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Dedicated Outdoor Air Systems

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What is a Dedicated Outdoor Air System (DOAS)?

- An HVAC subsystem specifically designed to . . .
  - Filter
  - Heat
  - Cool
  - Dehumidify
  - Deliver

  . . . required quantities of outdoor air to a building
  - while *decoupling sensible and latent cooling*

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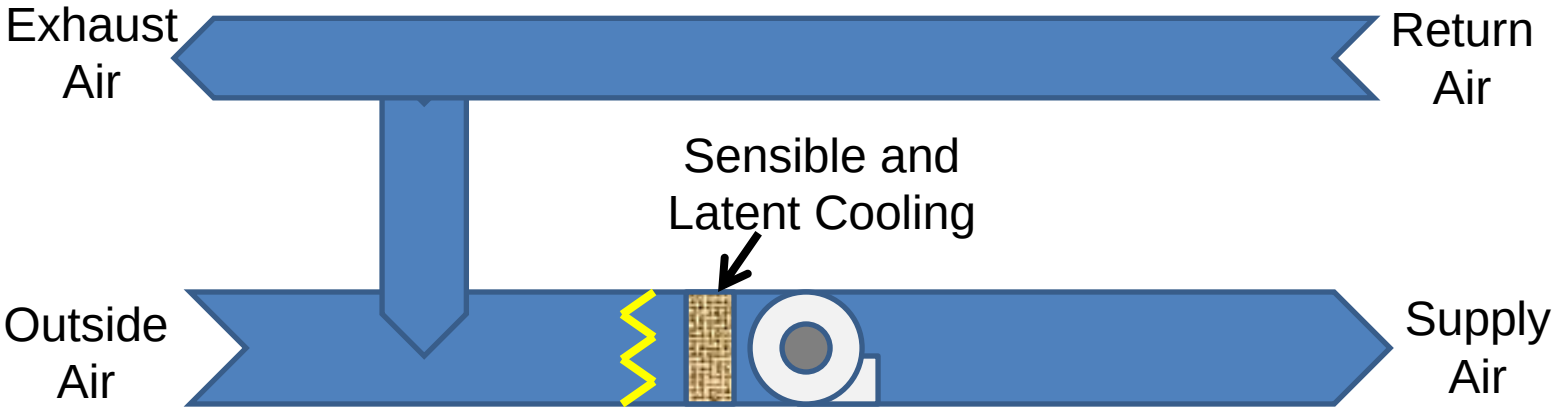
Typical All-Air HVAC System



- Optimized to control space Dry Bulb Temperature (DBT), however,
  - Marginal control of space Dew Point Temperature (DPT)
  - Marginal delivery of proper ventilation air quantities
    - (especially in VAV systems)
  - "Throws away" energy in exhaust air stream

The Army's Interest in DOAS

- Increasing emphasis on energy conservation
  - Executive Order 13514 – Federal Leadership in Environmental, Energy,and Economic Performance
  - Energy Policy Act of 2005 (EPAct 2005)
  - Energy Independence and Security Act of 2007 (EISA 2007)
- Ventilation for Acceptable Indoor Air Quality
  - ASHRAE Standard 62-2007
- Greater interest in sustainable systems
- Tighter Army budgets

The Army's Interest in DOAS

Wounded Vets Assaulted by Mold—Again

Soldiers ordered not to talk about conditions at XXXXXXXX stand-in

Aug 18, 2008 11:50 AM CDT

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Age, mold assail military barracks

Updated 5/9/2008 8:18 AM | Comments 249 | Recommend 46 | E-mail | Save | Print | Reprints & Permissions | RSS

Enlarge — By Ed Frawley via AP

A soldier from Charlie Company perches on a sink as he tries to unclog a drain in a flooded bathroom

By Alan Gomez, USA TODAY

At Fort [redacted] soldiers struggle in the hot [redacted] summers to keep mold from taking over their showers. In the cold winters of [redacted] Fort [redacted]s heating system in the 60-year-old wooden barracks can go from boiling to tepid.

In [redacted] in southern [redacted] officials closed down a Korean War-era building this year because it was "falling apart."

