Optimizing Air Exchange Rates in Hospitals:
Best Practices and New ASHRAE Guidance

Better Buildings Summit

Monday, May 9th

3:45-5:00pm

U.S. DEPARTMENT OF ENERGY

Agenda

- 3:45: Introduction
- 3:50: Chris Rousseau, Newcomb-Boyd (representing ASHRAE)
- 4:05: Ken Hansen, University of Nebraska Medical Center
- 4:20: Jim Prince, Ascension
- 4:35: Discussion

Today's Presenters

CHRIS ROUSSEAU, Partner, Newcomb & Boyd

Mr. Rousseau is a Partner at Newcomb & Boyd, a consulting and engineering firm in Atlanta, Georgia. He has 35 years of mechanical engineering experience in the health care design and construction industry. He has been a member of the Facilities Guidelines Institute Health Care Guidelines Revision Committee for 6 editions. He is currently Chair of ASHRAE/ASHE Standard 170, Ventilation of Health Care Facilities.

Today’s Presenters

KEN HANSEN, Associate Vice Chancellor for Facilities Management and Planning, University of Nebraska Medical Center and Nebraska Medicine

Ken Hansen is the Associate Vice Chancellor for Facilities Management and Planning at the University of Nebraska Medical Center and Nebraska Medicine. Ken is a registered professional engineer in the State of Nebraska with a Bachelor of Science in Civil Engineering from the University of Nebraska at Lincoln and a Master of Business Administration from The University of Nebraska at Omaha. Ken’s responsibility at UNMC includes Architectural Engineering, Architectural Planning, Facilities Operations, and campus Construction. Prior to 2005, Ken worked for the Omaha Public Power District over a period of 29 years in a variety of positions related to Facilities Management and Energy Services.

Today's Presenters

JIM PRINCE, Manager of Energy Management, Ascension Health

Jim joined Ascension Health in January of 2014 where he provides leadership for the energy management program in pursuit of Ascension's goal to reduce energy consumption by 20% by the year 2020. Jim has over 25 years of experience in Comprehensive Energy Management Programs, Supply-Side and Demand-Side Power Management, Cogeneration System Design, Chilled Water and Boiler Plant Optimization, HVAC System Optimization, and Facility Asset Management. Previously, Jim led the Project Development Team at M360, Inc, and led energy performance contract projects at Johnson Controls and as Principal at Prince Facility Consulting. He was employed for 11 years as Lead Facility Engineer at the United States Department of Energy site, the Idaho National Laboratory (INL). Jim is a CEM, and a member of AEE and ASHE. He holds a Bachelor of Science in Mechanical Engineering from Valparaiso University, and a Master of Science in Mechanical Engineering from the University of Idaho.

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ASHRAE Standar
170

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ASHRAE/ASHE Standard 170, Ventilation for Health Care Facilities

- ANSI Standard
- Minimum Standard
- Published with the FGI Guidelines
- Continuous Maintenance
- Addenda
- Next Publication - 2018

Procedure for Updates and Changes – Four Paths

- Change Proposals
- Official and Unofficial Interpretations
- FGI Guidelines Proposals
- Committee Members

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Evaluation of Changes

- Safety
- Comfort
- Energy

PROCESS

PAST

PRESENT

FUTURE

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ASHRAE

Past Energy Efficiency Features

- Patient Room Air Change Rates
- Displacement Ventilation
- Chilled Beams
- Heat Recovery
- Outpatient Return Air Plenums
- Reduced Humidity Requirements

Present Energy Efficient Features

- Laboratory Air Change Rates
- Exam Room Air Change Rates
- Adiabatic Atomizing Humidifiers
- Unoccupied Setback

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Future Energy Efficient Features

- Air Change Rate Reductions
- Ventilation Air Reductions
- Improved Air Distribution
- Alternate Compliance Method

PROCESS
PAST
PRESENT
FUTURE

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ASHRAE Standard 170

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Optimizing Air Exchange Rates

In an Academic Medical Center

A Case Study

Ken Hansen
Associate Vice Chancellor for
Facilities Management and Planning

University of Nebraska Medical Center
Nebraska Medicine

University of Nebraska Medical Center/ Nebraska Medicine

- Academic Medical Center – 8 million square feet of education, research and clinical space
- Aggressive energy reduction goals
  - ➢Reduced electric demand by 25% since 2010
  - ➢Reduced energy consumption by 25% since 2010
- New energy reduction goals
  - ➢Reduce peak demand and consumption an additional 10% by 2020

