Society of American Military Engineers

# Topic: Solving the Humidity Control Problem Using New ASHRAE® Design Guide, GSA/DoE Innovation Programs, and Technology

Academy Energy Group

Savannah Post

Society of American Military Engineers

**2025 Annual Program Review**
**Partnering For A Resilient Future**
**June 24-26, 2025**
**Savannah, GA**

## Innovative, Sustainable, Resilient Solutions:

New ASHRAE® Design Guide Overview Developed by USACE-CERL

***"Guide for Resilient Energy Systems Design in Hot and Humid Climates"***

Federal Government Technology Innovation Programs

&

Applying HVAC Technology to Solve Problems of Mold, Corrosion, Improve Indoor Air Quality (IAQ) & Save Energy Using Pretreatment of Outside Air for Chilled-Water Cooling & Dedicated Outside Air Systems (DOAS)

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# Think, Design, & Build Differently

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**<u>Bottom Line Up Front:</u>**

## ADAPT to Design Guides & Technology Changes

## "Collaborate to Deliver Solutions for Humidity Control Problems"

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# Why are we here today?

ACADEMY ENERGY GROUP

**To Educate and Demonstrate how to use ASHRAE® Design Guides to apply proven technology that improves HVAC systems for both retrofit & new construction.**

- Control Humidity
- Save Energy (90.1)
- Deliver Healthy Buildings
    - Improve Indoor Air Quality (IAQ)
    - Ensure Proper Ventilation (62.1)

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# AGENDA

- New ASHRAE® Design Guide Review by Andy Lynch of Academy Energy Group
  "Guide for Resilient Energy Systems Design in Hot and Humid Climates"
- Federal Government Technology Innovation Programs
- Technical Review by Bill Steiner of Academy Energy Group
- Overview
  - Common Humidity Control Methods & Challenges
  - A Better Approach
    - Decoupling Latent & Sensible Loads
    - Energy Savings
    - Desaturation Coils
    - Case Studies
- Conclusions/Observations
- Questions

# Altaire Overview – HVAC Manufacturer

## Advanced Dehumidification Airstream Pretreat Technology (ADAPT™)

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## Altaire Overview:

Veteran Founded HVAC Manufacturer and an Academy Energy Group Technology

## Altaire ADAPT™ Products are proven to:

- Saves Energy
- Improve Indoor Air Quality (IAQ)
- Provides a healthier safer, more productive Environment

## Designed to Battle Extreme Environments by Team of Subject Matter Experts:

- HVAC Construction
- HVAC Commissioning
- Building Building Automation Systems (BAS) Optimization

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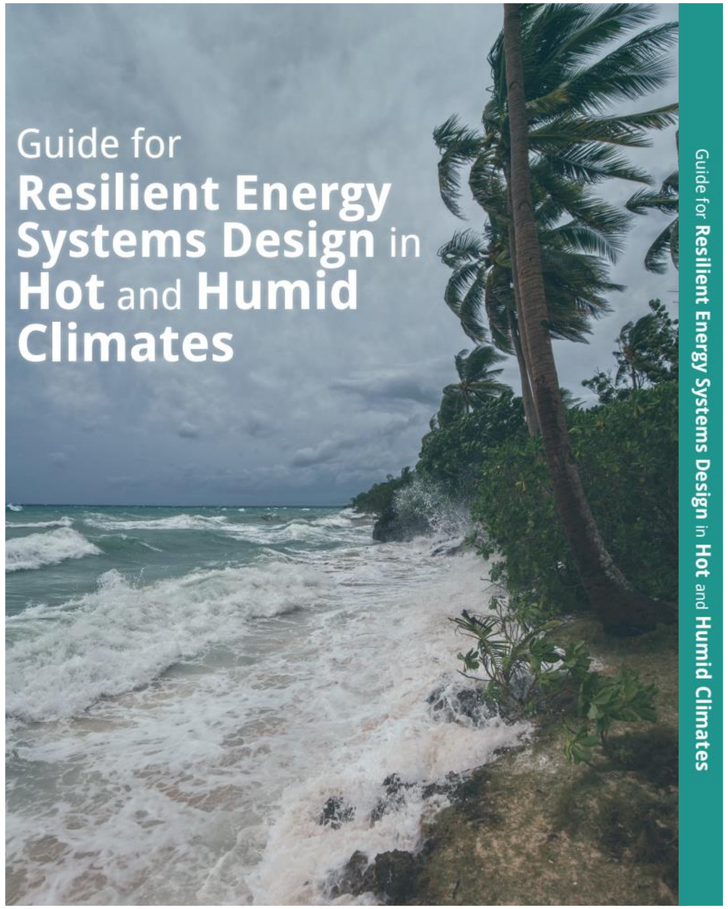
# NEW ASHRAE® Design Guide Developed by USACE CERL

ASHRAE®

US Army Corps of Engineers®

CERL CONSTRUCTION ENGINEERING RESEARCH LABORATORY ERDC




Hot and humid climates (HHC) present some of the most complex challenges for sustainable building design and operation to maintain high IAQ efficiently. Additionally, high temperatures and high humidity create extreme comfort issues and exacerbate the potential for condensation, mold, and mildew.

Buildings in humid climates, especially in coastal locations, are also subject to rust and the decay of materials much more quickly than in other environments. In extreme situations, e.g., at Kwajalein or Okinawa, concrete elements of the building envelope break down, and condenser units installed outside of the building envelope must be replaced within two to three years due to premature corrosion caused by salt-laden ambient air. Additionally, many coastal areas located in HHC are frequented by tropical storms and hurricanes with heavy winds, which can force water into the building and be damaging to the building envelope.

HHC provide unique challenges to HVAC, plumbing, and thermal energy system designers. Considering facility operation in the context of high OA temperatures and humidity, system reliability and building resiliency cannot be understated. This Guide describes best practice examples of robust and reliable systems emphasizing redundancy, durability, and functionality.

The target audience for this Guide is technical experts involved in building and energy systems design, renovation, operation, and maintenance; architectural and engineering professionals; and energy service companies. The content of this Guide may also be of interest to building owners, executive decision-makers, and energy managers of public, government, and military organizations.

The Guide was developed with partial support from the DOD Environmental Security Technology Certification Program, the Office of the Deputy Assistant Secretary of the Army (Energy and Sustainability), and the International Energy Agency Energy in Buildings and Communities Program Annex 73.

U.S. ARMY ESTCP US Army Corps of Engineers EBC ERDC

The following organizations significantly contributed to the content of this Guide:

ASHRAE CDC NIOSH RDH BUILDING SCIENCE ACADEMY ENERGY GROUP Danfoss RAMBOLL Lerch Bates SC-B CONSULTING Altaire MAKAI HEG

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# Editor: Dr. Alexander Zhivov

*"Guide for Resilient Energy Systems Design in Hot and Humid Climates"*

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- ASHRAE® Distinguished Service Award
- ASHRAE® Exceptional Service Award
- ASHRAE® Fellow
- International Forum on Energy Security Leader
- 250+ Books and Tech Papers

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# Reference Material for Whole Building Design Guide / Unified Facility Criteria (UFC) – 3-410-01 HVAC

WBDG Whole Building Design Guide

FEDERAL FACILITY CRITERIA | WHOLE BUILDING DESIGN | CONTINUING EDUCATION | ADDITIONAL RESOURCES | SEARCH

## UFC 3-410-01 Heating, Ventilating, and Air Conditioning Systems, with Change 9



**Thank you for visiting the Whole Building Design Guide**. Currently the WBDG is offering limited features as the NIBS team works diligently to bring the entirety of WBDG services back online. Learn more or reach out to WBDG Support at wbdg@nibs.org for additional assistance.

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**Related Materials**
ASHRAE 62.1 Flow Chart PDF
CERL Report Analysis of Large Thermal Energy Storage Applications PDF
CERL Report on Air Curtains PDF
Guide for Air Supply Strategies in Spaces PDF
Guide for Resilient Energy Systems Design in Hot and Humid Climates PDF

**Series**
3 - DISCIPLINE-SPECIFIC CRITERIA
3-400: MECHANICAL

**CCR**
CCR

**Tags**
HVAC SPECIFICATIONS

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# Table of Contents:
## *“Guide for Resilient Energy Systems Design in Hot and Humid Climates”*