Soldiers returning from Iraq and Afghanistan can find themselves living in less-than-ideal conditions as base commanders work to keep up with repairs to sometimes-century-old buildings.

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Soldiers: [redacted] barracks infested by mold

By Gregg Zoroya - USA Today
Posted : Monday Aug 18, 2008 13:57:21 EDT

[redacted] — Mold infests the barracks that were set up here a year ago for wounded soldiers after poor conditions at Walter Reed Army Medical Center triggered a systemwide overhaul, soldiers say.

Twenty soldiers, who spoke to USA Today early last week, say their complaints about mold and other problems went unheeded for months. They also said they had been ordered not speak about the conditions at [redacted]

Officers at the Army base last week ordered that ventilation ducts in two barracks be replaced and soldiers be surveyed, anonymously if they

USA TODAY

Mold can be found around some ducts in the barracks of the Wounded Transitional Unit at [redacted] Some soldiers say they have been affected by air in their rooms.

« Previous | 1 of 1 | Next »

The common denominator –

Uncontrolled Moisture

The Army's Interest in DOAS

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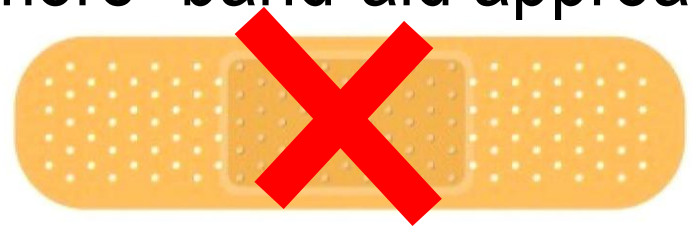
The Army's Response

- Improved building envelopes
  - Reduced air leakage
  - Better envelope vapor barriers
  - Enhanced thermal performance
- Aim for "Net Zero" installations
  - Drive facility energy requirements to minimum practical
- Seek permanent solutions in renovating existing buildings (no more "band-aid approaches")



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The Army's Response

- Instituted maximum envelope air leakage and envelope pressure testing requirements
  - <= 0.25 CFM / ft^2 @ 75 Pa
- More stringent thermal insulation requirements established for 8 standard facility types
- **<u>Serious effort to control moisture levels within facilities</u>**

Improved Envelopes Raise New Issues

- As building interiors are decoupled from exterior environment, active control of the interior environment becomes more critical
  - Ventilation for Acceptable Indoor Air Quality
    - ASHRAE Standard 62-2007
  - Makeup air to maintain building pressurization
  - Moisture control becomes more critical
  - Heat recovery from exhaust air streams

The Army's Interest in DOAS

Typical 1970's Era Volar Barracks

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DOAS Demonstration, Fort Stewart, GA

