusted Rheem quality and reliability
*Payback varies based on region, climate usage and utility rates.
I'm Cortana. Ask me anything.
11:57 PM
9/13/2016

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# Announcement!


**Over 45 Years Humidification Experience**

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# Hygromatic:

- HyLine; Electrode Humidifiers
  - Up To 1,280#/Hr
  - Stainless Steel Enclosure and Electrodes
  - Cleanable Cylinder
  - Basic, Comfort, Comfort Plus Control
  - Utilizes Standard Tap Water
  - Drain Water Tempering
- Compact Line: Electrode Humidifiers
  - Space Saving, Lower Cost
  - Up To 640#/Hour

# Hygromatic:

- Heater Line; Element Humidifiers
  - Raw, Softened or Mineralized Water
  - Up To 495#/Hour
- Mini Steam
  - Compact
  - Direct Room Humidifiers
  - 10-22#/Hour
- Direct Steam Humidifiers
- Atomizing Humidifiers
- Fan Unit – Direct Room Humidification (up to 66#)
- Sizing & Selection Software
- 2-3 Week Lead Time
- Can Be Expedited to 2-3 Days

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# Who is Ohio Facility Construction Commission (OFCC)?

- Merged State Architects Office with OSFC in 2012
- Guide Capital Projects For:
  - Stage Agencies
  - State Supported Universities
  - State Supported Community Colleges
  - K-12 Construction & Renovation
- http://ofcc.ohio.gov/

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# Who is Ohio Facility Construction

## Green Schools

The Green Schools program at OFCC has been in existence since September 2007, when the Commission adopted LEED for Schools® as the standard for K-12 school projects.

The LEED for Schools Rating System is a comprehensive tool that looks at design and construction practices including classroom acoustics, indoor air quality, selection of building materials and energy efficiency. The system is based on prerequisites and credits that address seven areas: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation in design and regional priority.

Once design and construction for a building are complete, its systems have been tested, and it has met LEED standards, a project is eligible for one of four levels of recognition based on the number of credits obtained: Certified, Silver, Gold or Platinum.

### Ohio LEED Certification Recognition Current Totals

| Recognition Level | Number |
|---|---|
| Certified | 6 |
| Silver | 178 |
| Gold | 86 |
| Platinum | 3 |
| **Total Certifications** | **273** |

# What Are OFCC HVAC Systems?

- Chiller & AHU With Energy Recovery, VAV
- Geothermal
- Variable Refrigerant Flow
- Chilled Beam

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# Chiller, AHU With Energy Recovery

# Chiller/AHU

System
- Air Or Water Cooled Chiller
- Boiler
- Pumps
- AHUs with Energy Recovery
- VAV Boxes With Reheat
- Lot of Physical Space Required


Comfort
- Modulating Chillers
- Modulating Boilers
- Modulating Fans/ VAVs

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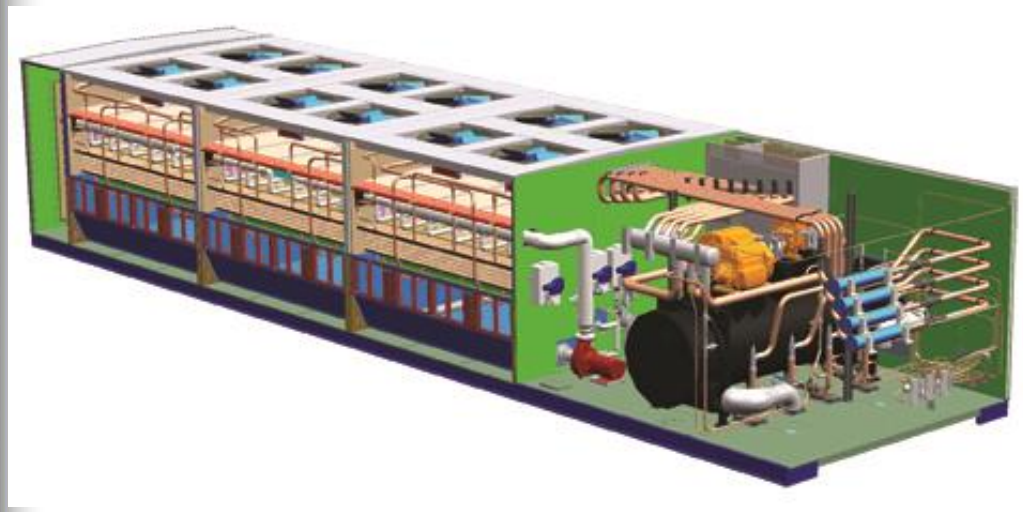
# Chiller/AHU

Flexibility
- Multiple Chillers/AHU Choices

Redundancy
- Multiple Compressors/AHUs



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# Chiller/AHU

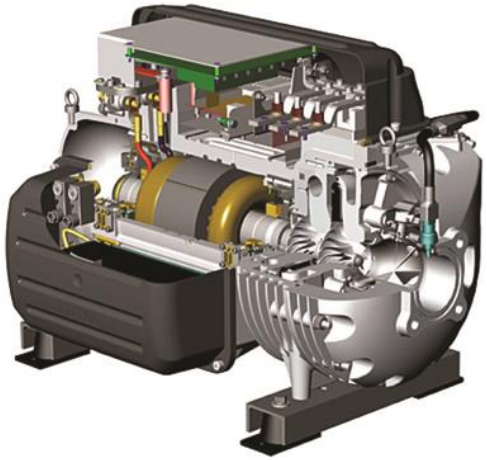
Equipment Cost
- Low To Moderate

Installation Cost
- Moderate

# Chiller/AHU

Energy Efficiency
- Chillers Up To 30 EER
- Energy Recovery AHUs
- Modulating Compressors
- ECM/VFD Evaporator Fans

Controls
- BACnet, Lon



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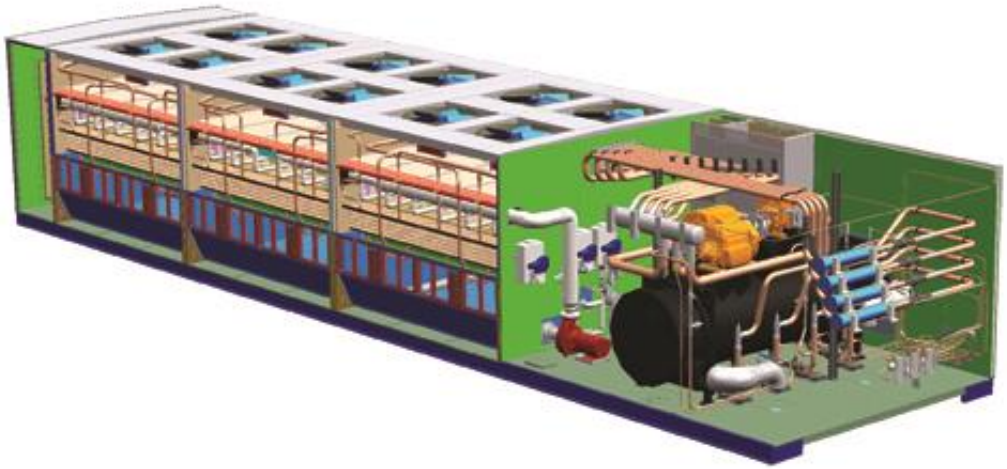
# Chiller/AHU

Maintenance

- Chiller
  - Clean Barrels
  - Clean Condenser Coils
  - Check Electrical
- Indoor Units
  - Removable Panels For Filter, Fan, Coil Access
  - Clean Filter
  - Check Fans
  - Check/Clean Fan, Coil, Cond Drain, Comp, Elect Conn
- Cooling Tower
  - Check/Clean Fan, Coil, Water Quality, Chemicals
- Boiler
  - Check/Clean Burner, Water Quality, Elect Conn
- Units Can Be Replaced With Different Manufacturers

# Chillers

- Evap Cooled Chiller
  - Less Water Cooling Tower
  - Less Energy Air Cooled
- TurboCor Compressor
  - High Energy Efficiency
  - Decreased Maintenance
- Factory Pump Package
  - Redundant Pumps
- Boiler
  - Factory Installed



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# Chillers

- Samsung DVMS Simultaneous Chilled/Hot Water
  - 10 & 15 Ton Capacities
  - Up To 16 Modules
  - System Redundancy
  - Cooling 14-77F
  - Heating 77-130F
  - 60dBA
  - Compact Design

# Chillers

- Water Furnace Modular Chiller/Boiler
  - Simultaneous Heat & Cool
  - Modular With Redundancy
  - Multiple LWTs
  - Water Cooled

# AHUs

- Mechanical Room Space Limited?
- Compact Vertical AHU
  - Energy Recovery Wheels
  - Gas Heat
- Custom AHU
  - Mechanical Room Requirements
  - Fan Walls
  - Sound Requirements

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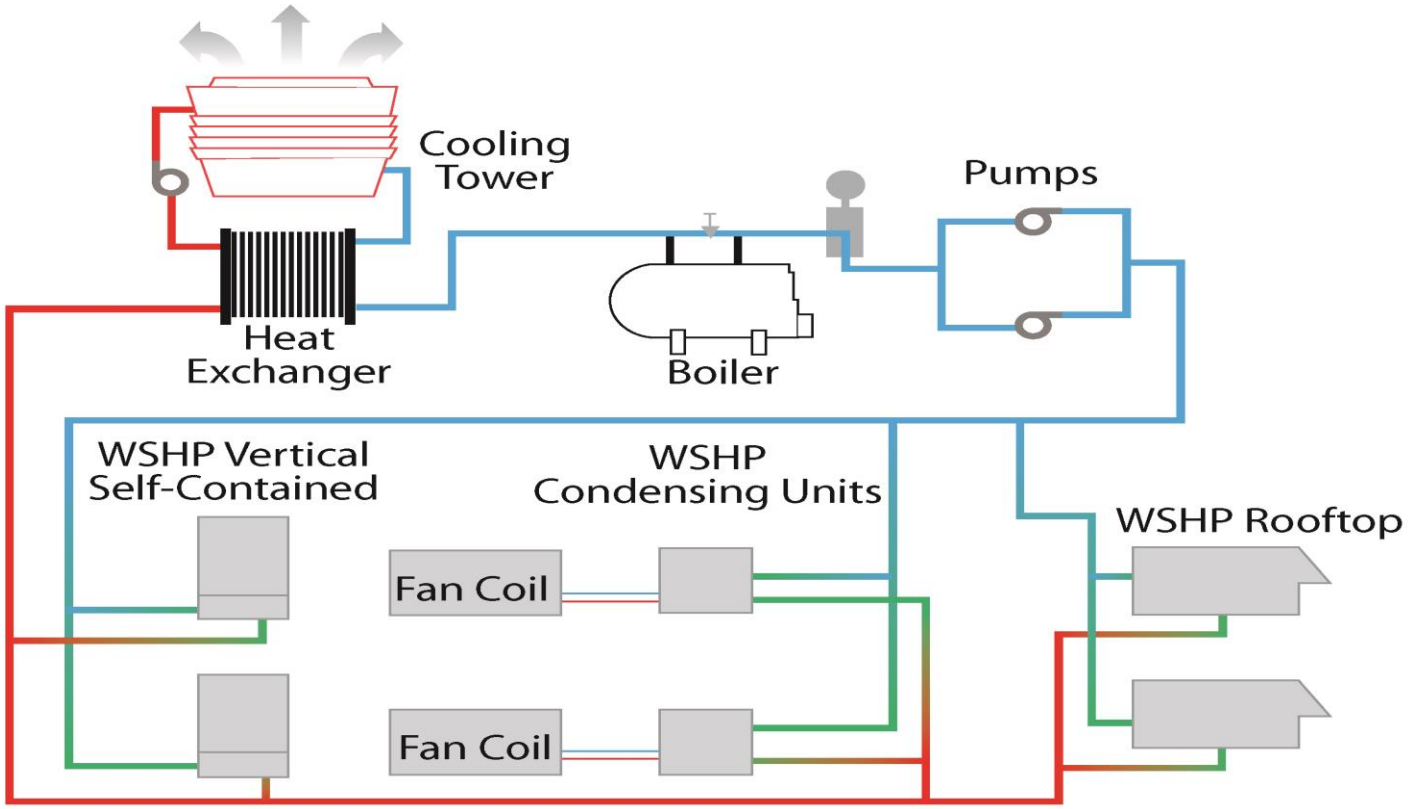
# Geothermal Heat Pumps