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# Chapter 5: HVAC

## SOLUTION: Separate Outdoor Air Pretreatment Dehumidification (Latent Load) & Building Cooling Load (Sensible Load)

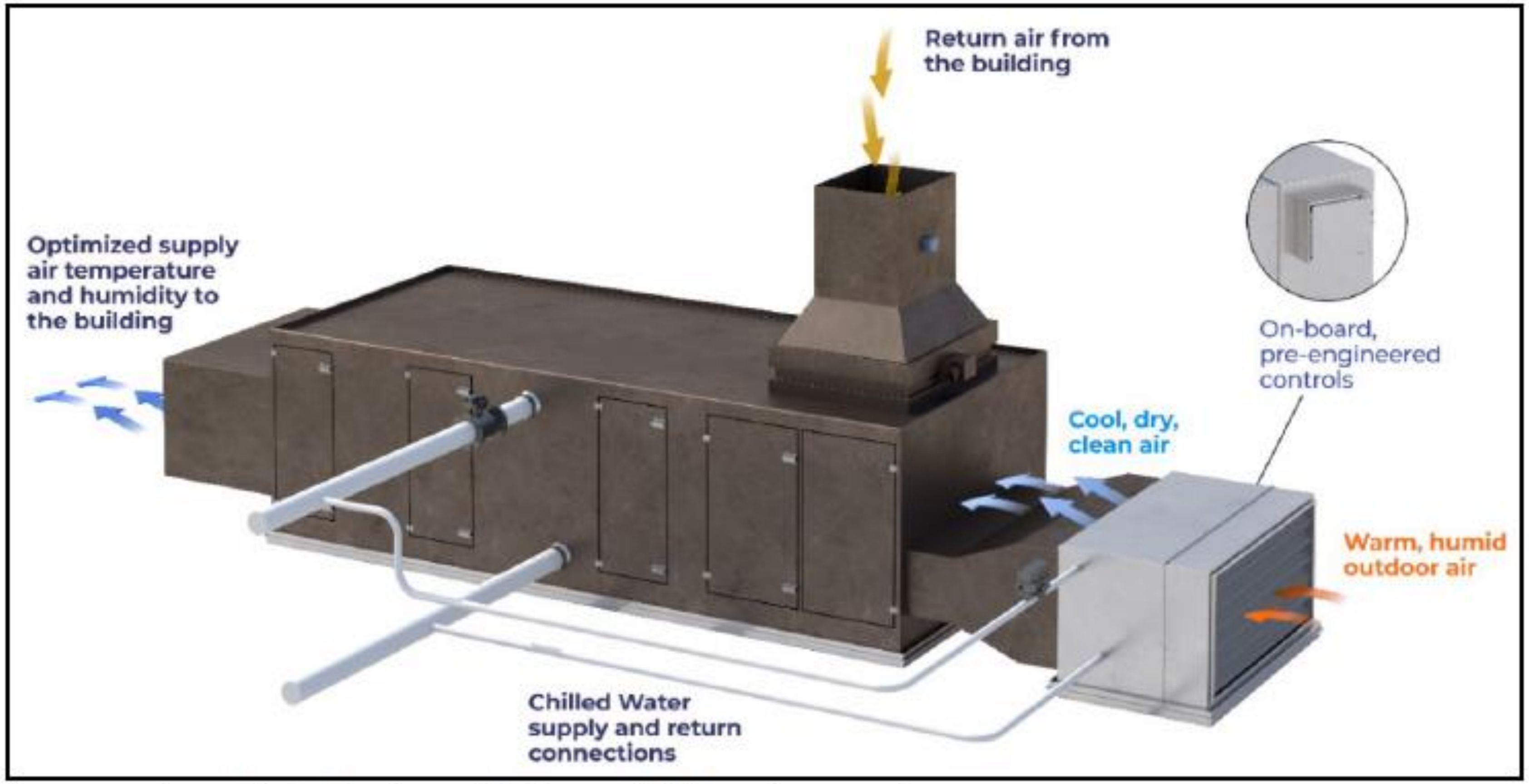


Image courtesy Altaire Systems, LLC (www.altairesystems.com).

Figure 5-3. Example outdoor air pretreatment device that decouples latent and sensible cooling loads.

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# 1.2. Hazards Specific to Construction in Hot, Humid Climates

1.2.1. High Ambient Temperature, Humidity, and Dewpoint

1.2.2. Intense Rain Periods

1.2.3. Monsoons

1.2.4. Tropical Storms, Typhoons, and Hurricanes

1.2.5. Storm Surges

1.2.6. Floods

1.2.7. High Water Table

1.2.8. Seismic Considerations

# 1.3. Special Issues Related to Coastal Areas

## 1.3.1. Tsunamis

## 1.3.2. Prolonged Elevated Temperatures

## 1.3.3. Salt-Laden Air

## 1.3.4. Severe Tidal Fluctuations

# 1.3. Special Issues Related to Coastal Areas

## Specific Issues

- Coastal

- Inland


## 1.4.1. Mold Considerations - Conditions for Mold Growth

# High Heat 80°F to 100°F

# +

# High Dewpoint (DP) > 60°F

# =

# Ideal Conditions for Mold Growth

# 1.4. Major Issues Affecting Building Sustainability in Hot & Humid Climates
## PROBLEM: Mold

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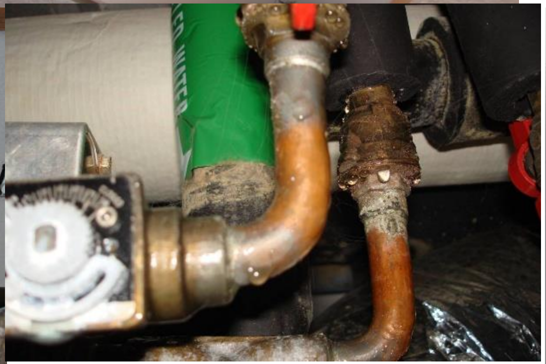

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# Army Finds Mold in Over 2,000 Facilities after Service-Wide Inspection

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## MOLD CAUSES HEALTH ISSUES

## Conditions for Mold Growth

High Heat 80°F to 100°F

+

High Dewpoint (DP) > 60°F

=

Ideal Conditions for Mold Growth

Senior Leaders at Fort Stewart and Hunter Army Airfield, Georgia, check barracks facilities for mold and other maintenance concerns.

**CREDIT: ArmyTimes.com by: Jonathan Lehrfeld**

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## 1.4.1. Mold Considerations - Health Effects of Toxigenic Molds and Mycotoxins.

1. **ALLERGY:**
   Type-1 allergy or immediate type hypersensitivity
2. **REACTIONS:**
   Delayed-type hypersensitivity reactions
3. **INFECTION**
4. **NERVE IRRATION:**
   Mucous membrane and trigeminal* nerve irritation (sensory info to skin/sinuses/face)
5. **HEADACHES, NASAL STUFFINESS, NAUSEA, VOMITING:**
   Adverse reactions to odor or pseudo allergy
6. **TOXICITY & DAMAGE SKIN, LUNGS, GUT, VASCULAR SYSTEM, BRAIN-CENTRAL NERVOUS SYSTEM:**
   Toxicity or neurotoxicity by molds and mycotoxins
7. **IMMUNE SYSTEM DAMAGE:**
   Immunotoxicity induced by molds and mycotoxins.

# 1.5. Corrosion
# PROBLEM: Corrosion

**PROBLEMS:**

Rapid Rust

Rapid Decay

Premature Failure / Increased Life Cycle Costs

Problems Across Many Systems

- Building Envelopes
- HVAC Systems
- Cooling Energy Generation, Storage, and Distribution Systems

**SOLUTIONS:**

Build With: Minimal Exposure to Corrosive Environment

Corrosion-Resistant Materials

Corrosion-Resistant Coatings

Humidity Control


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**Proper Design**

**+**

**Resilient Equipment Specification**

**+**

**Communication of Operational Requirements**

**+**

**Operation in Accordance with Design Requirements**

**+**

**Maintenance**

**=**

**HVAC can Protect Interior of Building that Envelope Alone Cannot**

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# GSA, VA, & U.S. Navy Implements HVAC Dehumidification

## Outdoor Air Pre-Treatment

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GSA | GPG Green Proving Ground Program

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy


GSA Federal Courthouse
Lufkin, TX

VA | U.S. Department of Veterans Affairs


Northampton VA Medical Center
Leeds, MA

NAVFAC Naval Facilities Engineering Systems Command

High Impact Technology Catalyst
Buildings

U.S. DEPARTMENT OF ENERGY


Naval Support Activity (NSA)
Orlando, FL

**Building. Solving. Serving.**

# Technical Review Agenda

**Overview**

Terms and Concepts

ASHRAE 62.1

**Common Humidity Control Methods & Challenges**

Series cooling and reheat

ASHRAE 90.1

Wheels

Wrap around heat pipe

Run around coils

Plate heat exchanger

Liquid desiccant systems

**A Better Approach:**

What is decoupling ?

What are the Energy savings?

What is a Desaturation Coil?

What is the cost of ownership?

Case Studies

# Terms and Concepts

- **<u>Latent Load:</u>** the amount of cooling load required to remove moisture from air
- **<u>Sensible Load:</u>** the amount of cooling required to achieve a desired dry bulb (DB) temperature – cooling for comfort
- **<u>Dry-Bulb Temperature (DB):</u>** the ambient air temperature only / regardless of moisture
- **<u>Wet Bulb Temperature (WB):</u>** the temperature of the air as cooled by evaporation – not the same as dew point
- **<u>Relative Humidity (RH):</u>** the amount moisture in the air relative to the DB temp
- **<u>Dew Point (DP):</u>** The temperature (°F) at which a given amount of moisture in the air will condense – this is independent of DB temperature

# ASHRAE 62.1 Ventilation and Acceptable Indoor Air Quality (IAQ)

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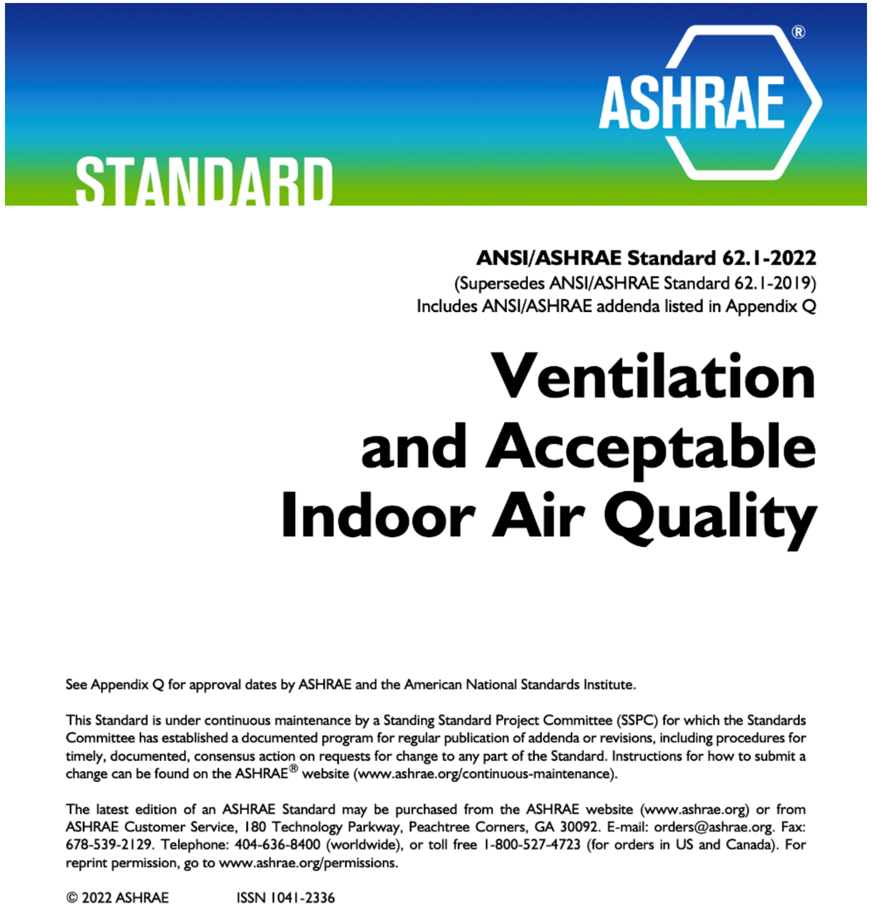
- Minimum Outside Air (OA) requirements,
  - Generally 20%

- Dew Point requirement of 62.1
  - 60 °F degrees max
  - 55 °F is generally the goal



STANDARD

ASHRAE

**ANSI/ASHRAE Standard 62.1-2022**
(Supersedes ANSI/ASHRAE Standard 62.1-2019)
Includes ANSI/ASHRAE addenda listed in Appendix Q

**Ventilation and Acceptable Indoor Air Quality**

See Appendix Q for approval dates by ASHRAE and the American National Standards Institute.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. Instructions for how to submit a change can be found on the ASHRAE® website (www.ashrae.org/continuous-maintenance).