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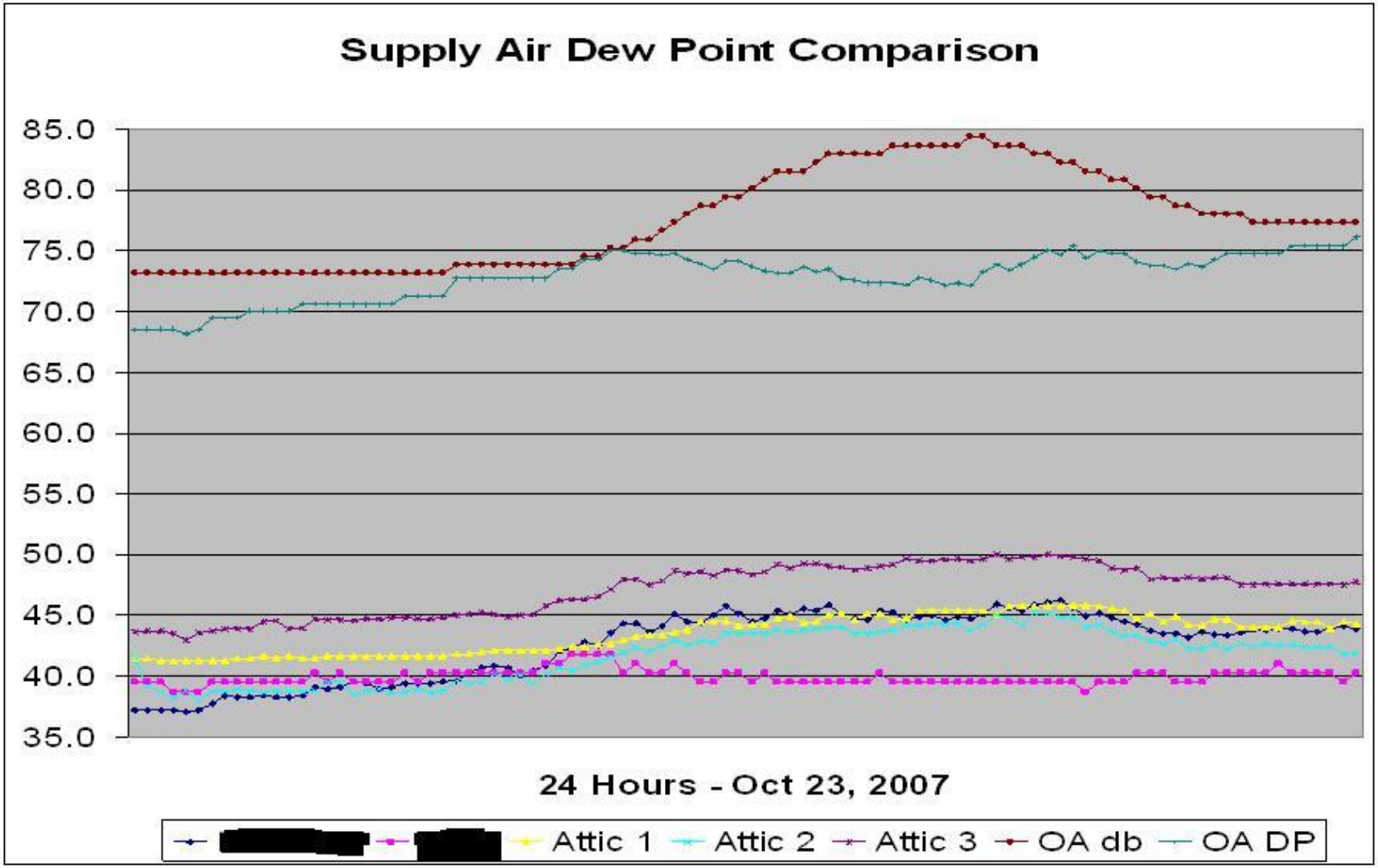
DOAS Demonstration, Fort Stewart, GA