# Heat Pumps

System
- HP’s
- DOAS
- Tower/Boiler/Pumps
- Geothermal Well Field/Pumps

Comfort
- Multi Speed Fans
- Variable Speed Compressors
- Moderate Noise

# Water Source Heat Pumps

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# Geothermal Heat Pumps

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# Heat Pumps

Flexibility
- Available Indoor/Outdoor from 0.5-300 Tons

Redundancy
- Each HP Own System


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# Heat Pumps

Equipment Cost
- Moderate To High

Installation Cost
- Geothermal (High)
- Water Source (Moderate)
  - Cooling Tower
  - Pumps
  - Boiler

# Heat Pumps

Energy Efficiency
- Up To 22 EER
- Heat Recovery
- Modulating Compressors
- ECM/VFD Evaporator Fans

Controls
- BACnet, Lon

# Heat Pumps

Maintenance

- Indoor Units
  - Removable Panels For Filter, Fan, Coil Access
  - Clean Filter
  - Check Fans
  - Check/Clean Fan, Coil, Cond Drain, Comp, Elect Conn
- Cooling Tower
  - Check/Clean Fan, Coil, Water Quality, Chemicals
- Boiler
  - Check/Clean Burner, Water Quality, Elect Conn
- Well Field
  - Check/Clean Strainers, Water Quality
- Units Can Be Replaced With Different Manufacturers

# Variable Refrigerant Flow

# VRF

System
- Heat Pump/Heat Recovery Units
- Fan Coil Units
- Mode Change Units
- DOAS

Comfort
- Multi Speed Fans
- Electronic Expansion Valves
- Variable Speed Compressors
- 100% Heat Capacity Available To -13F


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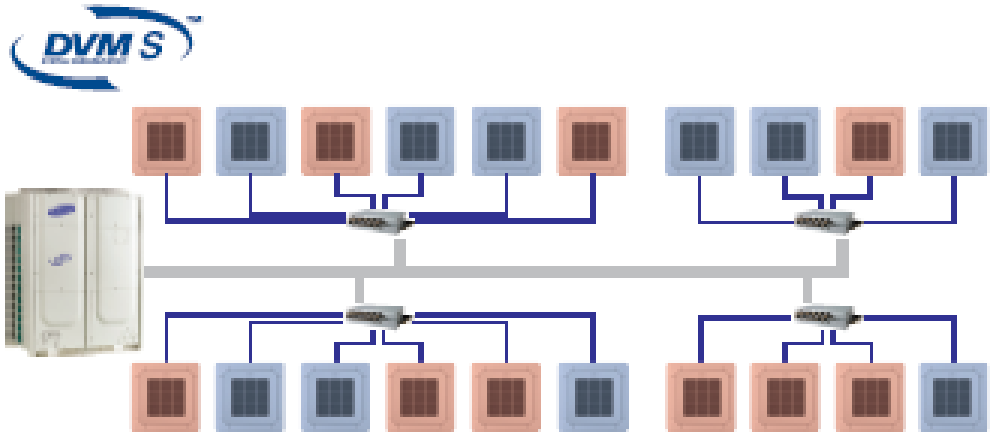
# VRF




- Totally independent indoor unit heating and cooling operation (simultaneous heating and cooling)
- Better heating performance than 2 pipe heat recovery systems at low ambient temperatures (liquid / gas mixture type)
- Less refrigerant pipe backtracking
- Flexible installation with 4 and 6 port MCU options (can connect 1 – 6 indoor units to MCU's)
- Highest simultaneous heat and cool efficiency
- Lower installation and running energy cost

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# VRF

Flexibility

- 20 Heat Recovery Systems Available From 6 to 44 Tons
- Heat Pumps Can Be Indoor/Outdoor and Air Cooled/Water Cooled
- 13 Indoor Models From 0.5 to 8 Tons
- Diversity Range 50-130% Capacity
- 656’ Available Piping (130-360’ drop/lift)


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# VRF

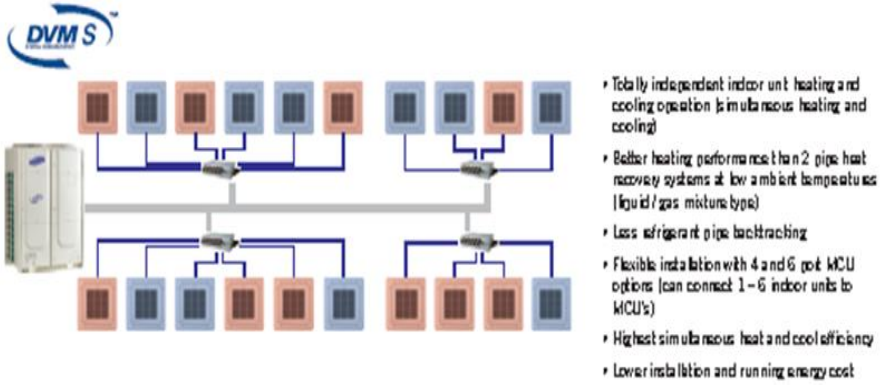
Redundancy

- Each HP/HR Has Minimum 2 Compressors
- Multiple HP/HR Per System
- Multiple Systems Per Project

# VRF

Equipment Cost
- Moderate To High
- Depends On Type/Quantity Of FCU

Installation Cost
- Refrigerant Piping
- Three Phase Power For HP
- Single Phase Power For FCU, MCU
- Control Wiring



# VRF

Energy Efficiency

- 38 SCHE (Simultaneous Heating & Cooling Efficiency)
- Heat Recovery
- Modulating Compressors
- Multi Speed Evaporator Fans
- Electronic Expansion Valves
- Constantly Compared To Water Source & Geothermal

Controls

- BACnet, Lon
- Touchscreen Or PC Interface

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# VRF

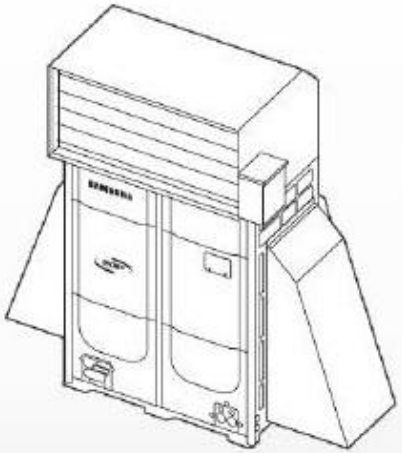
Maintenance

- Indoor Units
  - Removable Panels For Filter, Fan, Coil Access
  - Clean Filter
  - Check/Clean Fan, Coil, Cond Drain, Elect Conn
- Heat Pump
  - Check/Clean Fan, Coil, Elect. Connection
- System Diagnostics
- Units Can Not Be Replaced With Different Manufacturers

# VRF Changes & Improvements

# Accessories

## Low Ambient Cooling Hood



- Low ambient hood for DVM S Heat Pump systems that allows cooling operation down to -13°F for current DVM S heat pump systems (firmware upgrade required)
- Will be applied to 2017 DVM S Heat Recovery systems
- 100% cooling capacity at -13°F (before de-rating for pipe length, etc.)
- Cooling down to -13°F will require installation of LACH-*** side, rear, and front (18 ton chassis) guards

| New low ambient guard | Description |
|---|---|
| LACH-SL | Left guard |
| LACH -SR | Right guard |
| LACH-SLR | 18 Ton DVM right and left guard |
| LACH-R1 | Small chassis rear guard |
| LACH-R2 | Large chassis rear guard |
| LACH-R3 | 18 Ton DVM rear guard |
| LACH-F1 | 18 Ton DVM front guard |

# DVM S Indoor Units

## Smaller Capacity DVM S Cassette Models

- To help secure more projects, 5,000 and 7,500 Btu/h mini 4-way cassette indoor units will be added to the lineup

- Smaller capacity units may help reduce outdoor unit size due to current lack of smaller cassette units

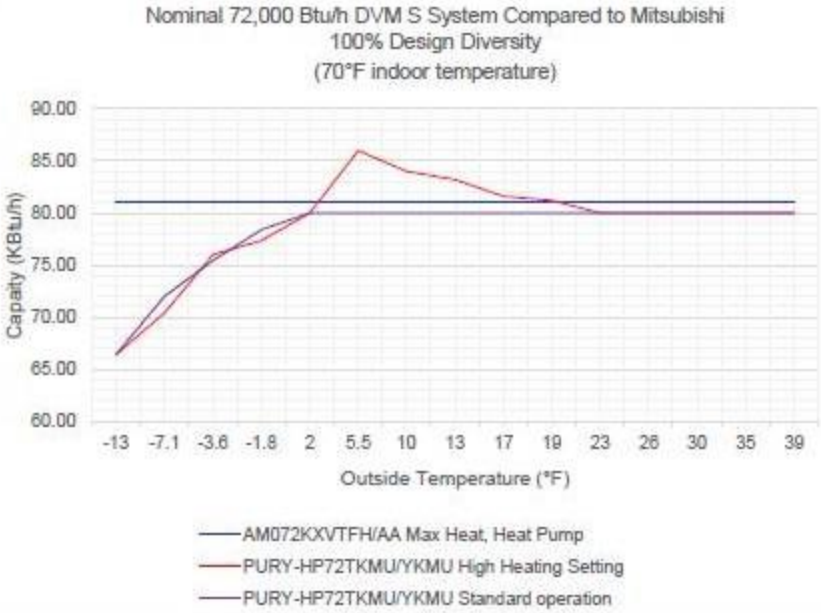
- RTS: October 22, 2016

# VRF

## Heat Recovery DVM S Max Heat Systems

- 100% heating capacity at -13°F
- Low ambient heating DVM S systems are currently heat pump only
- Heat recovery options will be added to the DVM S Max Heat Product line in 2017
- RTS: Q1 2017