The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 180 Technology Parkway, Peachtree Corners, GA 30092. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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# DEW POINT MAP:
# July 29th 2024

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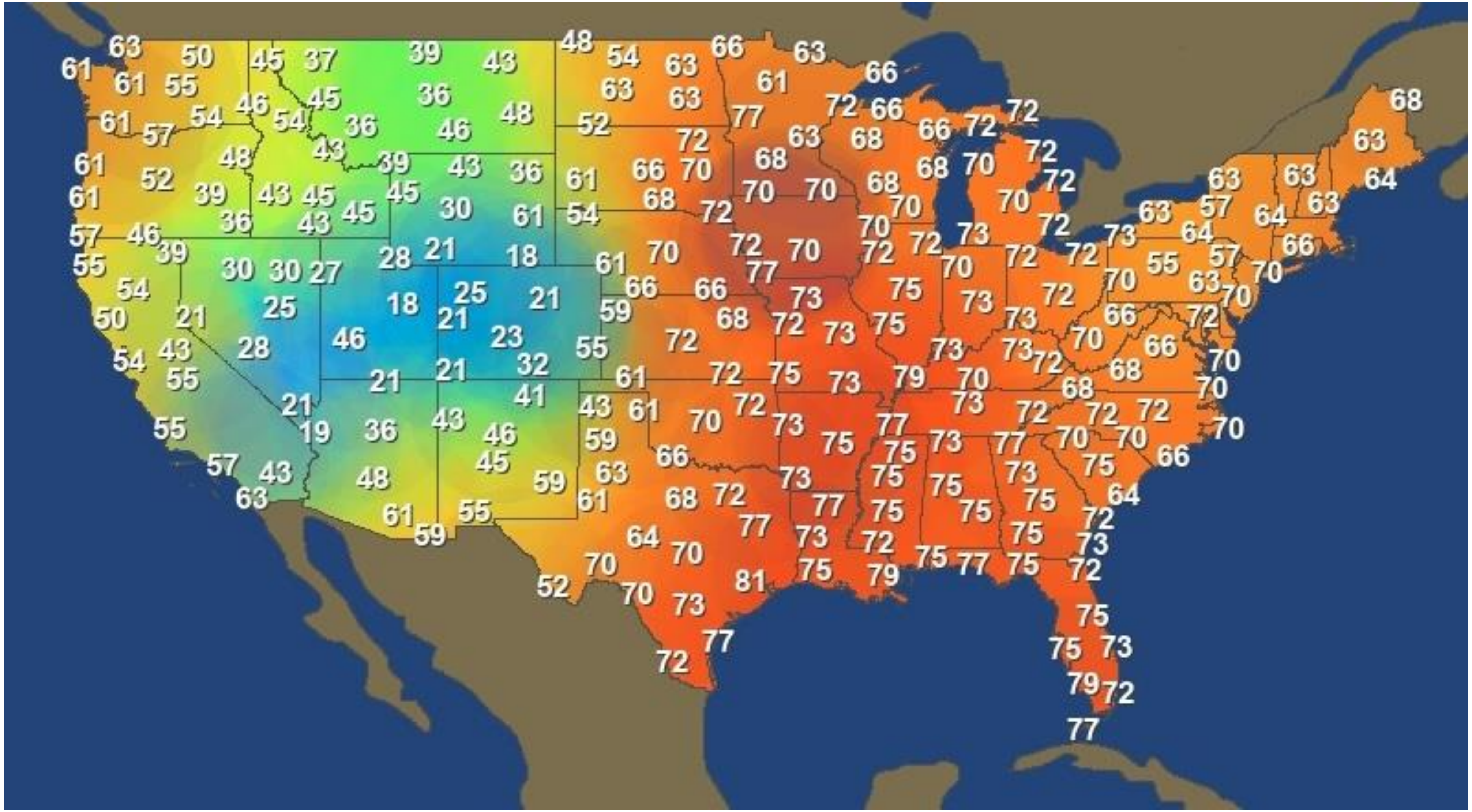


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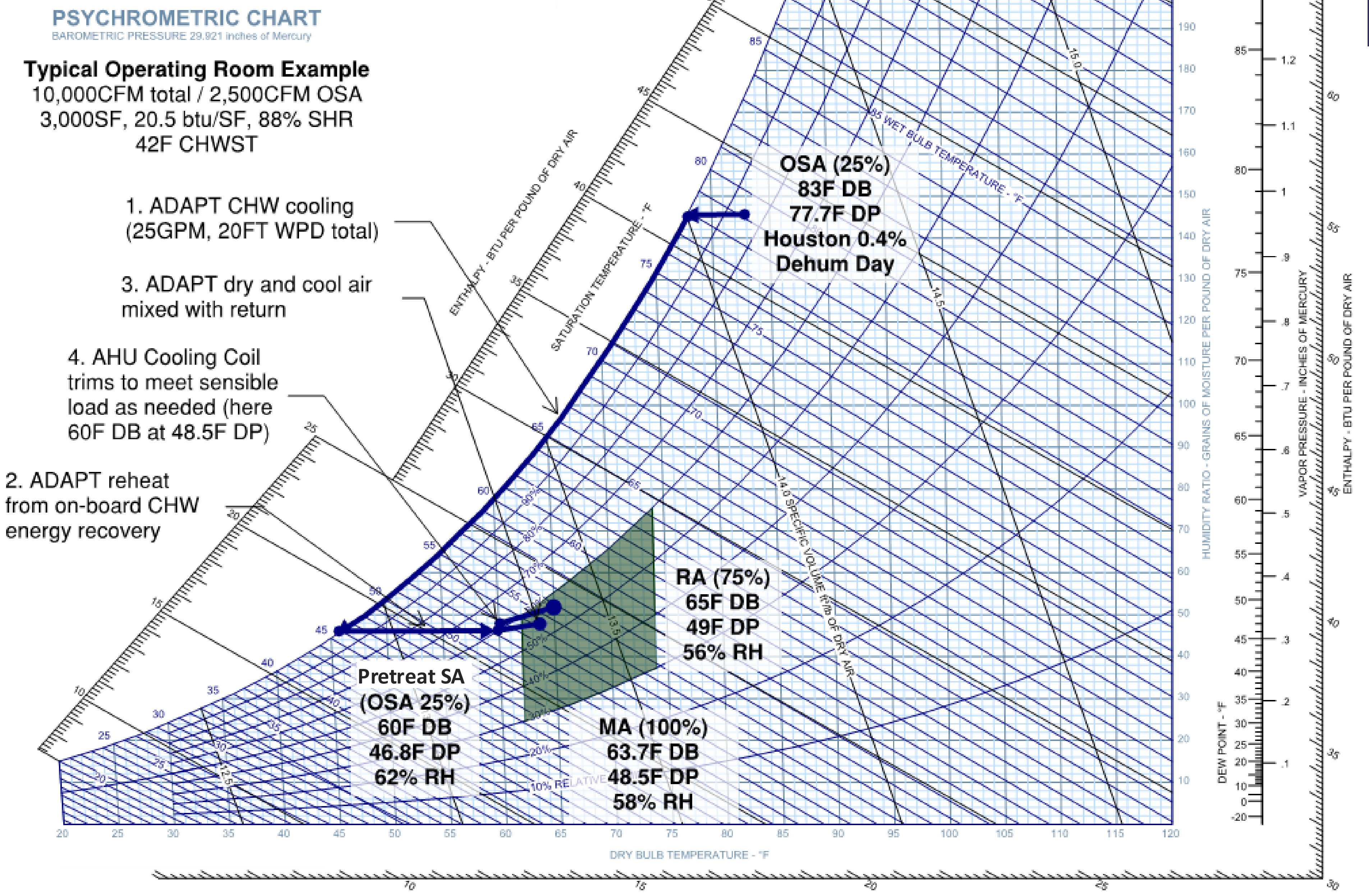
# Common Humidity Control Methods & Challenges

- Large Latent/Sensible Chilled Water Coils (CWC) in Air Handling Unit (AHU)
- Why do we have to reheat?

