Disease Resilient and Energy-Efficient Centralized Air-Conditioning Systems

#### Webinar 2 - Energy-Efficient Centralized Air-Conditioning Systems

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## Energy Efficient Centralized Air Conditioning Systems

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## Energy Efficient Centralized Air Conditioning Systems

- Overview of Energy spread in a commercial building and approach
- Best design practices for Energy Efficient HVAC Systems
  - Integrated Comfort System and Earthwise Systems
- Energy Efficient Strategies & Alternate Design Concepts
- How to achieve operational excellence

### Summary

### HVAC is a major energy consuming component in a facility ....



#### ... how to handle this huge varying load optimally ?



each component has an impact on the other in terms of performance

### Best Design practices for Energy Efficient CAC Systems

- Airside Systems
- Chilled Water System Design aspects
- Chiller Plant Management & Controls
- Condenser Water System Design aspects
- Refrigerant & Environmental aspects
- Equipment and SYSTEM Selection aspects

### **Airside Options**

- Airside Options
  - CAV Systems
  - VAV Systems
  - Treated Fresh Air Systems
  - Demand Controlled Ventilation
  - Economizers





Benefits of VAV System & Pressure Independent

- VAVS Energy Efficient System
- Individually controllable
- High comfort level
- Low sound level
- Modulating controls
- Accurate pressure and air volume control





### VAV control in a Centralized AC System



### **Demand Control Ventilation**



## **Room Air Diffusion Methods**

• Mixing Systems.

• Displacement Systems.

Introduction to Displacement Ventilation Overview Review of Mixing systems: • 55°F Supply Air

- Mix the entire space
- Diffusers drive air motion
- High velocity supply

#### • Under floor Air Distribution Systems



#### Introduction to Displacement Ventilation Overview

#### **Displacement Systems:**

- 65-68°F supply air
- Low velocity
- No mixing in space
- Heat sources drive air motion
- Stratified heat, contaminants
- Only conditions the occupied zone



## CHW System Design aspects

- Chilled Water System Design aspects
  - Constant Primary/Variable Secondary CHW Systems
  - Variable Primary Flow CHW Systems
  - Series-Counterflow CHW Systems
  - High delta T Systems on evaporator and condenser
  - Heat Recovery Chillers

## CHW System Design aspects



Reduction (%)

baseline

12.7

19.1

**LChWT** 

42 F

**ECWT** 

90 F

## **District Energy Systems**

Important parameters considered for selecting number of chillers.

- Anticipated- Peak diversified Cooling loads
- Winter- Minimum loads
- Average Cooling load
- Energy efficiency
- Phased Development and Construction

Diversity can be 50% to 80%



### **Load Determination**

- key to energy savings in a Chiller Plant

also when you bring the additional chiller with its auxiliary components to the circuit and when the same is removed when not required are important factors to achieve energy savings



### Reduce Energy & Operating Costs

# **Chiller/Cooling Tower Optimization**





#### Condenser Water System Design aspects & Controls

Load CW Temp —— Chiller Design Wet Bulb Load CW Temp Tower Design



#### **Equipment Selection aspects**

- Equipment Selection aspects
  - Chillers with best efficiency for the application
    - Centrifugal
    - Water Cooled Screw /Air Cooled Screw
  - Variable Air Volume Systems

# Low Flow, Low Temperature, High Efficiency Systems

Airflow Optimization & hence Energy Savings



## Low Flow Rates Save in First Cost, and Improve Dehumidification



# Energy Efficient Strategies & Alternate Cooling and Heating Concepts

- Waterside
  - Heat recovery based on applications
  - Geothermal
  - Cogeneration
  - Thermal storage
- Airside
  - Exhaust-air energy recovery

- Alternate Design Concepts
  - Radiant Cooling Applications
  - Ground Sourced Heat Pumps
  - Earth Air Tunnel Systems

### thermal storage - Benefits



Reduces energy costs

Shifts equipment operation to off-peak hours

 Reduces airside costs, both capital and operating Permits colder supply air



#### **Optimal Ice Melt Rate, Peak Shaving, Strategic Control**



### energy recovery & economizers



Comply with ASHRAE Standard 90.1

- Economizers can give additional energy savings in select climate zones
- Airside energy recovery required in smaller systems and more climate zones



### Alternative cooling and heating strategies

- Evaporative cooling 3 stage
- Heat recovery wheel/Free Cooling
- Radiant cooling/Chilled beams
- High efficient equipments



Radiant cooling pipes embedded in the slabs

### Smart buildings – Trending and Analysis of Energy Data

Energy Consumption - Conventional Building						
SDB-1 Area	Current KW	Today (KWH)	Previous Day (KWH)			
Lighting	7.6	84.5	321.2			
Raw Power	23.6	378.7	731.9			
UPS	87.4	694.8	1302.6			
HVAC	118.1	770.6	1690.5			
Total	237.1	1928.4	4046.1			
HVAC Equipment						
Chiller	73.8	451.7	955.1			
Conv Chiller For DOAS	-6.0	-61.7	-34.2			
AHU's	34.9	288.3	532.1			
HRW SA & EA Fans	6.3	32.3	64.5			
Toilet Exhaust Fan	0.0	1.8	0.0			
Cooling Tower Fan -1	0.7	3.3	24.6			
Cooling Tower Fan -2	0.9	4.0	24.9			
Primary Pumps	4.2	26.4	50.1			
Condenser Pumps	4.1	24.4	39.2			
Total HVAC	118.1	770.6	1690.5			

	Conventional	Radian
Chiller Kw/TR	0.60	0.32
Plant Kw/TR	0.68	0.44

Savings - Radiant Cooling		
KW Savings in % - Current	36.26	
KWH Savings in % -Today	30.20	
KWH Savings in % - Prev Day	53.25	

#### **Energy Reports**

HH:MM:SS 14 10 3

DT:MT:YR 16 11 20

Energy Consumption - Radiant Building						
SDB-1 Area	Current KW	Today(KWH)	Previous Day (KWH)			
Lighting	11.7	159.5	295.9			
Raw Power	38.4	448.7	925.2			
UPS	97.5	661.6	1283.9			
HVAC	75.3	537.8	790.2			
Total	223.2	1807.4	3295.2			
	HVAC E	quipment	-			
Chiller	41.5	281.3	504.1			
Conv Chiller For DOAS	6.0	61.7	34.2			
Cooling Tower Fan -1	1.3	9.9	12.6			
Cooling Tower Fan -2	1.4	10.2	15.4			
Primary Pumps	5.2	41.3	61.3			
Condenser Pumps	8.9	49.6	68.4			
HRW & RACoil Pumps	0.0	0.3	2.0			
DOAS - 1	4.5	33.2	51.4			
DOAS - 2	4.3	30.5	47.1			
Exhaust Fans	2.5	20.4	27.9			
Total HVAC	75.3	537.8	790.2			

ONV SYSTEM

	Conventional	Radiant	
ahu ikw/tr	0.28	0.20	



#### Measure, Monitor & Control

- You cannot control what you cannot measure !
- Energy metering, measuring, logging and analysis are very critical

- Starting point for energy efficiency measures in existing & new buildings



Each and every component needs to perform in the most optimum level to achieve Energy Savings

#### **Total Cost of Ownership & Life Cycle Impact Approach**



Hidden costs (operation and maintenance costs)

## SMART way of achieving Operational Excellence in Centralized Air Conditioning Systems

- **S** Systematic and Integrated approach
- **M** Measurable and Controllable
- **A** Achievable
- **R** Recurring Savings
- T Total Cost of Ownership

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