MAX HEAT
LOW AMBIENT SERIES




***Comparison***

6 ton DVM S Max Heat, Heat Pump system to Mitsubishi Hyper Heat

NOTE: "High heat setting" = higher power consumption



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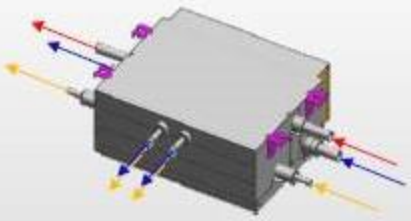
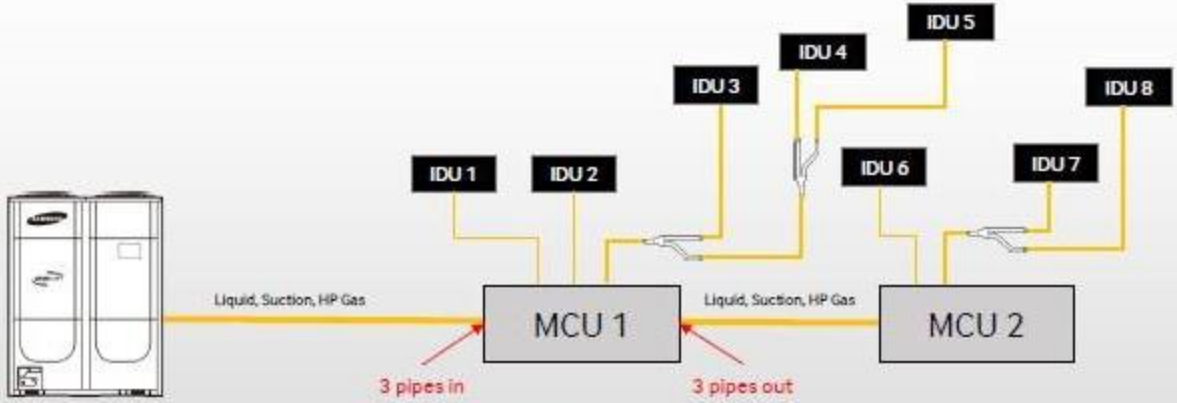
# Heat Recovery MCU

## New DVM S Heat Recovery Mode Control Units (MCU) - Continued

- Multiple indoor unit connection to a single MCU port
- Serial connection (see below)



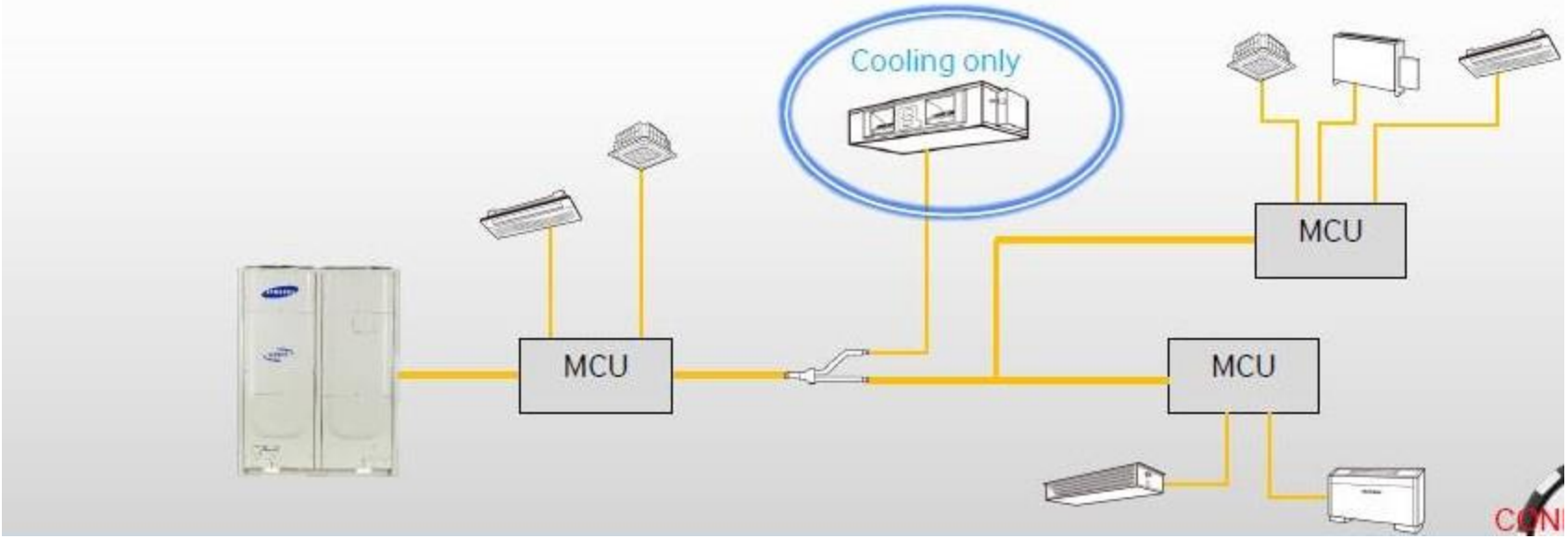



Serial connection – An MCU will have 3 inlet pipes and 3 outlet pipes to supply refrigerant to additional MCU's downstream (in addition to ports serving indoor units)

# VRF

## Cooling Only Indoor Units on Heat Recovery Systems

- Indoor units that are connected to heat recovery systems but are used for cooling only can be connected direct to the liquid and suction lines without connecting to an MCU

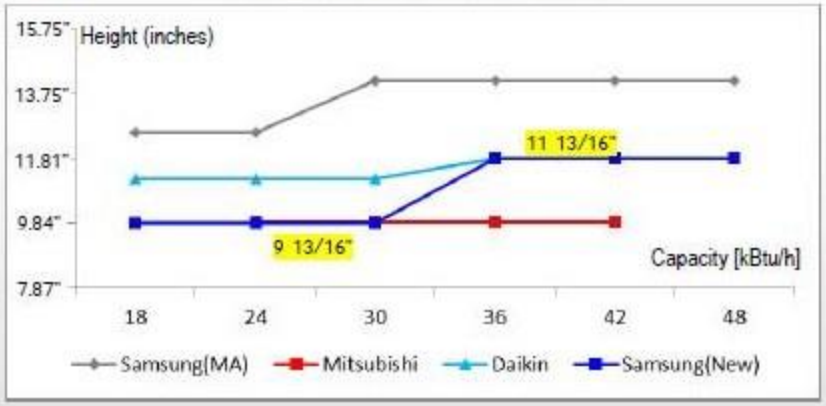


# DVM S and CAC Indoor Units

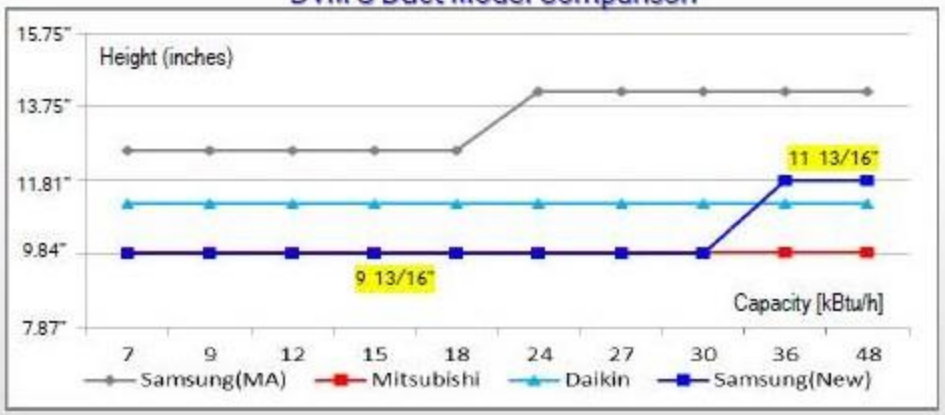
## DVM S and CAC Duct Unit (continued)

- Competitors: 11.81" and shorter. Current Samsung models: 12.59" – 14.17"
- Installation is difficult or impossible in some applications due to limited ceiling space.

CAC Duct Model Comparison




DVM S Duct Model Comparison

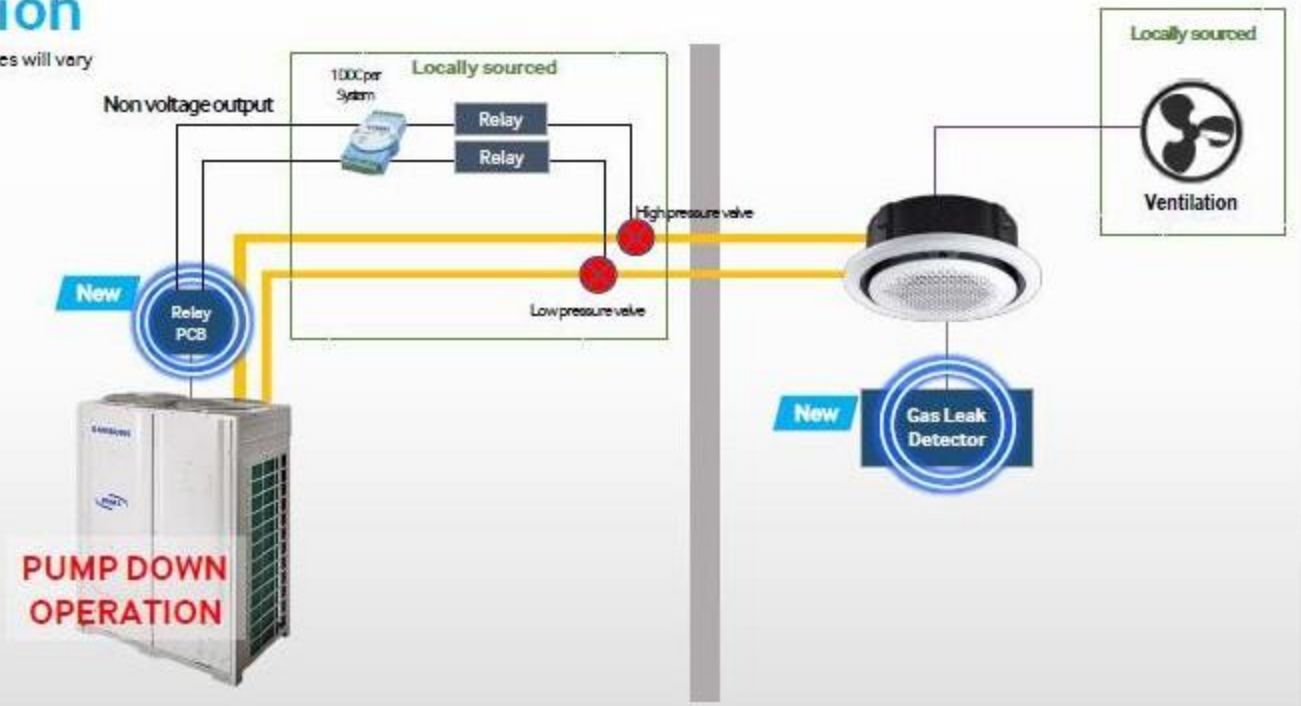


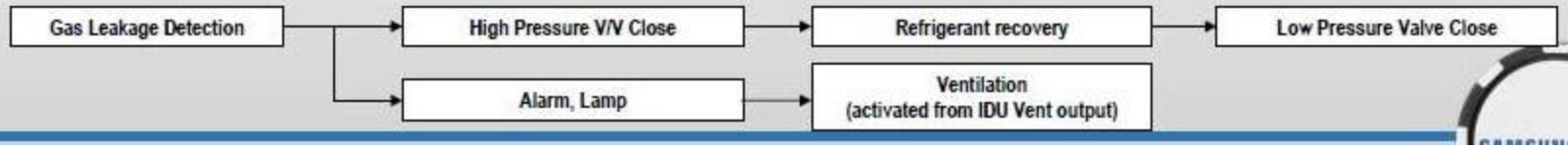
# VRF

## Gas Leakage Detection

NOTE: For general reference only, actual sequence and features will vary

- Pump down operation via external signal that will work along with refrigerant detection systems to secure system refrigerant in the outdoor unit
- DDC system, external solenoid valves, and relays will need to be sourced locally
- Subject to change