# Psychrometric Analysis



# Common Methods Of Addressing Humidity

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## ASHRAE 90.1

### 6.5.2.3 Dehumidification

Where humidity controls are provided, such controls shall prevent reheating, mixing of hot and cold airstreams, or other means **of simultaneous heating and cooling of the same airstream.**

*Exceptions to 6.5.2.3*

1. ***The system is capable of and configured to reduce supply air volume to 50% or less of the design airflow rate or the minimum outdoor air ventilation rate specified in ASHRAE Standard 62.1 or other applicable federal, state, or local code or recognized standard, whichever is larger, before simultaneous heating and cooling takes place.***
2. The individual fan cooling unit has a design cooling capacity of 65,000 Btu/h or less and is capable of and configured to unload to 50% capacity before simultaneous heating and cooling take place.
3. The individual mechanical cooling unit has a design cooling capacity of 40,000 Btu/h or less. An individual mechanical cooling units is a single system comprising a fan or fans and cooling coil capable of providing mechanical cooling.
4. Systems serving spaces where specific humidity levels are required to satisfy process needs, such as vivariums; museums; surgical suites; pharmacies; and buildings with refrigerating systems, such as supermarkets, refrigerated warehouses, and ice arenas, and where the building includes site-recovered energy or site-solar energy that provide energy equal to at least 75% of the annual energy for reheating or for providing warm air in mixing systems. This exception does not apply to computer rooms.
5. ***At least 90% of the annual energy for reheating for providing warm air in mixing systems is provided from site-recovered energy (including condenser heat) or site-solar energy.***
6. Systems where the heat added to the airstream is the result of the use of a desiccant system, and 75% of the heat added by the desiccant system is removed by a heat exchanger, either before or after the desiccant system, with energy recovery.

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# Common Humidity Control Methods & Challenges

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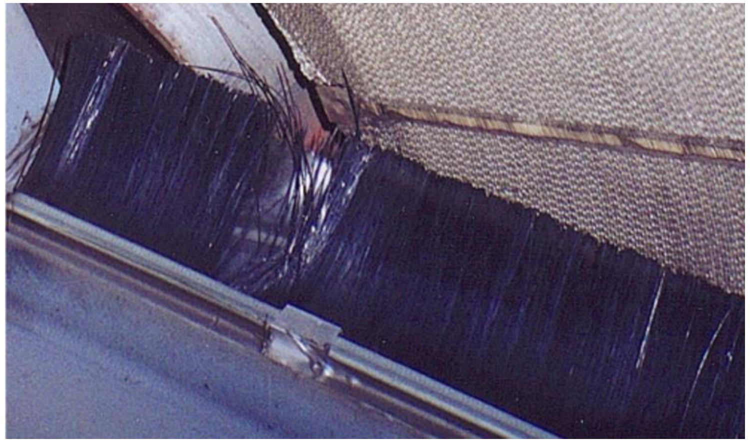
## Energy Recovery/Desiccant Wheels

- Poor sealing
- Difficult controls
- Generally requires hot process air (120 or 200+)/ additional energy inputs
- More complex AHU design/larger size
- Energy to spin wheel
- Requires replacement of wheel every 10 years
- Nearly impossible retrofit



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# Common Humidity Control Methods & Challenges

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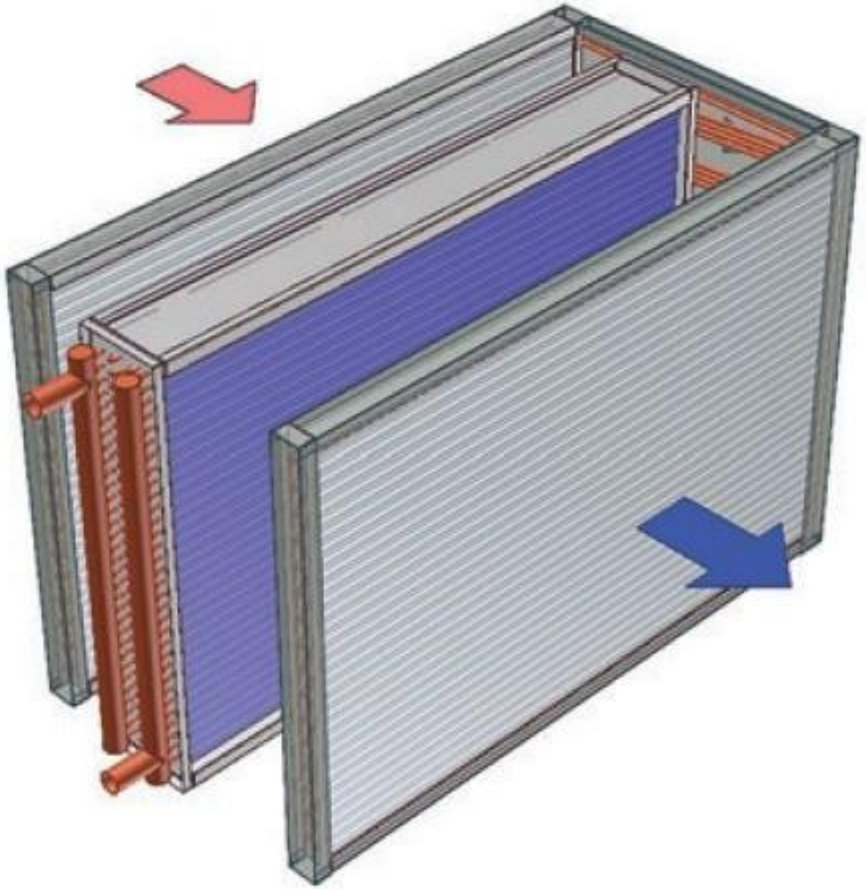
## Wrap Around Heat Pipe

- Using 3 coils where 2 would work
- Only provides “free” reheat
- Higher Static Pressure Loss



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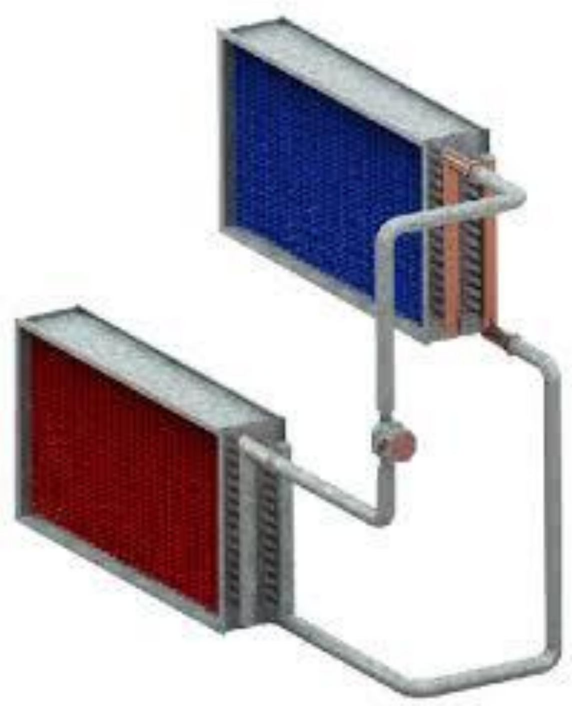
# Common Humidity Control Methods & Challenges

## Run Around Coils

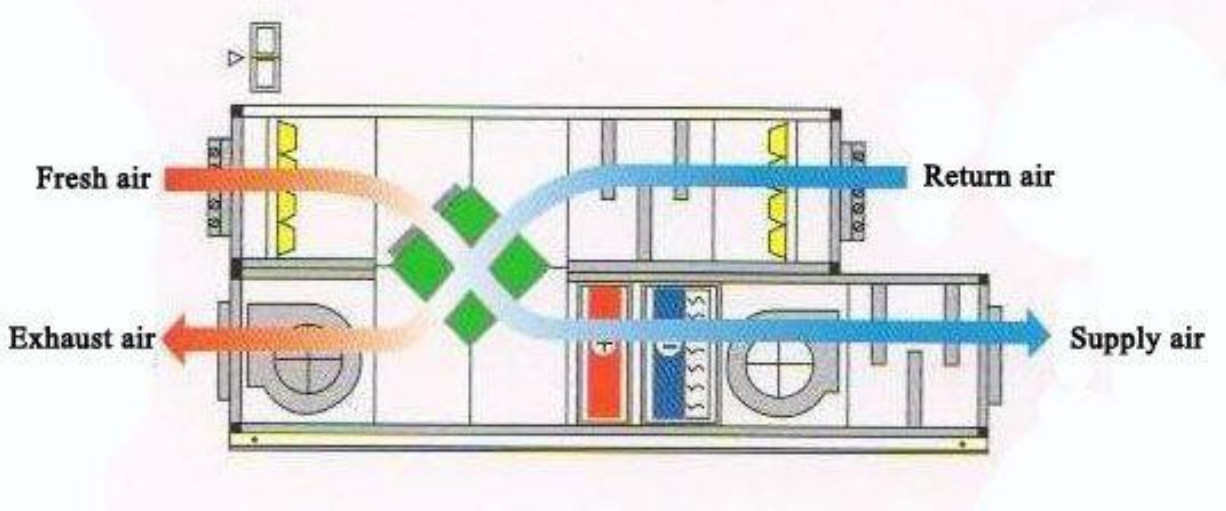
- Exhaust Air (EA) temps aren't low enough to address latent loads,  CWC still needs to address latent loads
- Reheat is still required
- Additional Static Pressure Loss on both Exhaust Air (EA) and Supply Air (SA) fan arrays
- Difficult Retrofit