Case Study: Durham Research Center II

- 250,000 square feet
- 98 Laboratories
- 54 Ducted fume hoods
- 20 Ducted biologic fume hoods

Case Study: Durham Research Center II

- Original Design Parameters
  - 2003 IBC, IMC, IECC
  - Labs at 15 ACH – constant volume
  - VAV boxes on supply and exhaust in all lab spaces – designed to maintain positive /negative pressure only
  - Variable speed drives on main supply and exhaust fans – used for soft start and building pressure control

Case Study: Durham Research Center II

- System Improvements
  - Incorporated an “Aircuity” air sampling system
  - Incorporated high speed actuators on all VAV boxes
  - Updated lab control modules and integrated them into the building management system

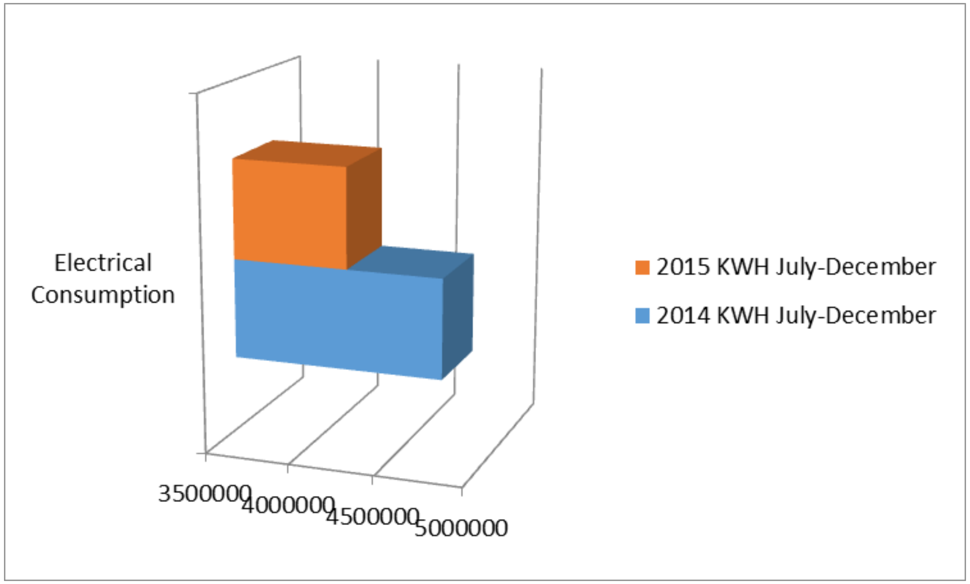
Case Study: Durham Research Center II

- System Design Improvements
  - Reduce ACH
    - 6 ACH Occupied
    - 2 ACH Unoccupied
  - Increase flows on change in hoof sash position
  - Increase flows on data from Aircuity system by sensing of contaminants
  - Training Research Staff
    - Close hoods when not in use
    - Work in hoods, not on the counters