The Army's Interest in DOAS

Volar Barracks Renovation, Fort Polk, LA

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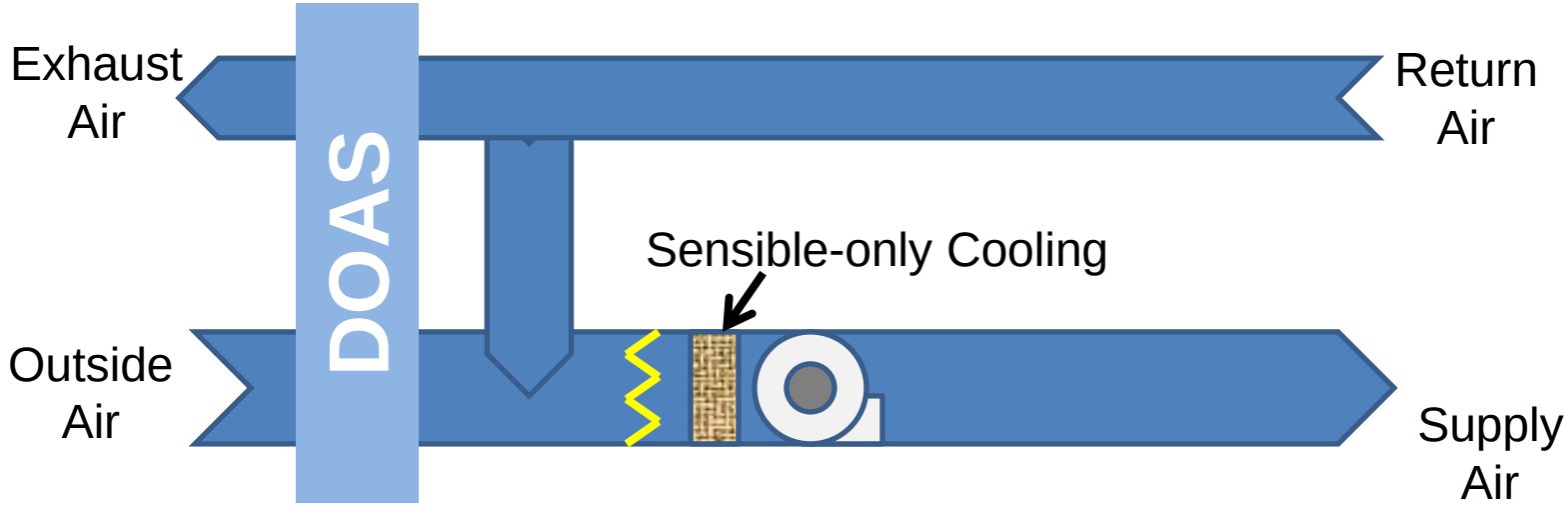
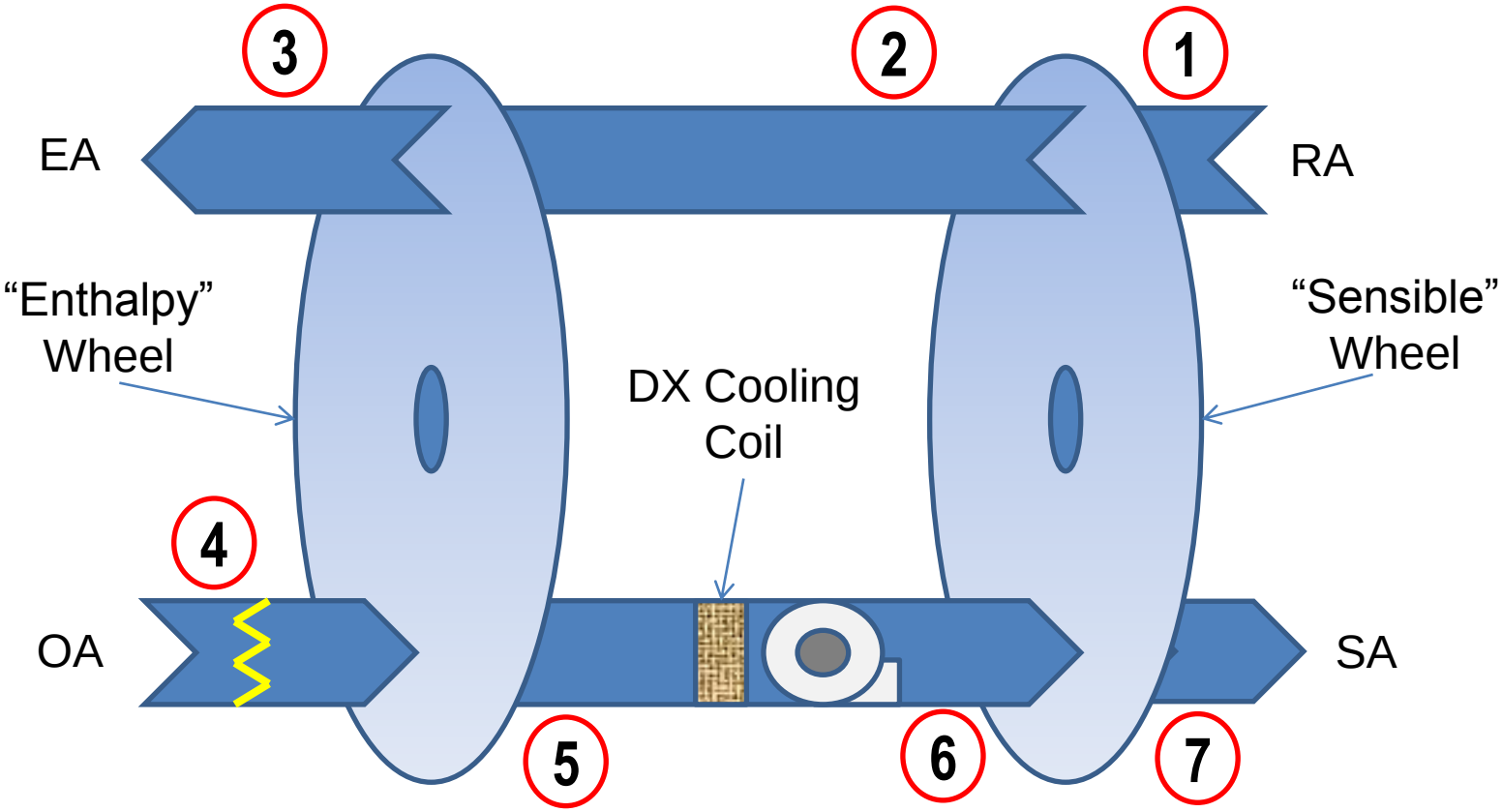
All-Air HVAC System with DOAS