# Common Humidity Control Methods & Challenges

## Plate Heat Exchanger

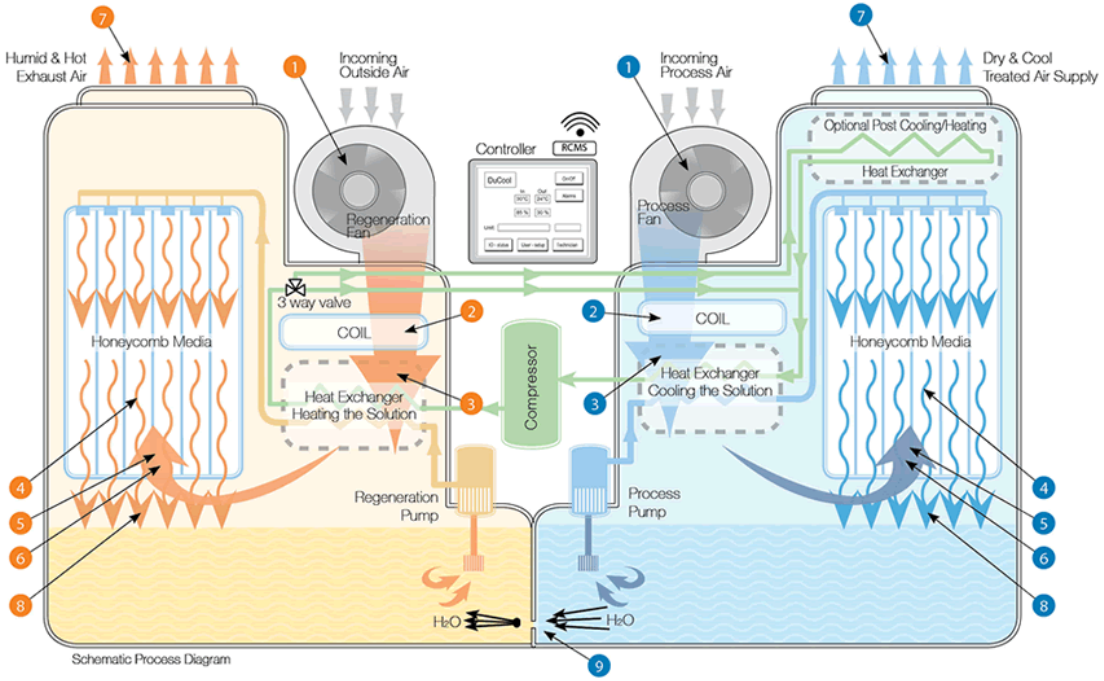
- Doesn’t address latent loads
- Requires convergence of all air streams
- More complex AHU design
- Subject to fouling, additional maintenance
- Nearly impossible retrofit



# Common Humidity Control Methods & Challenges

## Liquid Desiccant Systems

- Complex systems
- Require frequent maintenance
- Additional energy consumption – process air/pumping of desiccant
- Media needs to be replaced (5-10 years avg.)
- Crystallization of liquid systems is a concern
- High Total Cost of Ownership & Life Cycle Costs




1) Outside air enters system
2) Air heated by heat exchanger
3) Liquid desiccant heated by heat exchanger
4) Heated liquid desiccant flows on and soaks honeycomb media
5) Air passes through soaked media
6) Liquid desiccant releases transferred moisture
7) Hot & humid air released to outdoors
8) Concentrated liquid desiccant drains back into pool

1) Air (to be treated) enters system
2) Air cooled by heat exchanger
3) Liquid desiccant cooled by heat exchanger
4) Cooled liquid desiccant flows on and soaks honeycomb media
5) Air passes through soaked media
6) Liquid desiccant absorbs humidity, cleans and cools air
7) Treated air conditions room
8) Diluted liquid desiccant drains back into sump
9) Water diffuses to higher Liquid Dessicant concentration to reach equilibrium

# Technical Review Agenda

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**Overview**

- Terms and Concepts
- ASHRAE 62.1

**Common Humidity Control Methods & Challenges**

- Series cooling and reheat
  - ASHRAE 90.1
- Wheels
- Wrap around heat pipe
- Run around coils
- Plate heat exchanger
- Liquid desiccant systems

**A Better Approach:**

- What is decoupling ?
- What are the Energy savings?
- What is a Desaturation Coil?
- What is the cost of ownership?
- Case Studies

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# What is Decoupling?

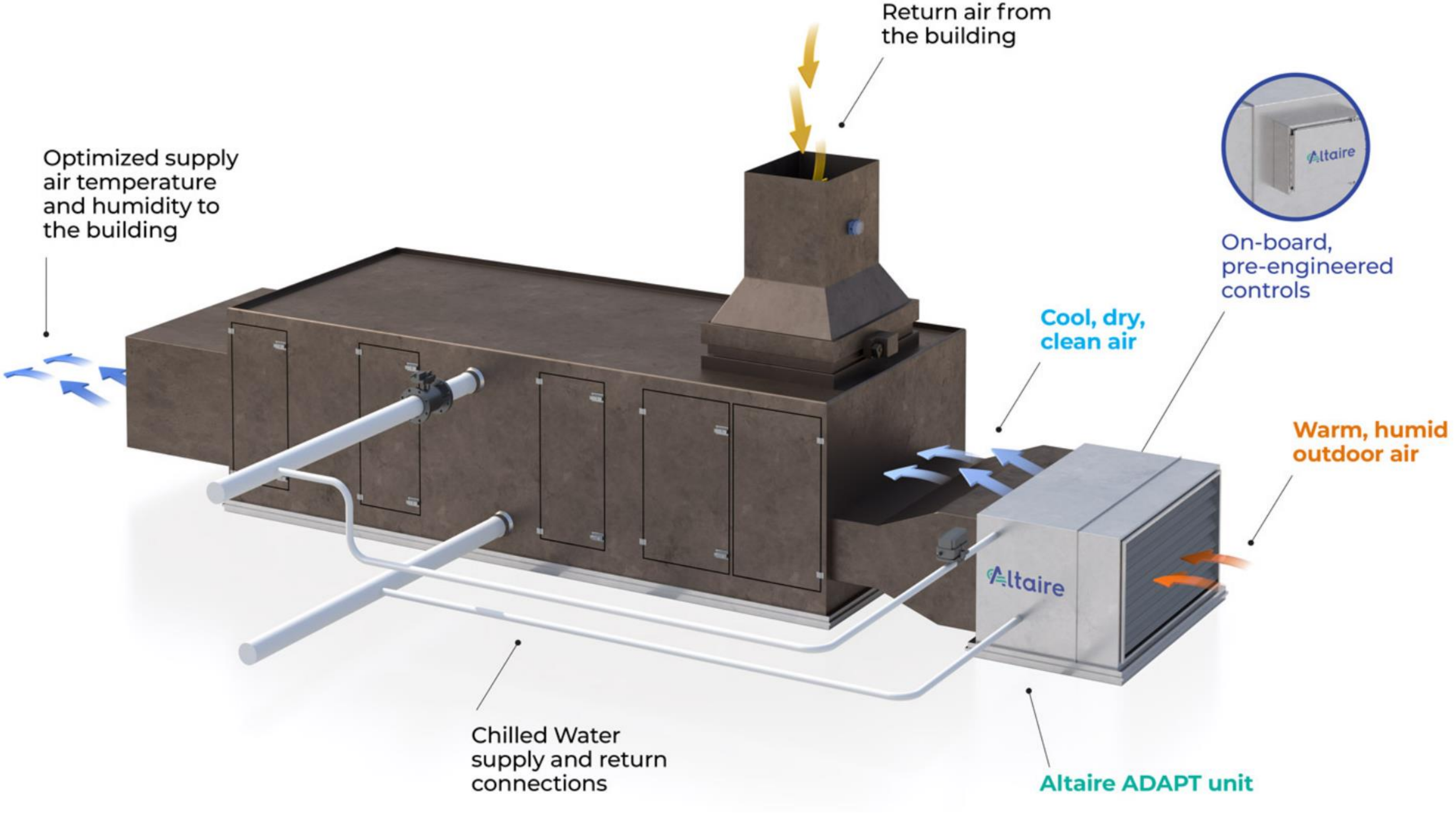
## What is Decoupling?

Cooling/dehumidification and reheat the Outside Air (OA) air stream separately before it is mixed with the Return Air (RA) Advantages

## What are the Advantages?

- OA is fully conditioned (cooled, dehumidified and reheated) before mixing with the RA resulting in minimal AHU size, Increased AHU life, total humidity control.
- Use Supply Air Temperature Resets (SATR) – will not loose control of humidity if throttled back.
- Low cost of ownership, minimal maintenance.
- Can be retrofit or new construction to any AHU(s) using chilled water.

# What is Decoupling?
# Advanced Dehumidification Airstream Pretreat Technology (ADAPT™)

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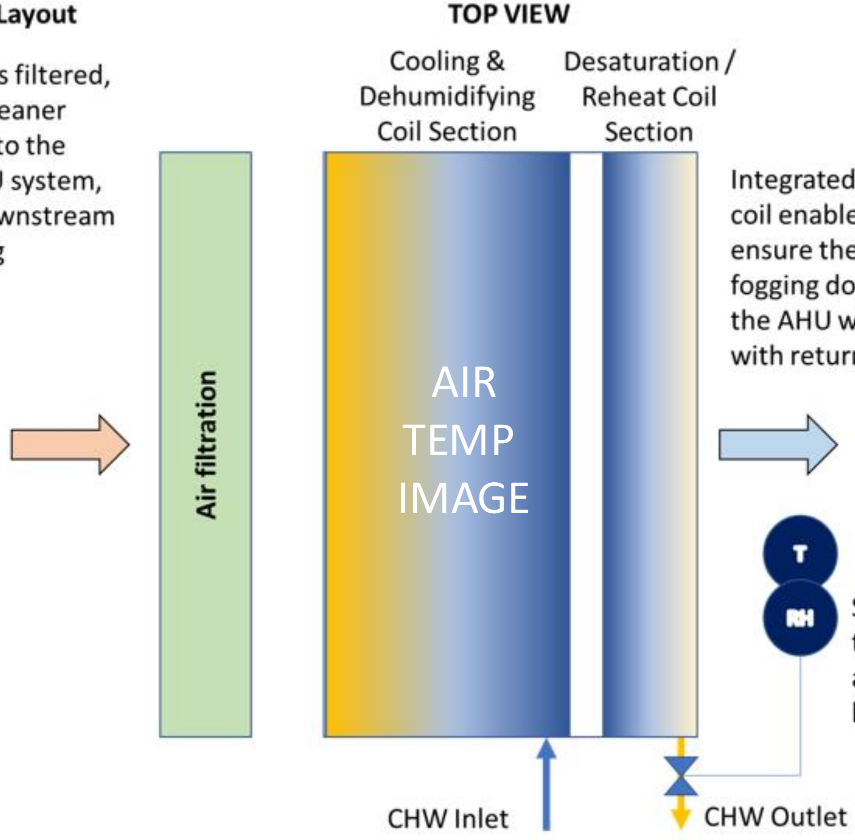
# What is a desaturation coil?
# Designed with Integrated Chilled Water Heat Recovery

**ADAPT Coil Layout**

Outside air is filtered, delivering cleaner outdoor air to the existing AHU system, reducing downstream filter loading




Integrated desaturation coil enables control to ensure there is no fogging downstream in the AHU when mixing with return air

Single valve is used to control both temp and humidity of the leaving air

ADAPT designed with low pressure drop based on unit size, coil selection, and configuration to allow the unit to be bolted onto most existing AHUs without limiting airflow

# How is ADAPT™ ASHRAE 90.1 Compliant?

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- 100% Site Recovered Energy for Reheat
  - Meets Dehumidification Exceptions:
    - <u>6.5.2.3 #1:</u> **Treat of Minimum Outdoor Air (Decoupling)**
    - <u>6.5.2.3 #5:</u> **90% of energy for Reheat is provided by site recovered energy**
  - Meets Exhaust Energy Recovery Exceptions:
    - <u>6.5.6.1.2 #7:</u> **Climate Zones 0-4 with Min SEER of 0.40 Exhaust side recovery not required**

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# How does ADAPT™ Save Energy?