Case Study: Durham Research Center II

Preliminary Results

Improvements completed in June 2015



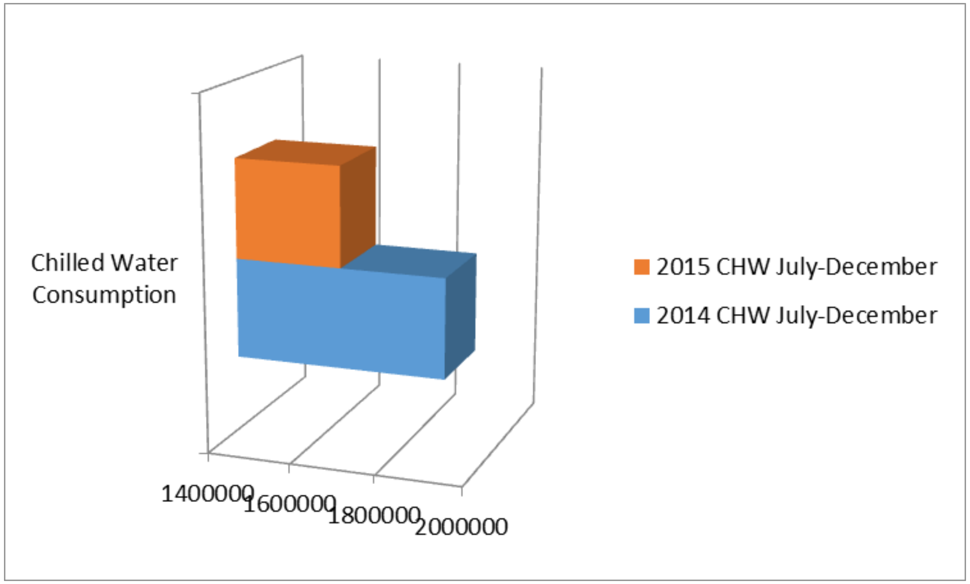
ELECTRICAL
11.8% Reduction

- Reduced Fan Energy

Case Study: Durham Research Center II

Preliminary Results

Improvements completed in June 2015



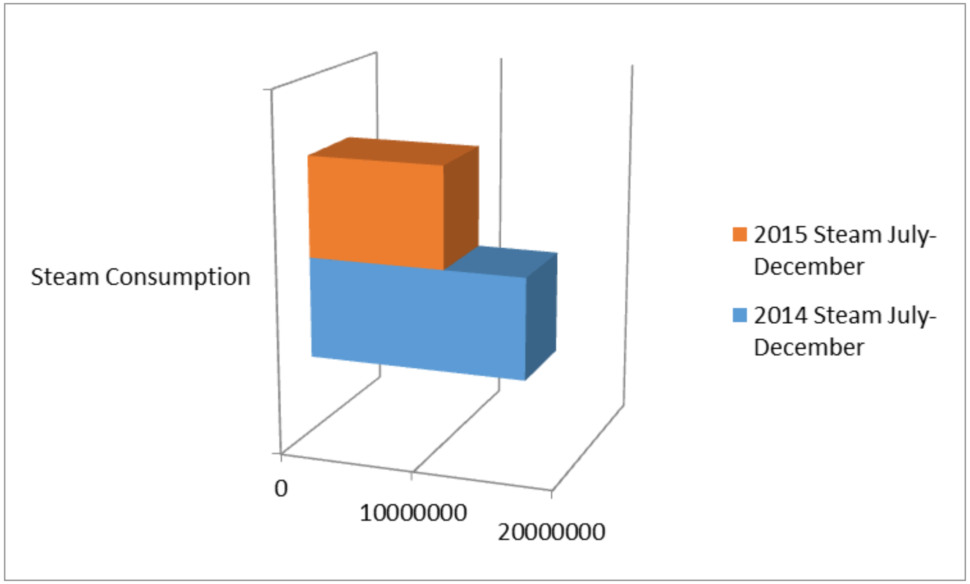
CHILLED WATER
13.0% Reduction

- Reduced Airflow

Case Study: Durham Research Center II

Preliminary Results

Improvements completed in June 2015



STEAM
37.1% Reduction

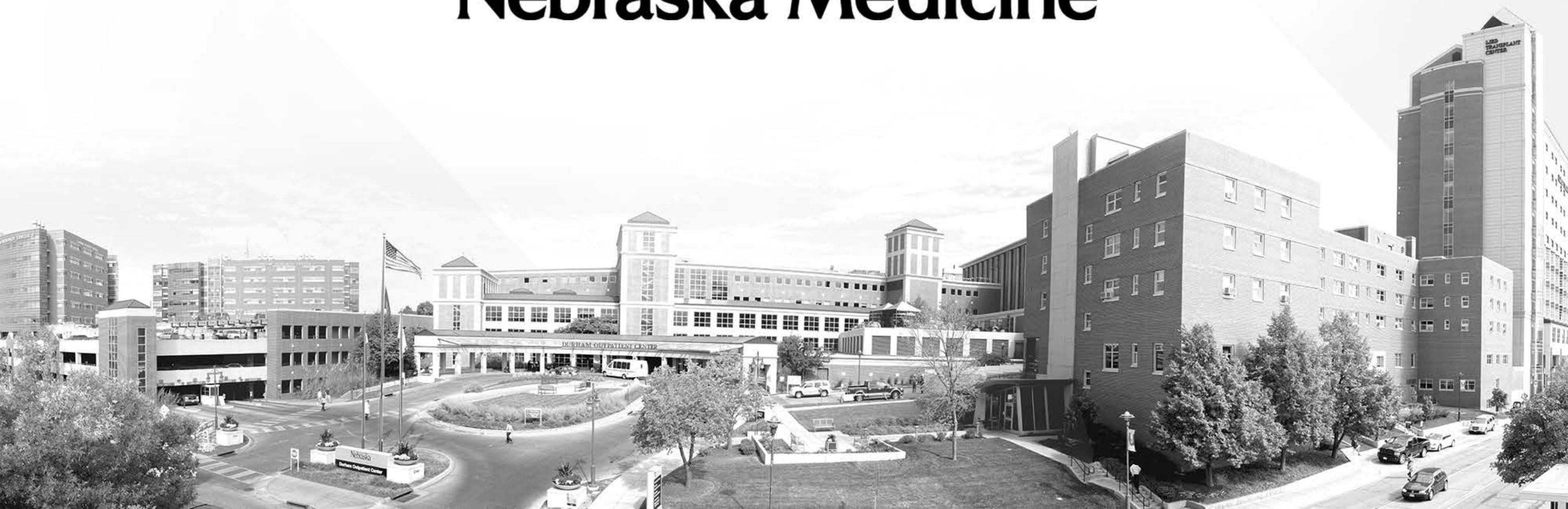
- Reduced VAV Reheat

Optimizing Air Exchange Rates in the Clinical Environment

- How do we do it?
  - ➢ Technology