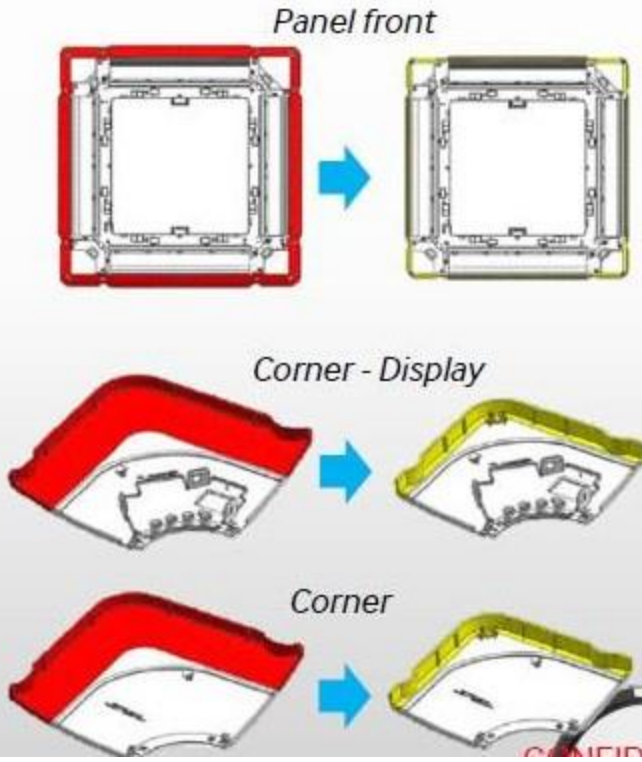


# VRF

## New Mini 4-Way Panel Size – 26 3/8" → 24 3/8"

- Mini 4-way cassette panels will be upgraded to a smaller version
- Installation near lights will be easier as the panel will not interfere with bulb replacement or other devices on in the ceiling
- RTS: January, 2017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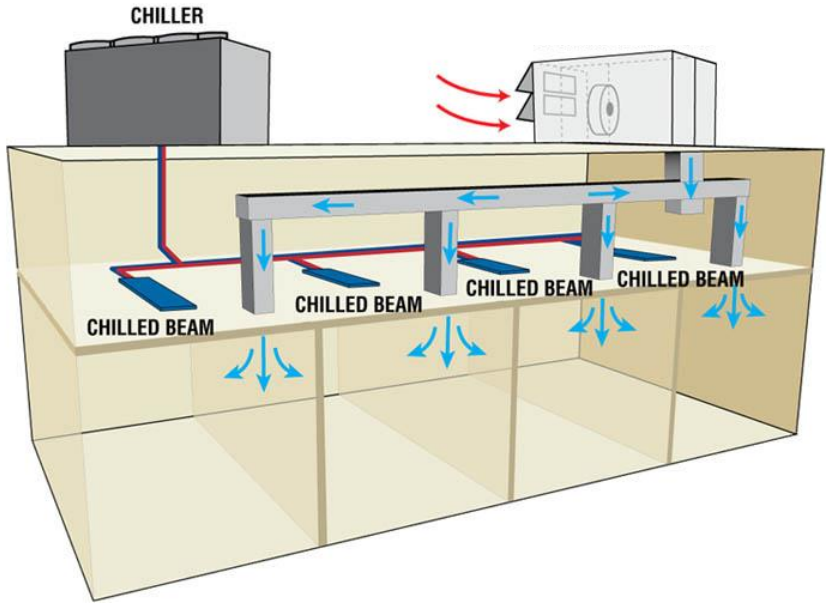
# Chilled Beams

# Chilled Beams

System
- Chiller With Pumps
- Boiler With Pumps
- DOAS
- Chilled Beams

Comfort
- Variable Speed Compressors
- Variable Speed Pumping
- No Need For Reheat
- Extreme Low Sound

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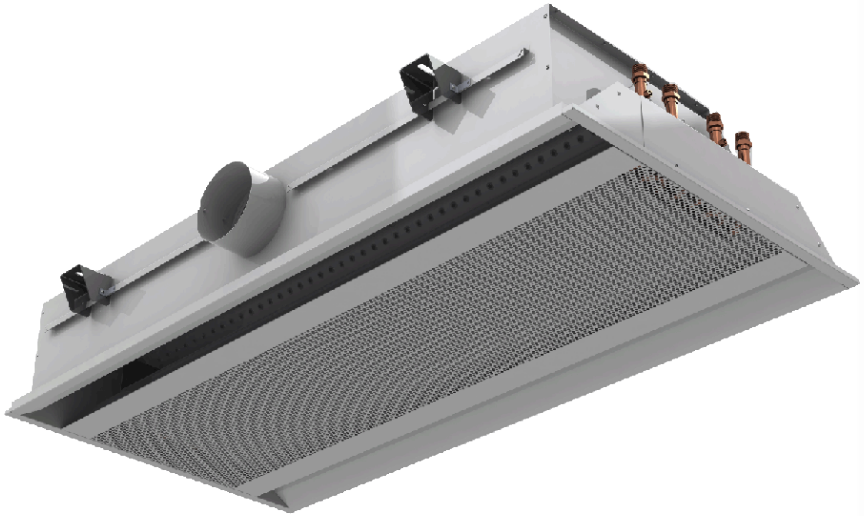
# Chilled Beams

Flexibility

- Various Size and Capacity Beams
- 1 Way, 4 Way, Linear With Adjustable Lengths
- Minimum Duct & Pipe



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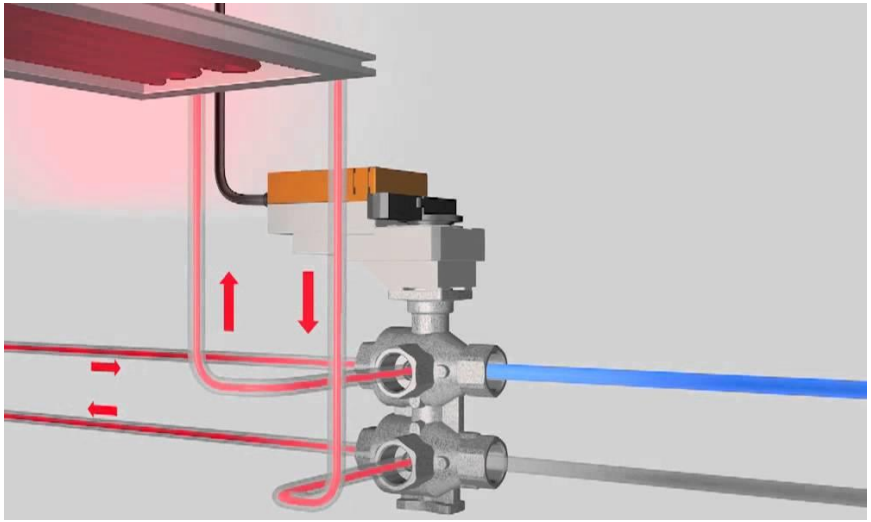
# Chilled Beams

Equipment Cost
- Moderate To High

Installation Cost
- Chilled Water / Hot Water Lines
- Can True 4 Pipe Or Changeover 4/2 Pipe
- Primary Power For Chiller, Boiler, Pumps, DOAS
- Low Voltage Power For Controls



# Chilled Beams

Energy Efficiency

- Up To 30 EER Chiller
- Heat Recovery
- Modulating Compressors
- Multi Speed Evaporator Fans
- Reduced Fan Power

Controls

- Typical Factory Chiller/Boiler/Pump Controls
- 2/6 Way Valves For Beams

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# Chilled Beams

Maintenance

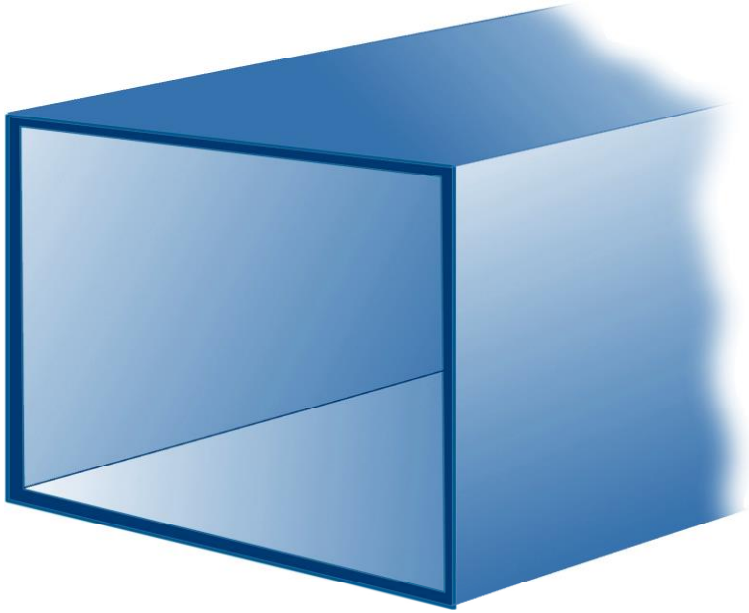
- Beams
  - Inspect Coils
- Chiller
- Boiler
- Pumps

## Chilled Beams

- Smaller ductwork and air handling units
  - Reduced vertical (ceiling) space requirements
  - Increased utilization of floor space