- **Decoupling Latent and Sensible Loads:**
  - Eliminates the need to sub-cool and reheat entire SA air volume, only OA is subcooled for dehumidification.
- **Integrated Chilled Water Heat Recovery**
  - 100% of Energy for Reheat is recovered with ADAPT™ Integrated Heat Recovery
- **Reduction in Chilled Water Load and Flow**
  - ADAPT™ reduces chilled water consumption by up to 40%

**Enhanced Air Handler Efficiency**

  - Pretreating Outside Air (OA) separately before mixing is more efficient – lower loads
- **Reduced AHU Loads**
  - AHU does minimal to no cooling on part load days
- **Supply Air Temperature Resets**
  - Outdoor Air Pretreatment controls humidity and allows for temperature setbacks during off hours without concern of losing control of humidity
- **Winter Season Option**
  - Exhaust Energy Recovery for Multi-Season Zones

# Application Performance Examples: Peak Sensible Load Day
## Example Peak Sensible Day Requiring 56F Supply Air Temp to Meet Space Loads (SHR=0.91)

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### Typical AHU Design

**OUTDOOR AIR (20%)**
92 °F DB
72 °F DP
52% RH

**RETURN AIR (80%)**
74 °F DB
55 °F DP
52% RH

**MIXED AIR**
77.5 °F DB
59.1 °F DP
53.1% RH

COOLING COIL

**FAN SECTION**
53.7 °F DB
53.7 °F DP
100% RH

**DISCHARGE**
56 °F DB
53.7 °F DP
92% RH

### With Outdoor Air Pretreatment Device (ADAPT™)

**OUTDOOR AIR (20%)**
92 °F DB
72 °F DP
52% RH

**ALTAIRE ADAPT**
56 °F DB
48 °F DP
75% RH

**RETURN AIR (80%)**
74 °F DB
55 °F DP
52% RH

**MIXED AIR**
70.3 °F DB
53.7 °F DP
55.6% RH

COOLING COIL

**FAN SECTION**
54 °F DB
53.7 °F DP
98.9% RH

**DISCHARGE**
56 °F DB
53.7 °F DP
92% RH

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# Application Performance Examples: Part Load Day
## Example Part Load Day Requiring 62F Supply Air Temp to Meet Space Loads (SHR = 0.88)

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### Typical AHU Design

Overcooled or Requires Reheat

**OUTDOOR AIR (20%)**
77 °F DB
66 °F DP
69% RH

**RETURN AIR (80%)**
74 °F DB
55 °F DP
52% RH

**MIXED AIR**
74.6 °F DB
57.6 °F DP
55.3% RH

**COOLING COIL**

**FAN SECTION**
53.7 °F DB
53.7 °F DP
100% RH

**DISCHARGE**
56 °F DB
53.7 °F DP
92% RH

### With Outdoor Air Pretreatment Device (ADAPT™)

**OUTDOOR AIR (20%)**
77 °F DB
66 °F DP
69% RH

**ALTAIRE ADAPT**
55 °F DB
48 °F DP
77% RH

**RETURN AIR (80%)**
74 °F DB
55 °F DP
52% RH

**MIXED AIR**
70.1 °F DB
53.7 °F DP
56% °F RH

COOLING COIL

**FAN SECTION**
59.7 °F DB
53.7 °F DP
80.5% RH

**DISCHARGE**
62 °F DB
53.7 °F DP
74.2% RH

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# Example of Water Side Energy Savings Mixed Air Unit

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## System Size:

25,000 CFM Mixed Air AHU Supply Air Volume

5,000 CFM Outside Air (ADAPT™ 5000)

## Design Conditions:

Dry Bulb (DB) / Wet Bulb (WB)

- Outside Air (OA): 95/78 (DB/WB) (#1)
- Return Air (RA): 75/62.5 (DB/WB) (#2)
- Supply Air (SA): 66DB Dew Point <55
- Average of 42% less chilled water consumption with ADAPT™