    - Building automation system
    - Integration to other systems for instantaneous decisions
    - Occupant feedback
    - Immediate response
  - ➢ Experience
    - Success follows success
  - ➢ Trust
    - Senior level buy-in

University of Nebraska Medical Center

Nebraska Medicine



Optimizing Air Change Rates at Ascension Hospitals

James M. Prince
Manager of Energy Management
Facilities Resource Group
St. Louis, MO

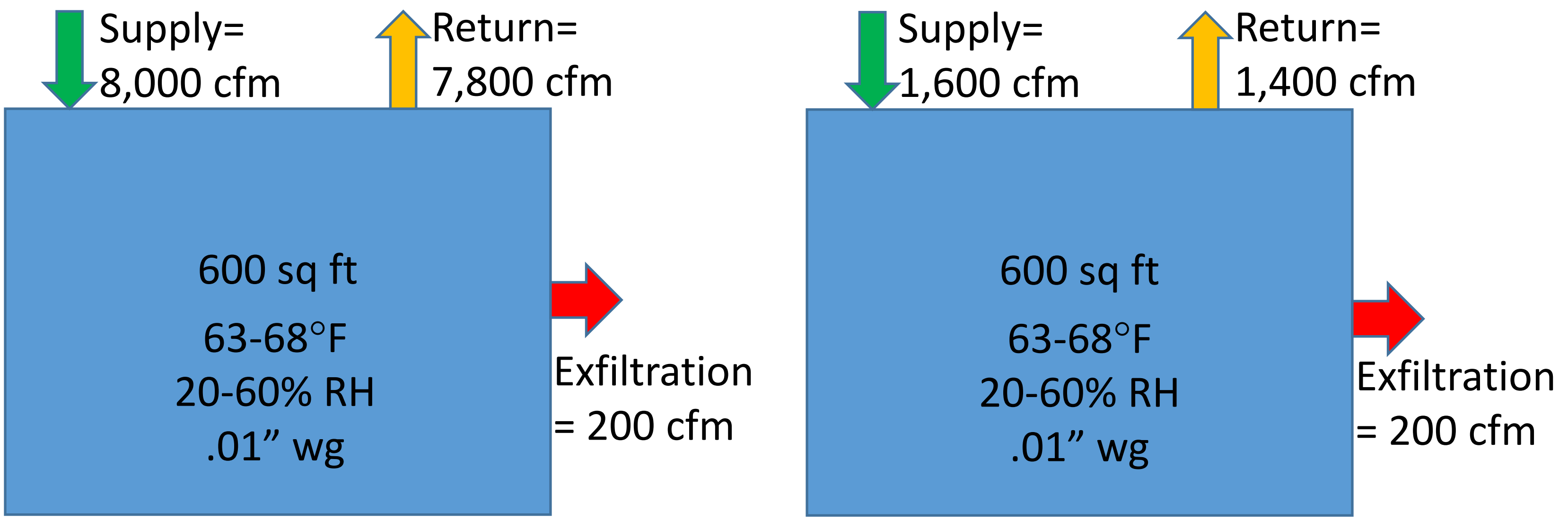
Airflow Optimization

1. ORs and Procedure Rooms
2. Non-clinical Areas
3. Patient Rooms
4. Area Use Changes
5. CAV vs. VAV
6. Terminal Box Sequences
7. Using the Multiple Space Equation
8. Room Ventilation Schedule