- Optimized to control space *DBT and DPT*
  - Good control of space humidity conditions
  - Accurate delivery of proper ventilation air quantities
  - Energy recovered from exhaust air stream

Double-Wheel DOAS System



NOTE: There are numerous other types and configurations of DOAS systems

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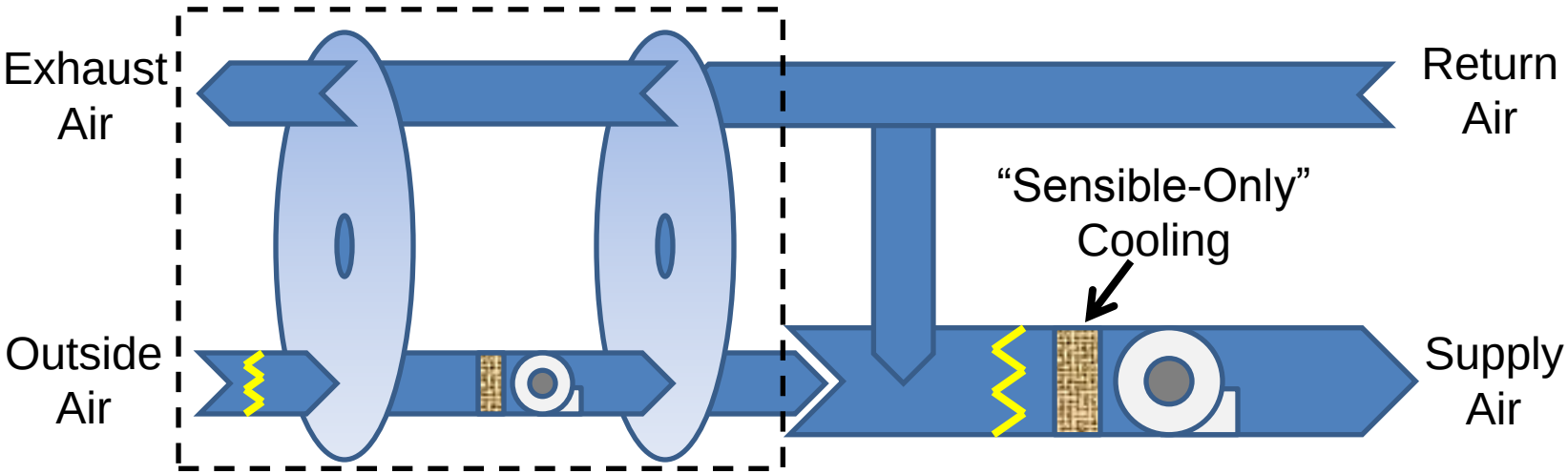
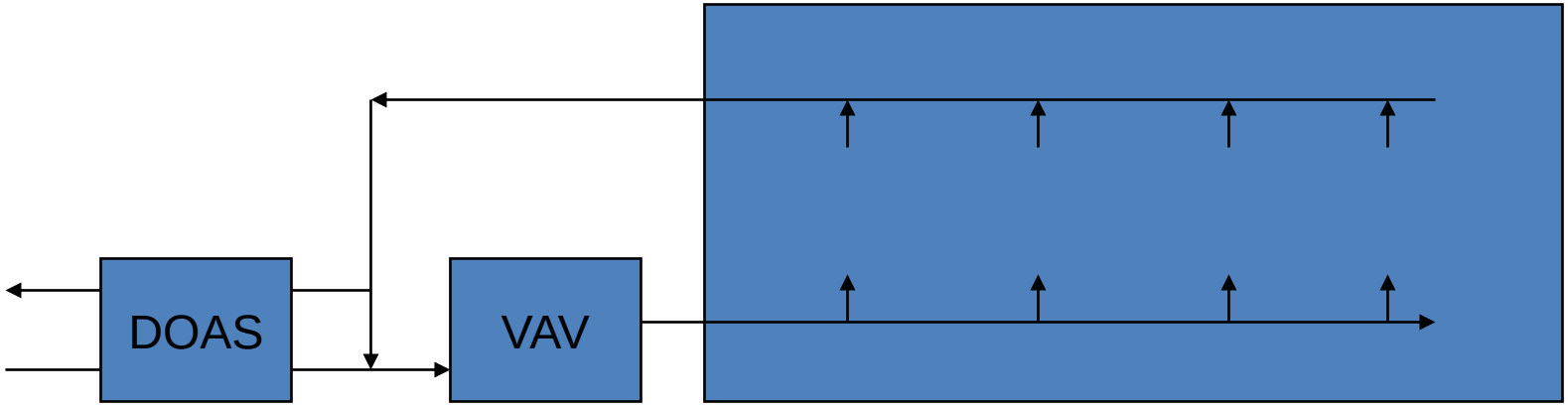
“All-Air” HVAC System with DOAS