## TABLE ABBREVIATION CHART (TAC):

(CWT): Chilled Water Temperature

(LWT): Leaving Water Temperature

(GPM): Gallons Per Minute

(LAT): Leaving Air Temperature

(DP): Dew Point

(DB): Dry Bulb

(WB): Dry Bulb

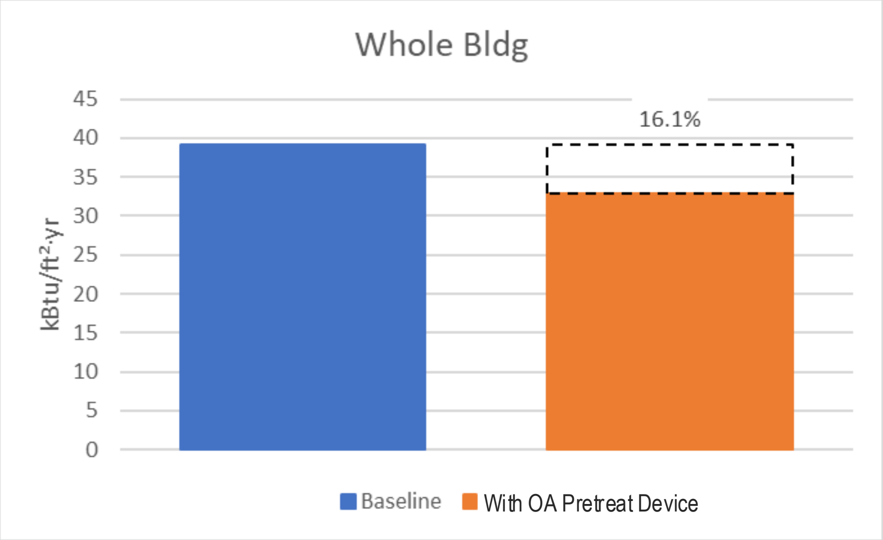
(AHU): Air Handling Unit

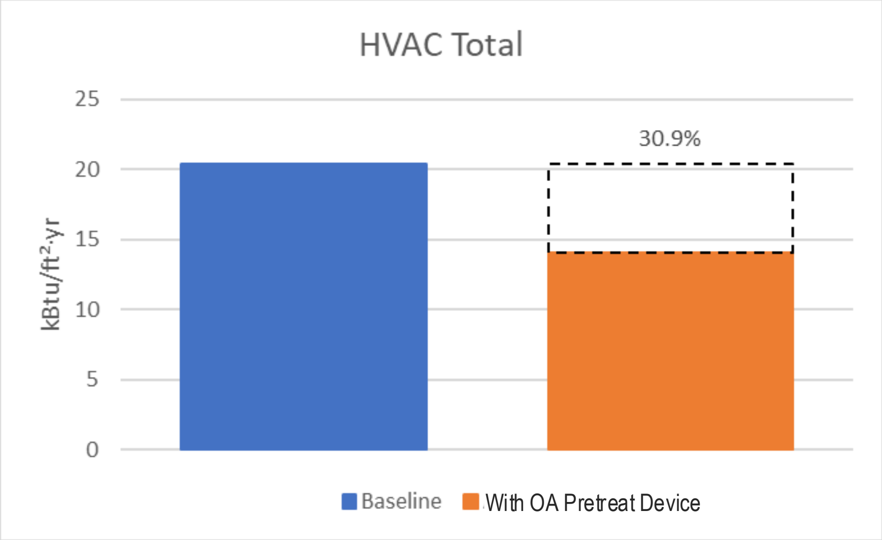
(CWC): Chiller Water Coil

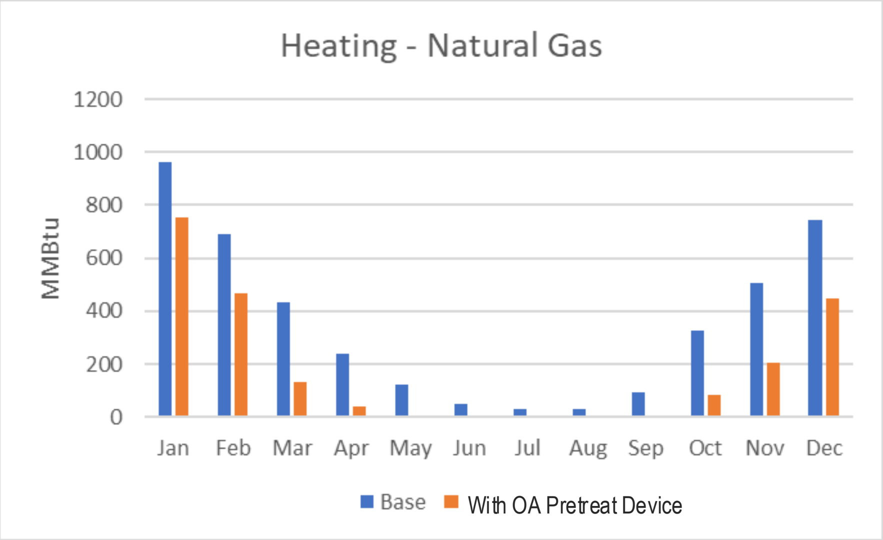
(FPI): Fins Per Inch

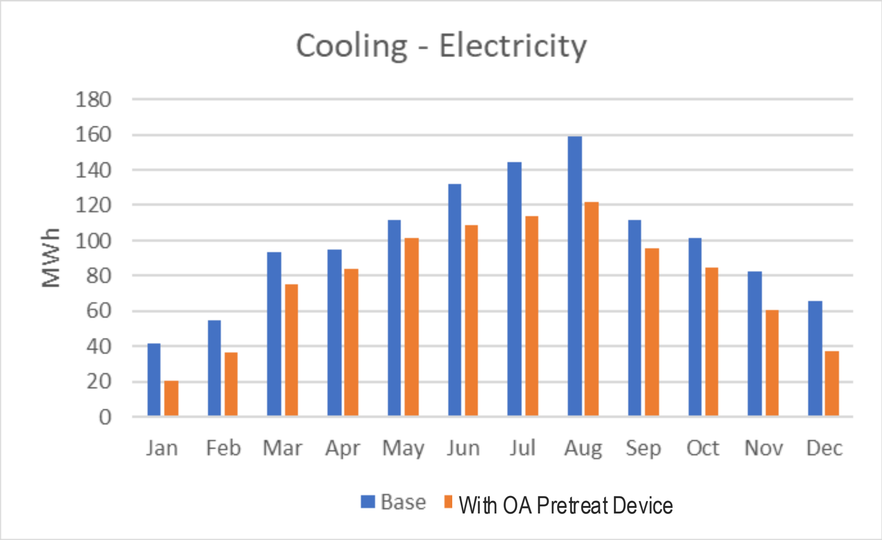
| | ADAPT™ Performance (#5 - #6) | | | | | | Mixed Air (#6-#7-#8) | | | | AHU Performance | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | With ADAPT™ | | Without ADAPT™ | | With ADAPT™ (#4-#10-#12) | | | | | | Without ADAPT™ (#3-#9-#11) | | | | |
| Chilled Water Temp. | CWC LWT (#5) | LWT (#5) | Delta (#5) | GPM (#5) | LAT DB/WB (#6) | Dew Point (#6) | Mixed Air DB/WB (#6-#7) | Dew Point (#6-#7) | Mixed Air DB/WB (#8) | Dew Point (#8) | AHU CWC LAT DB/WB (#10) (#12) | Dew Point (#10) (#12) | LWT (#4) | AHU CWC GPM (#4) | Total GPM (AHU + ADAPT) (#4) | AHU CWC Rows/FPI | AHU CWC LAT DB/WB | Dew Point | LWT | AHU CWC GPM | AHU CWC Rows/FPI |
| 44 | 73.7 | 69.3 | 25.3 | 30 | 63.9/56.5 | 51.5 | 72.8/61.3 | 54.2 | 79.0/65.6 | 58.4 | 65.6/58.4 | 53.7 | 59 | 29 | 59 | 2/7 | 57.3/55.4 | 54.1 | 59 | 103 | 4/12 |
| 46 | 73.8 | 69.6 | 23.6 | 32 | 64.1/56.6 | 51.5 | 72.8/61.3 | 54.2 | 79.0/65.6 | 58.4 | 65.7/58.6 | 54 | 61 | 27 | 59 | 2/8 | 57.2/55.6 | 54.5 | 61 | 102 | 5/11 |
| 48 | 74.2 | 70.4 | 22.4 | 34 | 63.8/56.5 | 51.6 | 72.8/61.3 | 54.2 | 79.0/65.6 | 58.4 | 65.9/58.7 | 54.1 | 63 | 26 | 60 | 2/9 | 56.5/55.5 | 54.8 | 63 | 103 | 6/12 |
| 50 | 72.8 | 69.9 | 19.9 | 38 | 62.8/56.6 | 52.5 | 72.7/61.3 | 54.3 | 79.0/65.6 | 58.4 | 65.9/58.8 | 54.2 | 65 | 25 | 63 | 2/10 | 55.4/55.0 | 54.8 | 65 | 107 | 10/10 |

# NREL Modeled ADAPT™ Energy Savings (Energy Plus)
# Sample Typical Office Building – Atlanta, GA

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# ECM Calculations and M&V

- Energy Calculation Model, using 8,760 hours of historical data from NOAA Weather Station System, estimates energy savings based on the existing system after the application of an Outdoor Air Pretreatment Device (ADAPT™)
- Field Measurement and Verification
  - CHW tons
  - CHW Plant kWh
  - Reheat: HHW, steam, electricity
  - AHU Fan kWh
- Per, Department of Energy (DoE): Adjusted baseline may be needed for buildings with Outside Air (OSA) flows below design ASHRAE® 62.1 Ventilation requirements.

## Where & How can an Outdoor Air Pretreatment Device that Decouples the Latent and Sensible Loads be Deployed?

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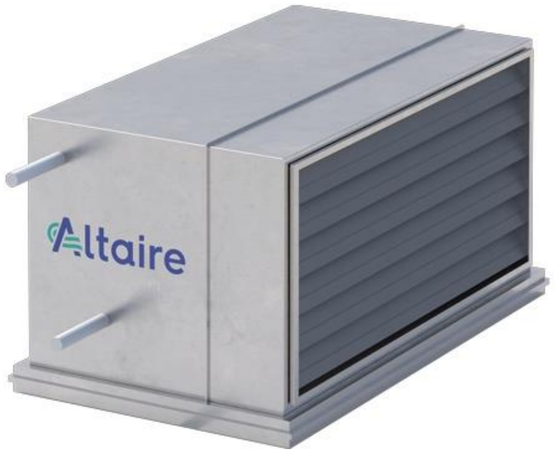
- Retrofit or New Construction
  - Reduce Downstream AHU Size and Cost
- Recirculating Air Handling Unit (AHU)
- Dedicated Outdoor Air Supply (DOAS)
- Standard or Custom sizes based upon CFM Requirement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# ADAPT™ Control System Architecture: Stand-Alone or BAS Integration



**1. Factory-Mounted, Pre-Programmed Controls**

Each ADAPT™ unit comes with factory-installed controls that are pre-programmed with optimized algorithms, eliminating the need for custom field programming

**2. Open Protocol Compatibility**

The control system leverages open protocols, including Tridium Niagara Framework® and BACnet, facilitating seamless integration with various BAS platforms

**3. Integrated Sensing and Monitoring (BAS Integration)**

Onboard sensors continuously monitor airflow and humidity levels, ensuring optimal performance and providing real-time data to the BAS for proactive management.

# ADAPT™ Standard Construction Details for Long Life

- All 5052 Aluminum Construction with 316 Stainless-Steel Hardware
- Coils are fully coated for additional corrosion protection
- Low face velocities <300 FPM low total static pressure loss <0.75” Water Column (W.C.)
- High water side Delta T – 17 to 25 degrees °F
- Wintertime Exhaust Energy Recovery Optional

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# Cost of Ownership/ Life Cycle Costs Assessment (LCCA) Example Comparison ADAPT™ vs. Wheel (ERV / Desiccant)

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## Outdoor Air Pretreatment Device (ADAPT™):

- **Lower First Cost** – Efficient Design
- **No Moving Parts** unless Fan needed for Static or DOAS version
- Unit requires only annual coil cleaning and filter changes
  - **No Belts**
  - **No Bearings**
  - **No Brush Seals**
  - **No Motors (unless Fan for Static or DOAS version)**
  - **No Media to replace**
- **Life expectancy 40+ years**

## Wheel (ERV / Desiccant):

- **High First Cost** – Complicated Design
- **Many Moving Parts**
- Requires annual coil cleaning and filter changes Plus Maintenance & **Replacement**:
  - **Belts**
  - **Bearings**
  - **Brush seals**
  - **Motors or**
  - **Media**
- Typical Wheel Life expectancy 10 Years
- Life Cycle Cost Requires Wheel Replace 4-8 Times

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# Case Studies

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SDVOSB

NAVFAC
Naval Facilities Engineering Systems Command

High Impact Technology Catalyst
Buildings


Naval Support Activity (NSA)
Orlando, FL

VA | U.S. Department of Veterans Affairs

Northampton VA Medical Center
Leeds, MA

GSA | GPG Green Proving Ground Program

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

GSA Federal Courthouse
Lufkin, TX

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# Initial Problem Statement/Facility Situation for NSA Orlando NAVFAC SE

- The facility was having Humidity Control Problems.
- The facility was experiencing Ventilation Problems.
  - Original Building Design -17,000 CFM Outside Air
  - Actual Outside Air measured - 4,000 CFM.
- The facility was not compliant to ASHRAE 62.1 for Ventilation.
- The facility was in need of HVAC controls upgrades to monitor, track, and improve Energy Performance.