*14“ x 14“*

*Air Duct*



*1“ diameter*

*Water Pipe*

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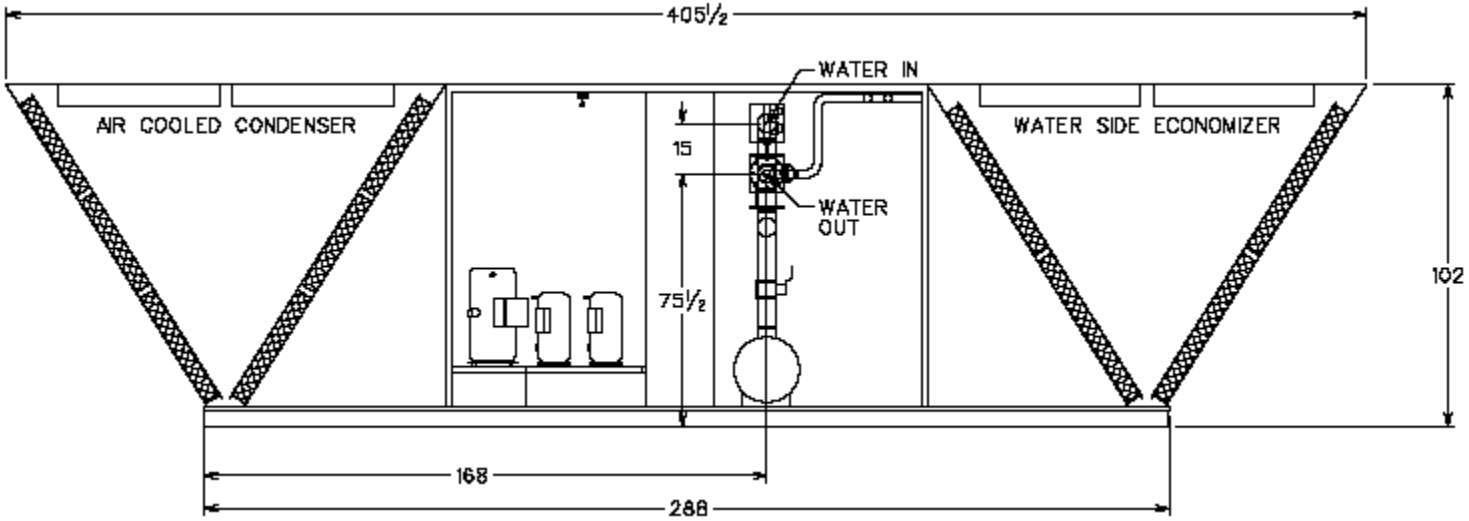
## Chilled Beams

- Deliver 57-58°F Water
  - Air Cooled Chiller (Factory Installed Pumping Systems)
  - Geothermal (Minimal Compressor Run Time)
  - Waterside Economizers (Reduce Compressor Run Time)



## Chilled Beams

- Deliver 55°F Dehumidified Air
  - Packaged or Air Handlers
  - Vertical or Horizontal
  - Energy Recovery Wheels
  - Desiccant (Below 50°F Dewpoint)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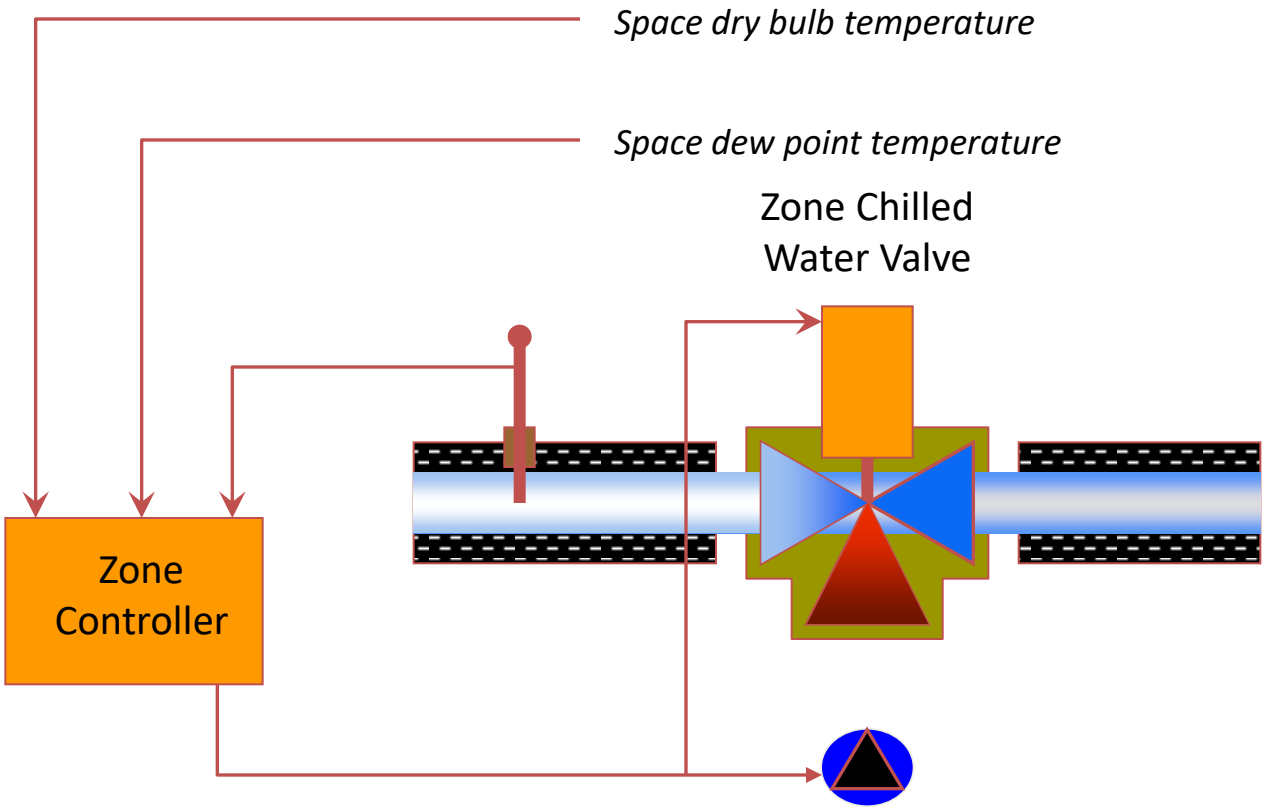
# Chilled Beams

*May be performed on an individual or multiple zone basis*

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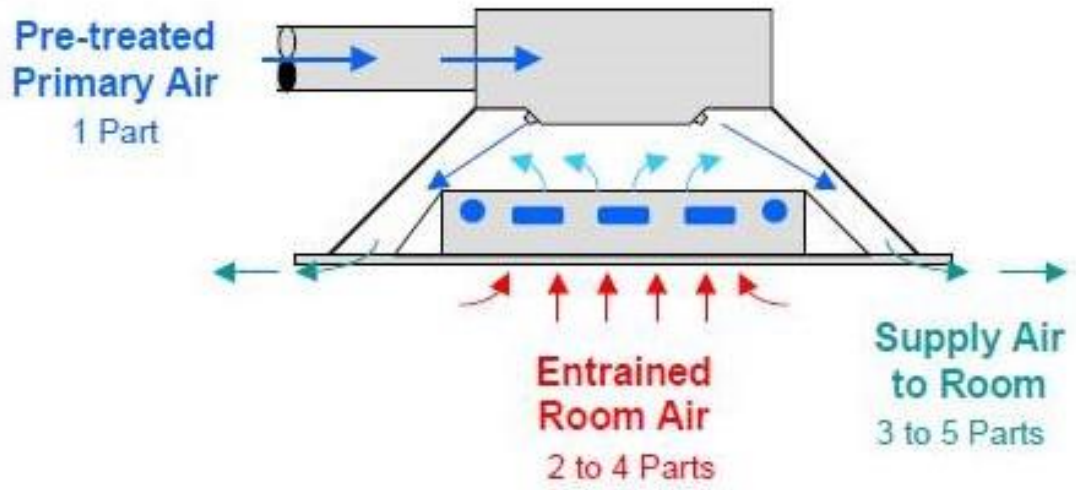
# Chilled Beams




- Combines sensible, latent cooling and ventilation
- Room air induction ratio determined by nozzle size
- Modular design for ceiling integration

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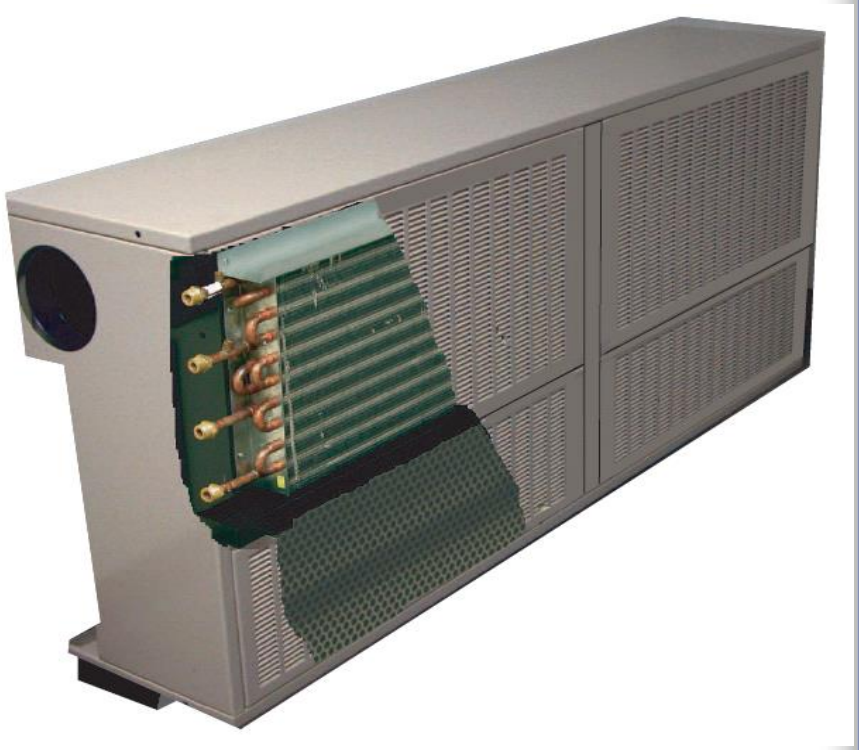
# Chilled Beams

- Induction Nozzles
  - **Primary air delivered at 50 to 55ºF**
  - **Mixing within terminal elevates supply air to appropriate temperature**
- Integral Heat Transfer Coil
  - **Room air induced through coil**
  - **Supplements space cooling**
  - **Eliminates separate heating system**