Airflow Optimization

1. ORs and Procedure Rooms

Occupied	Unoccupied
20 ACH Total 4 ACH OA	6 ACH Total



Airflow Optimization

2. Non-clinical Areas

- Common misconception
- Unoccupied scheduling
  - Cfm, OA%, Temperature
  - AHU Level
  - Terminal Box Level

Airflow Optimization

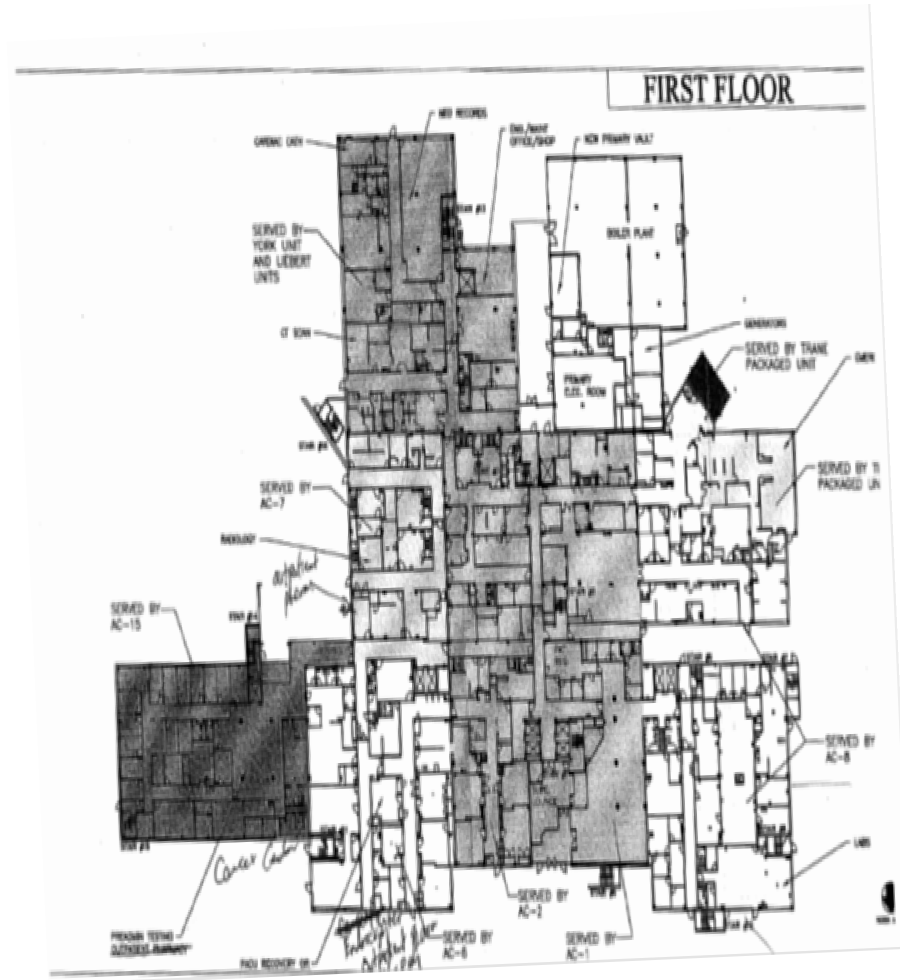
3. Patient Rooms

   - ASHRAE 170
     - Patient Rooms, 6 to 4 ACH
     - Adoption varies by state

Airflow Optimization

4. Area Use Changes

    - Michigan example
    - ORs to Medical Records Storage



Airflow Optimization

5. CAV vs. VAV

- Common misconception
- Many VAVs are operating as CAVs

Airflow Optimization

6. Terminal Box Sequences

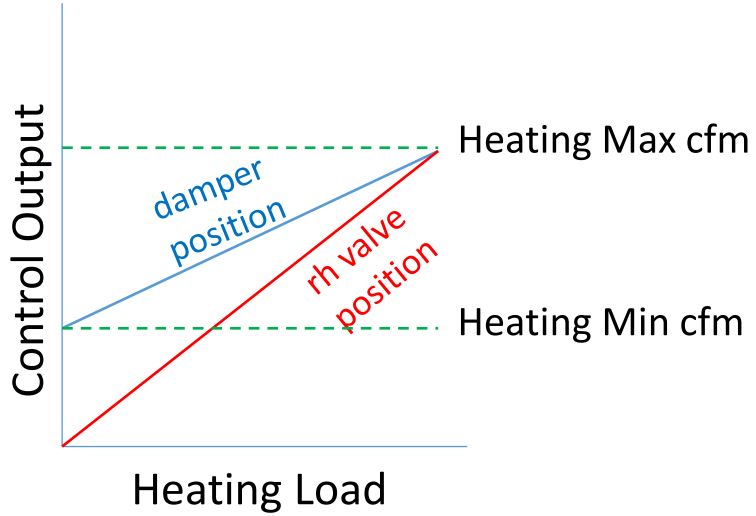
	Occupied	Unoccupied
Cooling Min cfm	Standard Driven*	?
Cooling Max cfm	Load Driven	Load Driven
Heating Min cfm	Standard Driven*	?
Heating Max cfm	Load Driven	Load Driven

* Minimum occupied ACH required

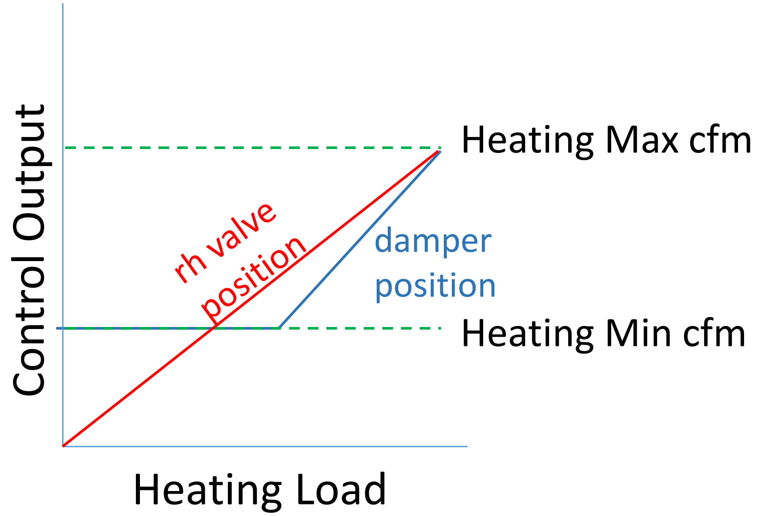
Airflow Optimization

6. Terminal Box Sequences, cont'd

Typical Heating Sequence



Better Heating Sequence



Airflow Optimization

7. Using the Multiple Space Equation to Establish AHU OA %
   - The "old" way

ASHRAE 170 Designation	ASHRAE 170 Guideline Requirements			
	OSA (AC/Hr)	Total (AC/Hr)	Pressure	100% Exhaust