- After Outdoor Air Pretreatment Device installation – Outside air – 34,000 CFM

# Roof Top Installation
# (7) Outdoor Air Pretreatment (ADAPT™) Units
# (3) 10,000CFM, (3) 2,500CFM (1) 5,000CFM

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## U.S. Navy – Naval Support Activity (NSA) Orlando, FL
## National Renewable Energy Laboratory (NREL) – Instrumentation & M&V


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# Project Delivery Process NAVFAC SE:

Design-Build Approach was Selected

<u>Utilization of Best Practices from:</u>
Design Build Institute of America (DBIA)

**“Design with System Commissioning in Mind”**

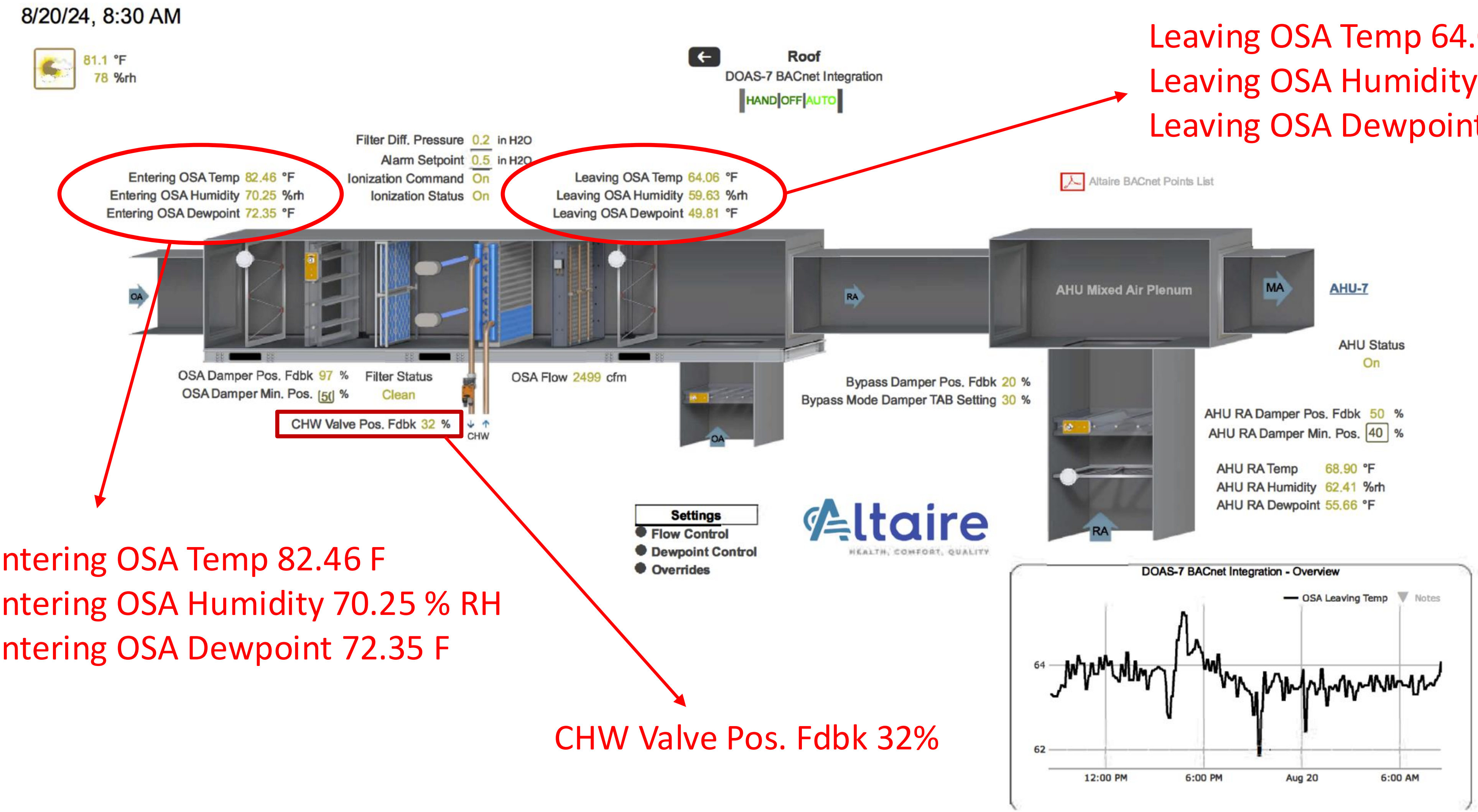
# Operations & Maintenance (O&M) System Performance – NSA Orlando

NAVFAC Naval Facilities Engineering Systems Command

AEG ACADEMY ENERGY GROUP

SDVOSB

Leaving OSA Temp 64.06 F
Leaving OSA Humidity 59.63 % RH
Leaving OSA Dewpoint 49.81 F




Entering OSA Temp 82.46 F
Entering OSA Humidity 70.25 % RH
Entering OSA Dewpoint 72.35 F

CHW Valve Pos. Fdbk 32%

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# PROBLEM STATEMENT



## Initial Problem Statement/Facility Situation for Western MA VAMC

- A Sterile Process Department (SPD) was having Humidity Control Problems.
  - SPDs have a nominal requirement of 72F with a RH of 20-60%.
- Additional spaces in the building required conditioned outside air.
- The existing DOAS providing the outside air was determined as root cause of humidity control problems and was determined to need replacement.

# Dedicated Outside Air System (DOAS) 10,000 CFM (ADAPT™)

U.S. Department of Veterans Affairs - Northampton


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U.S. General Services Administration

# Initial Problem Statement/Facility Situation for East TX Federal Courthouse

- Courthouse had humidity control problems and insufficient outside air ventilation
  - Original Building Design – Outside Air 1,910 CFM
  - Actual Outside Air Measured – 1,364 CFM
- Root cause identified equipment deficiencies and building operation as contributing factors.
- Space constraints required modular design (basement installation).
- After Outdoor Air Pretreatment Device (ADAPT™): Outside air – 2,100 CFM

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U.S. General Services Administration

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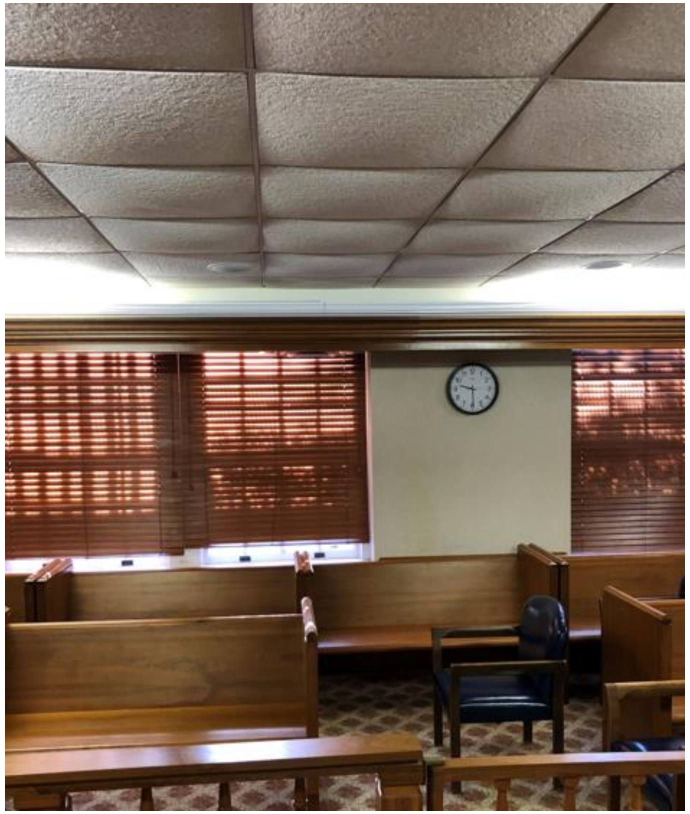
# GSA Region 7 – Ward R. Burke Federal Courthouse - Lufkin, TX




**2,500 CFM ADAPT™**

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# CONCLUSIONS / OBSERVATIONS

1. Industry & ASHRAE®: suggest decoupling sensible & latent loads

2. Owners: are changing their requirements and adopting best practices

3. Engineers: are learning new design methods

4. Contractors: are learning how to estimate and build the new designs

**Let's Collaborate to Deliver Solutions for Humidity Control Problems**

**Is it an Unreasonable Time to Adapt?**

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# Contact Us

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## Thank you for participating!

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# APPENDIX

# QUESTIONS:
# Example of Water Side Energy Savings Mixed Air Unit

1. Ambient outside air conditions – in summer (likely 95 DB / 78 WB)
2. RTU Return air conditions (likely 78 db / 62 wb for a military application – or much cooler for a hospital)
3. RTU cooling coil Chilled water flow rate, & entering and leaving water temperatures – **WITHOUT THE ADAPT™ unit**
4. RTU cooling coil Chilled water flow rate, & entering and leaving water temperatures – **WITH THE ADAPT™ unit.**
5. **ADAPT™** unit chilled water flow rate & entering and leaving water temperatures.
6. **ADAPT™** unit leaving air conditions / RTU entering air conditions
7. Mixed Air conditions (outside air from the **ADAPT™** unit has mixed with the return air from the building).
8. Mixed Air conditions for RTU without **ADAPT™** unit (untreated outside air has mixed with return air from the building)
9. RTU coil leaving air conditions for unit **<u>without</u> ADAPT™** unit
10. RTU coil leaving air conditions for unit **<u>with</u> ADAPT™** unit
11. Unit leaving air conditions for unit **<u>without</u> ADAPT™** unit
12. Unit leaving air conditions for unit **<u>with</u> ADAPT™** unit

| | ADAPT™ Performance (#5 - #6) | | | | | | Mixed Air (#6-#7-#8) | | | | AHU Performance | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | With ADAPT™ | | Without ADAPT™ | | With ADAPT™ (#4-#10-#12) | | | | | | Without ADAPT™ (#3-#9-#11) | | | | |
| Chilled Water Temp. | CWC LWT (#5) | LWT (#5) | Delta (#5) | GPM (#5) | LAT DB/WB (#6) | Dew Point (#6) | Mixed Air DB/WB (#6-#7) | Dew Point (#6-#7) | Mixed Air DB/WB (#8) | Dew Point (#8) | AHU CWC LAT DB/WB (#10) (#12) | Dew Point (#10) (#12) | LWT (#4) | AHU CWC GPM (#4) | Total GPM (AHU + ADAPT) (#4) | AHU CWC Rows/FPI | AHU CWC LAT DB/WB | Dew Point | LWT | AHU CWC GPM | AHU CWC Rows/FPI |
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