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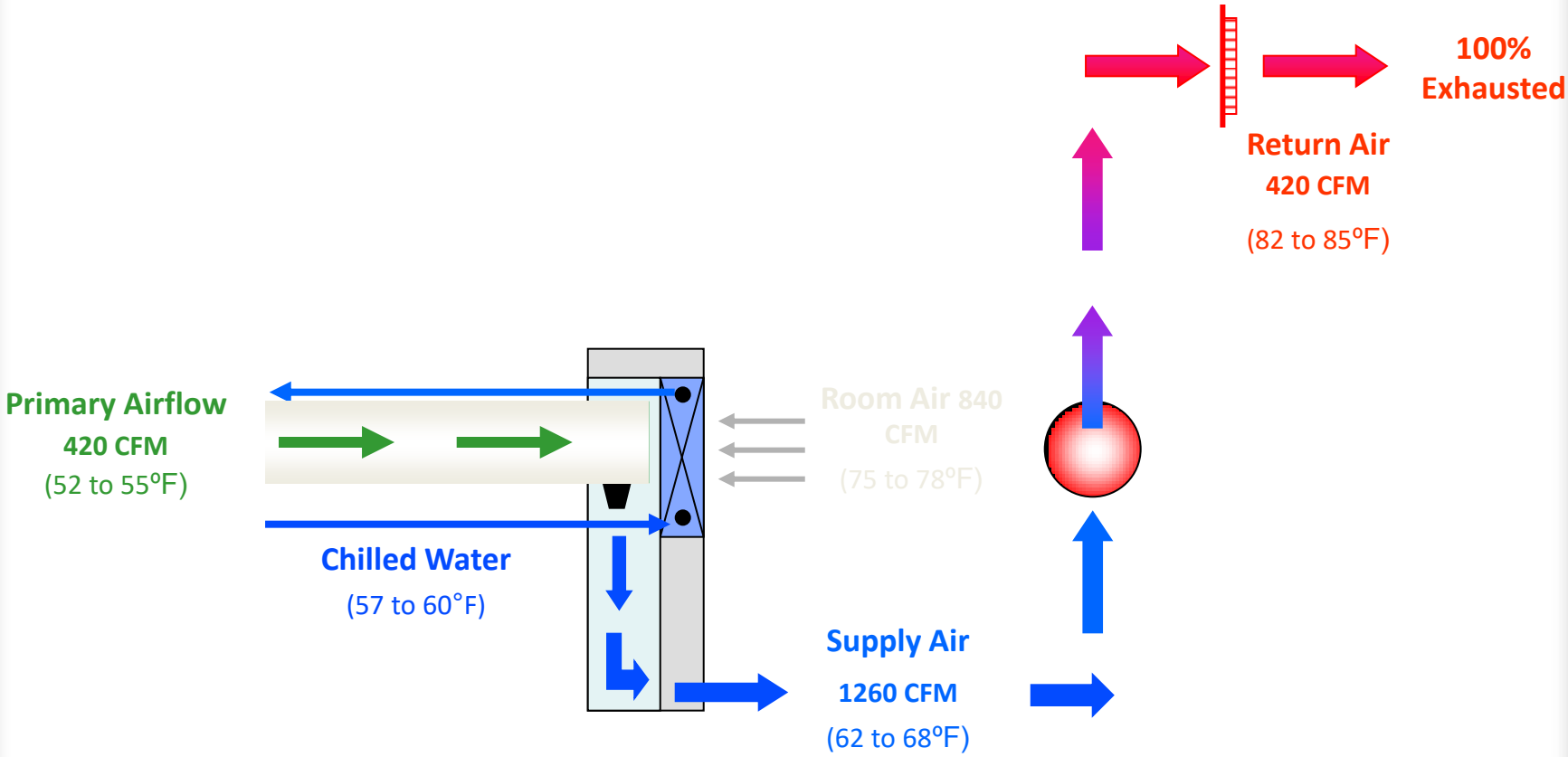
# Chilled Beams

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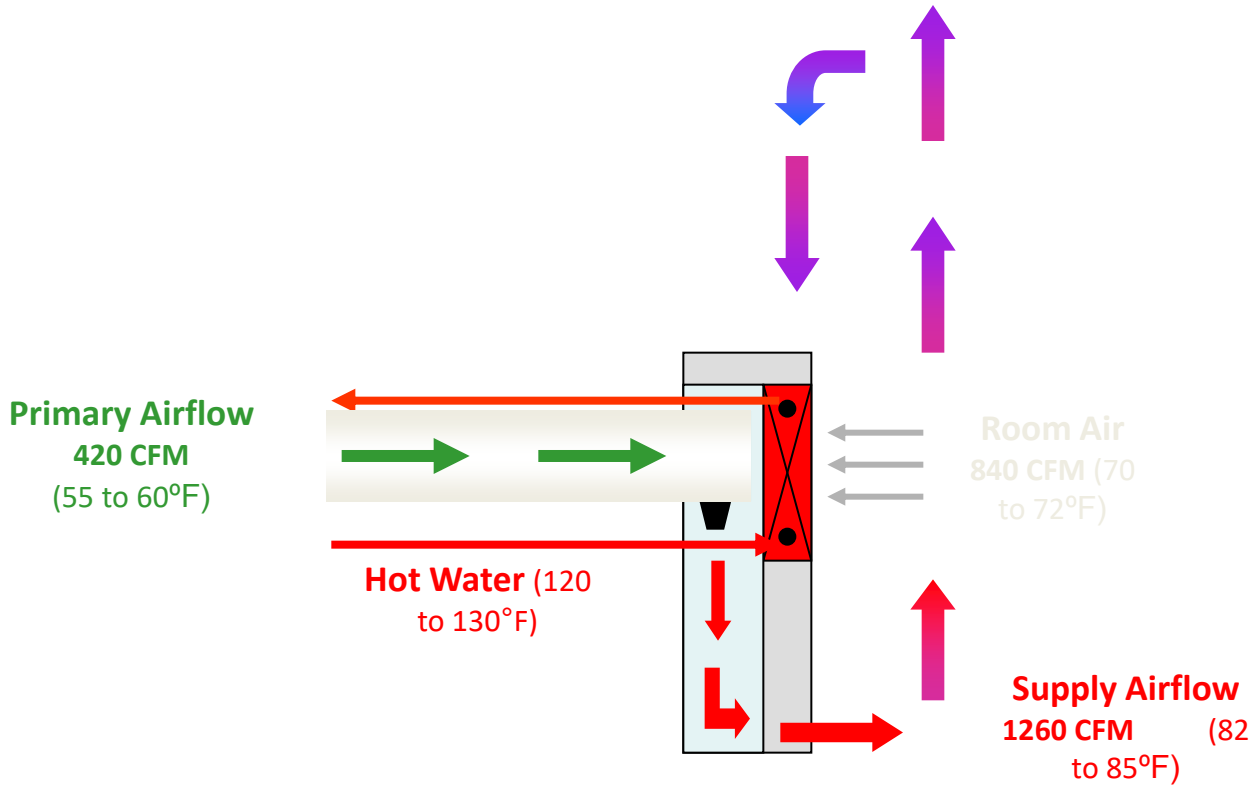
# Chilled Beams

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# Chilled Beams

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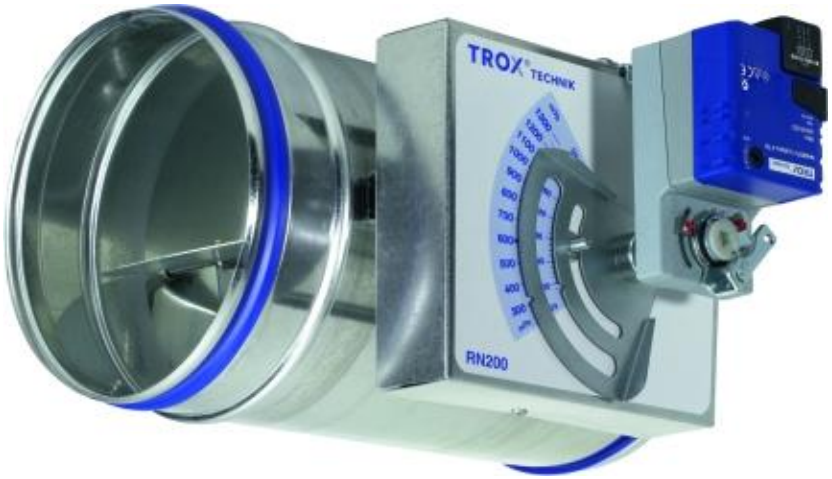