Soiled Linen Storage	N/A	10	IN	Yes
Soiled or Decon Room	2	6	IN	Yes
Soiled Workroom or Soiled Holding	2	10	IN	Yes
Sterile Storage	2	4	Out	No

Decon Room: 2/6 = 33%

Soiled Workroom: 2/10 = 20%

Sterile Storage: 2/4 = 50%

AHU OA Fraction: 50%

Airflow Optimization

7. Using the Multiple Space Equation to Establish AHU OA %

- The "current" ASHRAE 170 way

AHU	Calculated Min System Ven Eff Zone	Hand Entered Min System Ven Eff	OA Frac	Zp Max
AHU-1	0.693	0.70	0.193	0.500

19.3% !!!

Airflow Optimization

8. Air Balancing Using the Room Ventilation Schedule (RVS)
   - Room-by-room account of space type, size, airflow requirements.
   - Spreadsheets can perform Multiple Space calculations for you.
   - Right-sizing airflow in your facility will generate dramatic financial results… SPB< 1 year!
   - Most benefit to spaces with good DDC terminal box coverage.

Deliver the right amount of air—
no more, no less!

Airflow Optimization

Summary

- Occupancy Varies throughout the day
- Space Use Changes over Time
- Standards Change over Time
  - ASHRAE 170 2008 + Addenda
    - Patient Rooms, 6 to 4 ACH
    - OA Fractions Using the Multiple Space Equation

Deliver the right amount of air—
no more, no less!

Discussion

Thank you!

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