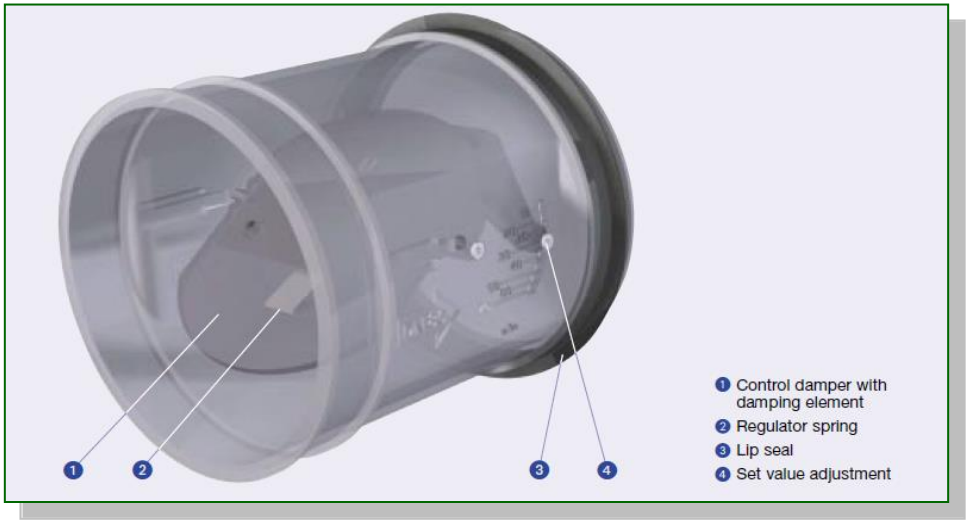


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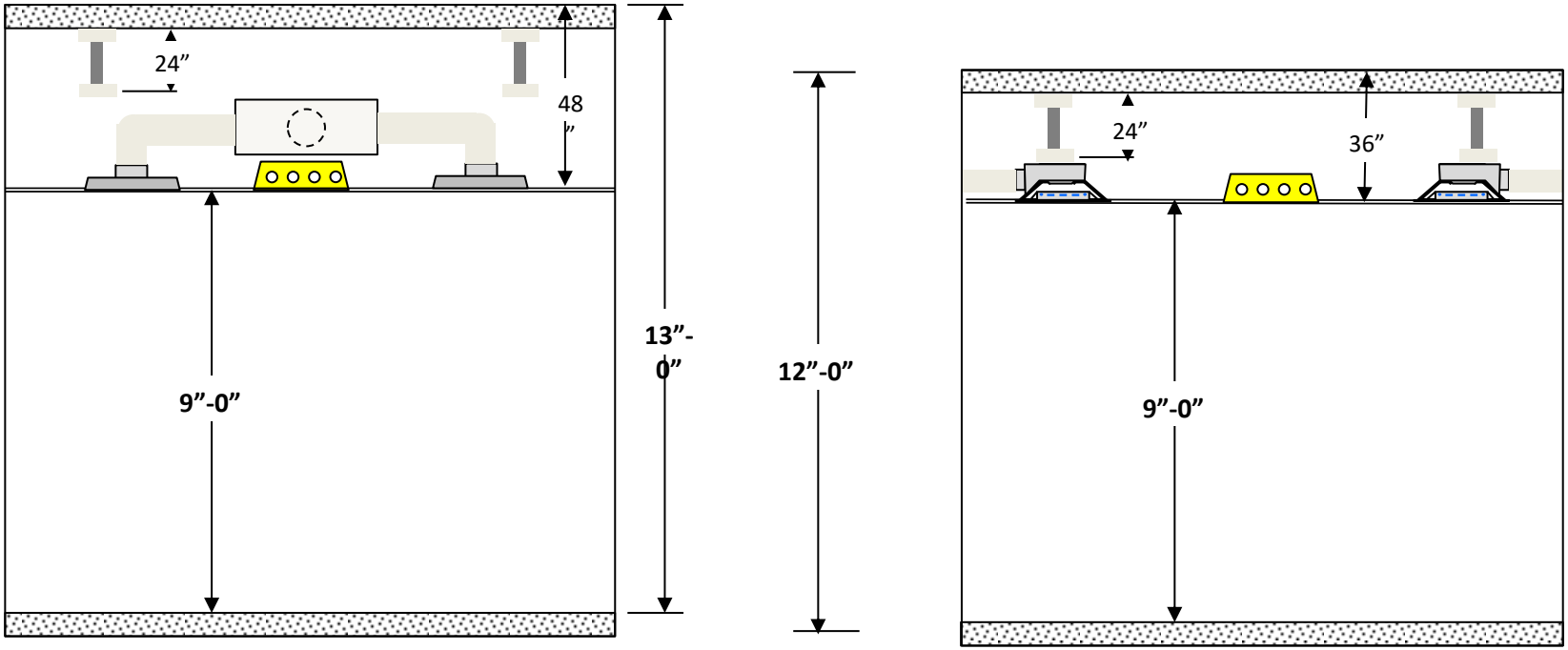
# Chilled Beams



# Chilled Beams

- Ductwork and component sizes
  - Duct area reduced by 50 % or more
  - Fire and smoke dampers smaller
  - Supply and return chases reduced by 50%
- Air handling unit size reduced
  - AHU footprint reduced by 30 to 40%
  - Potential increase in usable floor space

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# Chilled Beams

## Air handling unit savings

- Design BHP reduced by 50%
- Annual fan energy savings of 30 to 40%

## Chiller savings

- Dependent upon chiller strategy
- Higher return water temperature to chiller increases COP by 2 to 4%
- Dedicated chiller COP's increased by 25 to 30%

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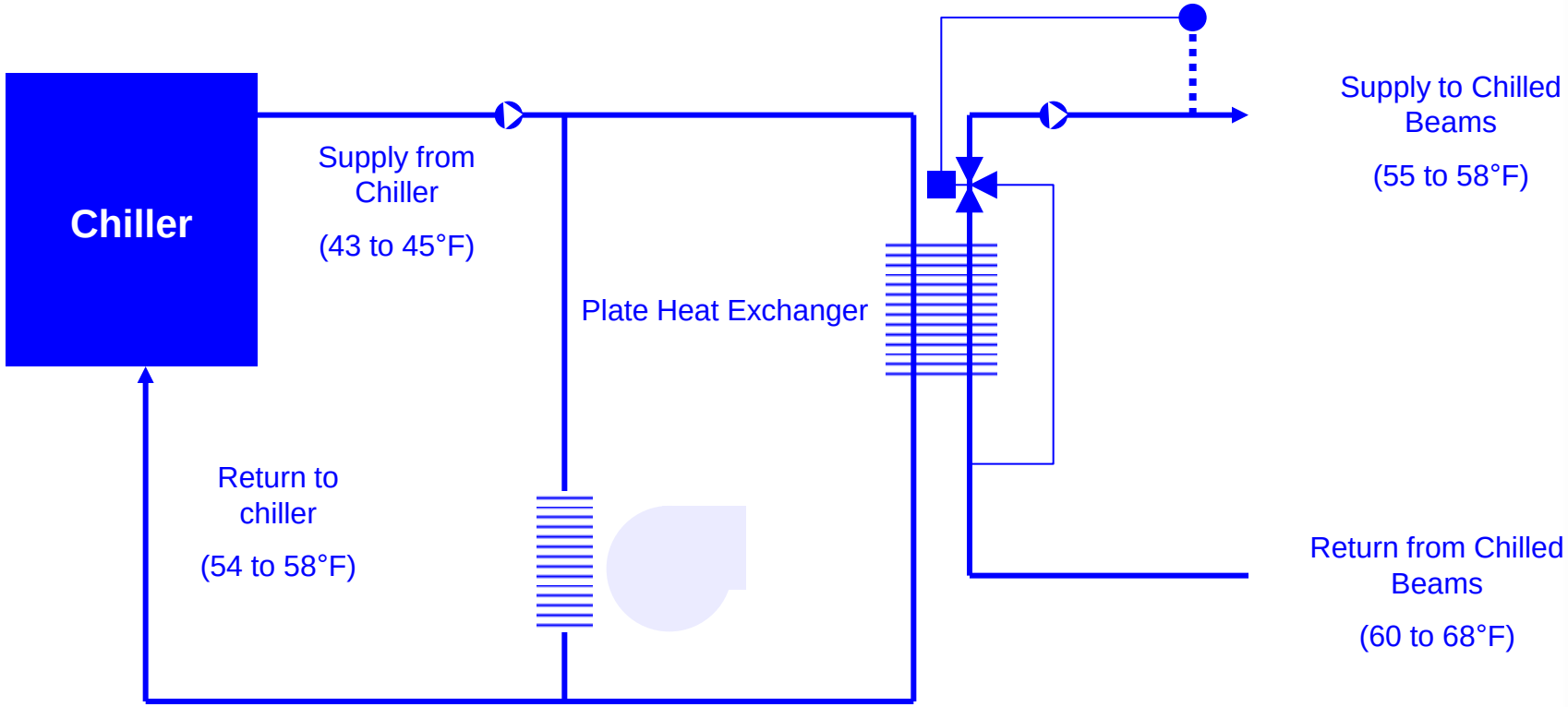
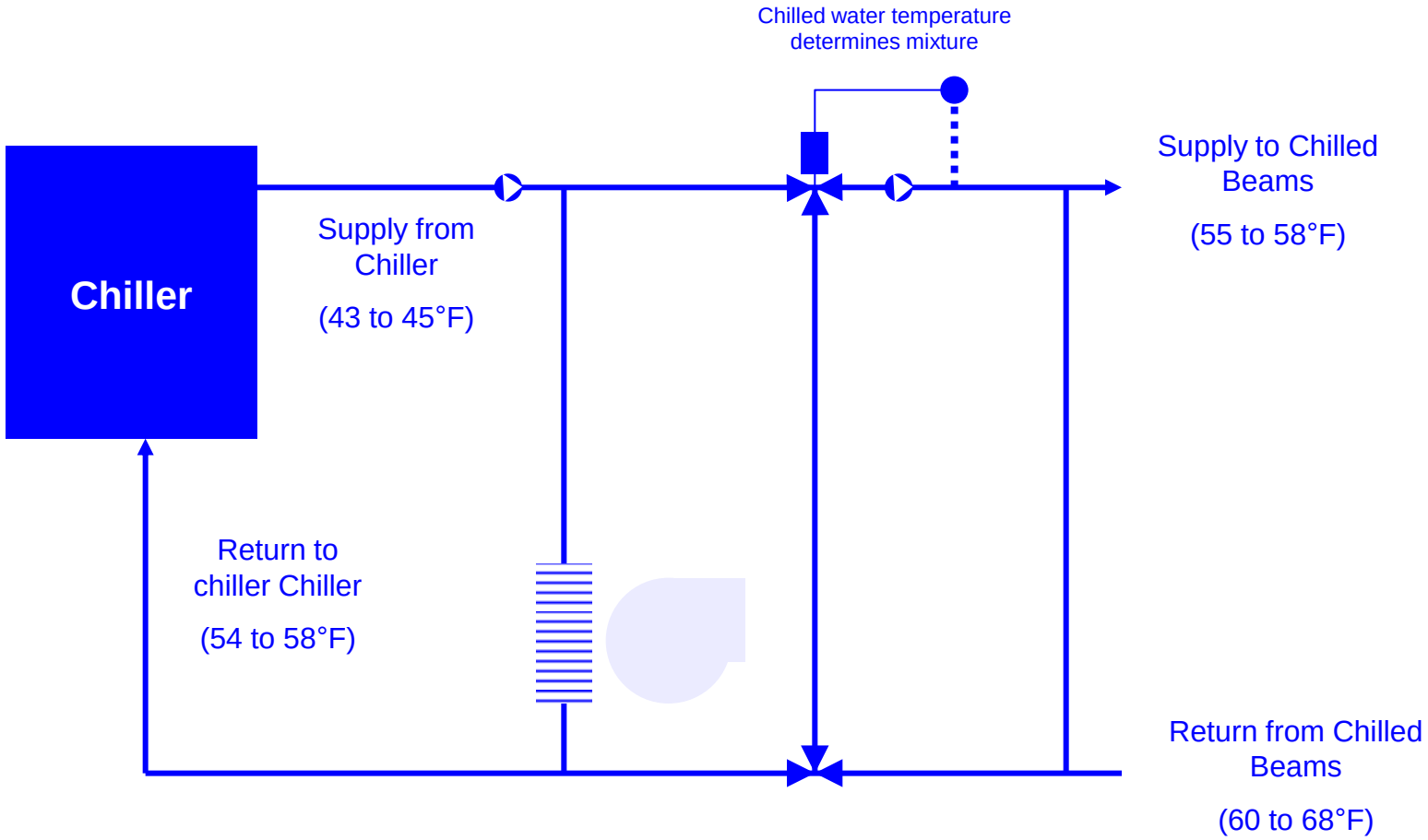
# Chilled Beams – Closed Loop, Shared Chiller



# Chilled Beams – Open Loop, Shared Chiller

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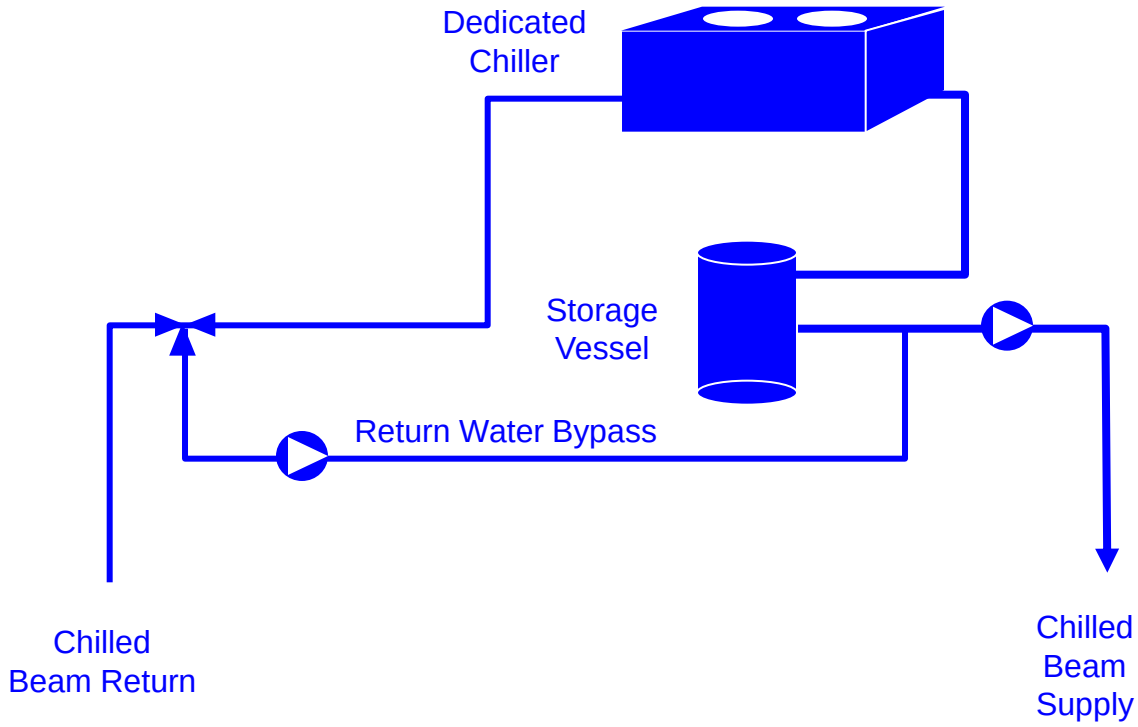
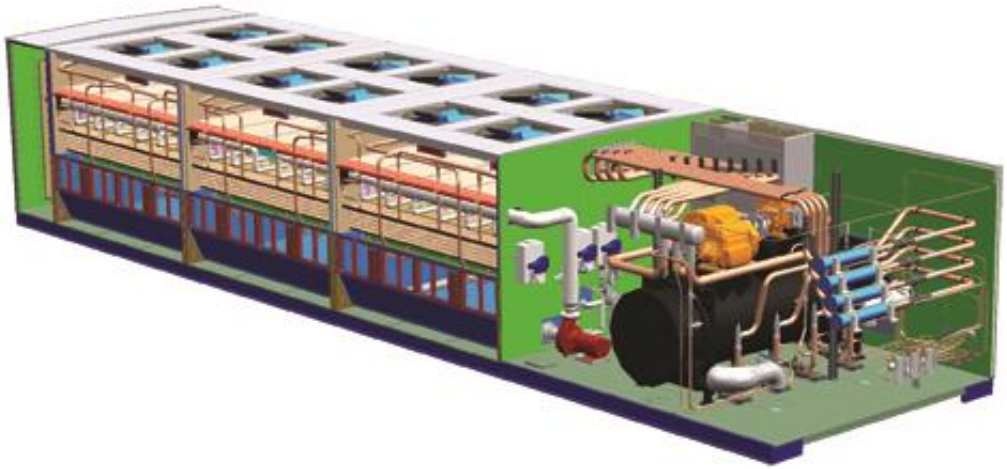
# Chilled Beams – Dedicated Chiller



# Chillers

- Evap Cooled Chiller
  - Less Water Cooling Tower
  - Less Energy Air Cooled
- TurboCor Compressor
  - High Energy Efficiency
  - Decreased Maintenance
- Factory Pump Package
  - Redundant Pumps
- Boiler
  - Factory Installed



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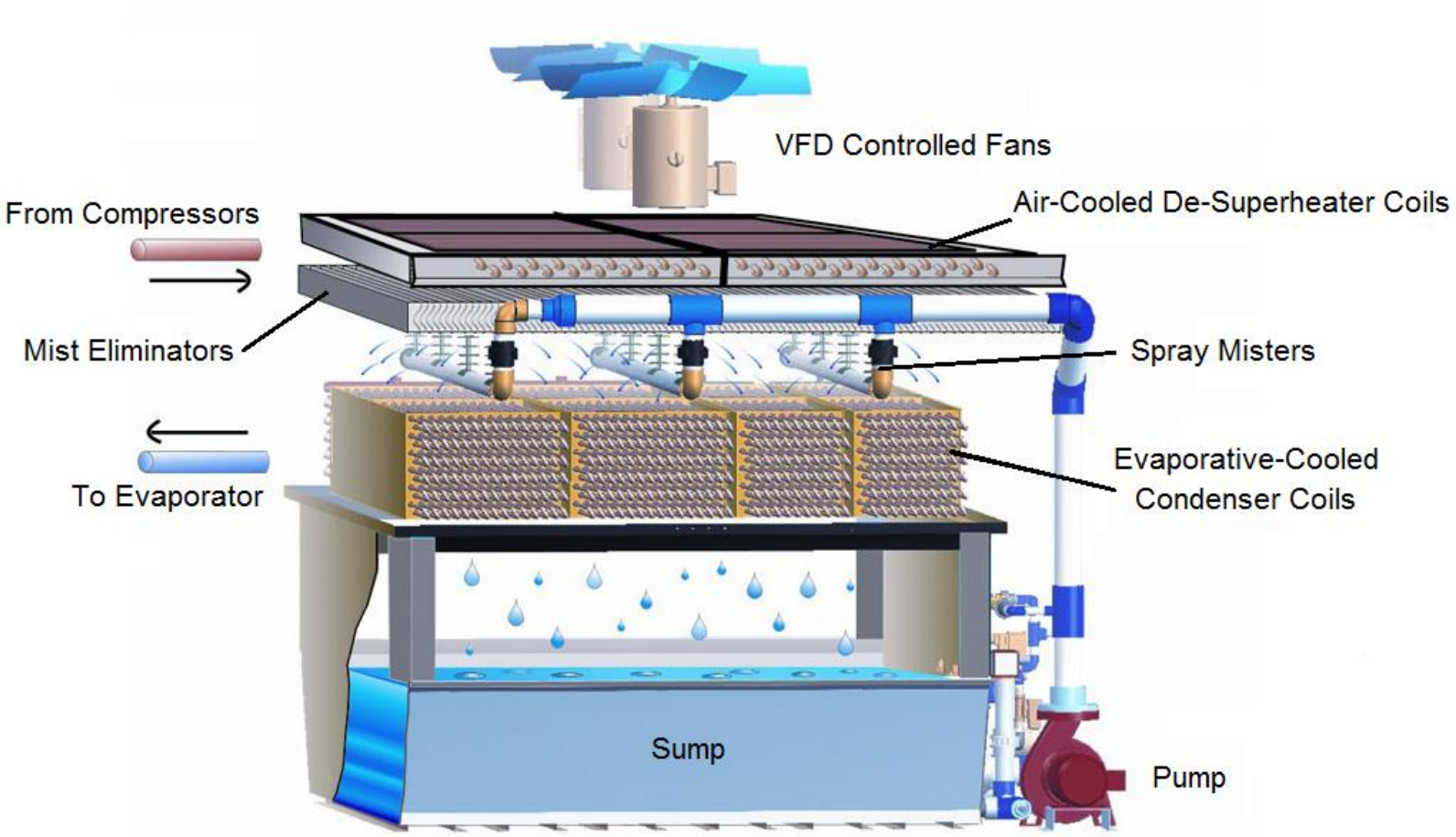
# Chillers

- Samsung DVMS Simultaneous Chilled/Hot Water
  - 10 & 15 Ton Capacities
  - Up To 16 Modules
  - System Redundancy
  - Cooling 14-77F
  - Heating 77-130F
  - 60dBA
  - Compact Design

# Chillers

- Water Furnace Modular Chiller/Boiler
  - Simultaneous Heat & Cool
  - Modular With Redundancy
  - Multiple LWTs
  - Water Cooled

# Chilled Beams

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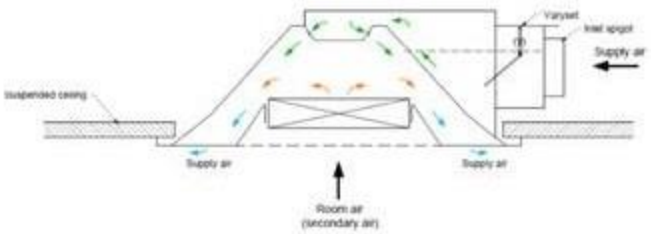
# Chilled Beams

## Basic concept of initial prototypes

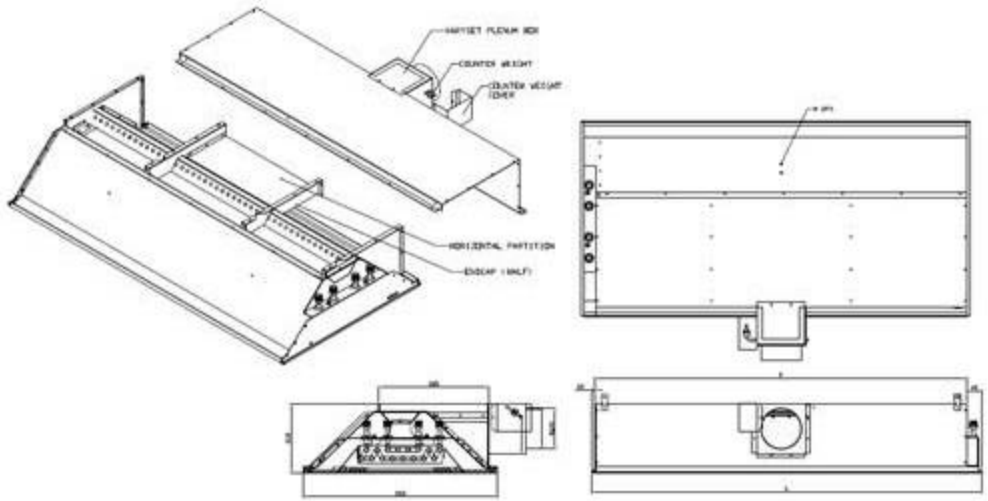



First concept was dividing beam in 3 chambers

Full flow = 3 chambers

Partial flow = 3 chambers in partial flow

Minimum flow = 1 chamber at their full flow



# Chilled Beams

**Figure 1:** With Varyset; V= 15 l/s; Δt= - 12 K
Coanda Effect is maintained.

**Figure 2:** Without Varyset; V= 15 l/s; Δt= - 12 K
Dumping is evident.

***System Cross Reference***

| | Chiller/AHU | Heat Pump | VRF | Chilled Beam |
|---|---|---|---|---|
| Mechanical Space | 4 | 3 | 1 | 2 |
| Comfort | 3 | 3 | 4 | 4 |
| Flexibility | 2 | 3 | 4 | 3 |
| Efficiency | 2 | 4 | 3 | 2 |
| Construction Cost | 2 | 4 | 3 | 3 |
| Maintenance | 3 | 4 | 2 | 2 |


Low Moderate High

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Thank You!

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