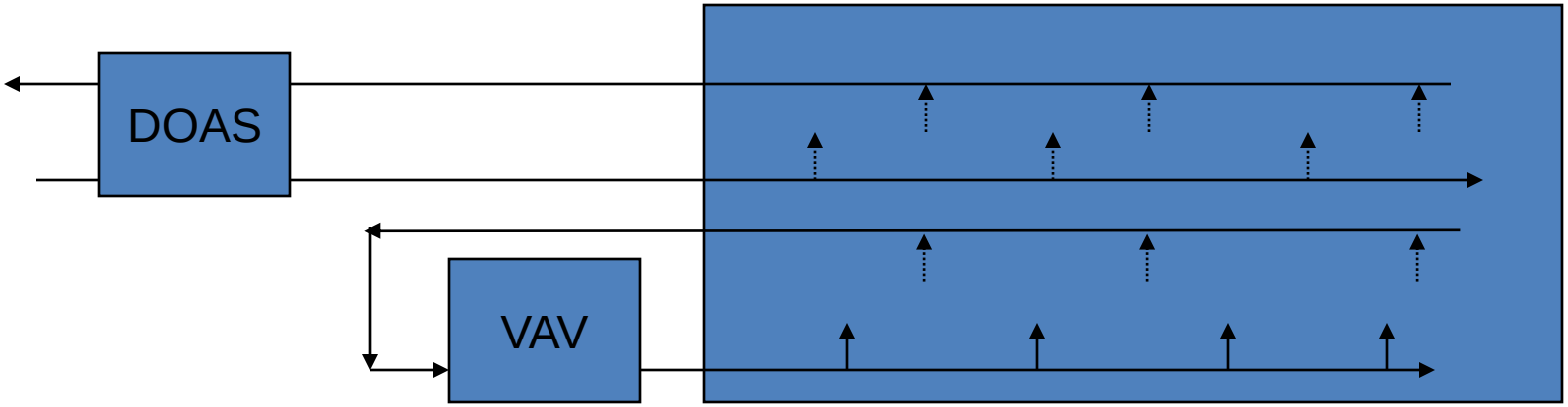


- DOAS optimized to deliver dry ventilation air
- HVAC AHU provides “sensible-only” cooling
- Delivery of ventilation air quantities well controlled
- Energy recovered from exhaust air stream

Series or Parallel Arrangement?



DOAS-VAV Series Arrangement

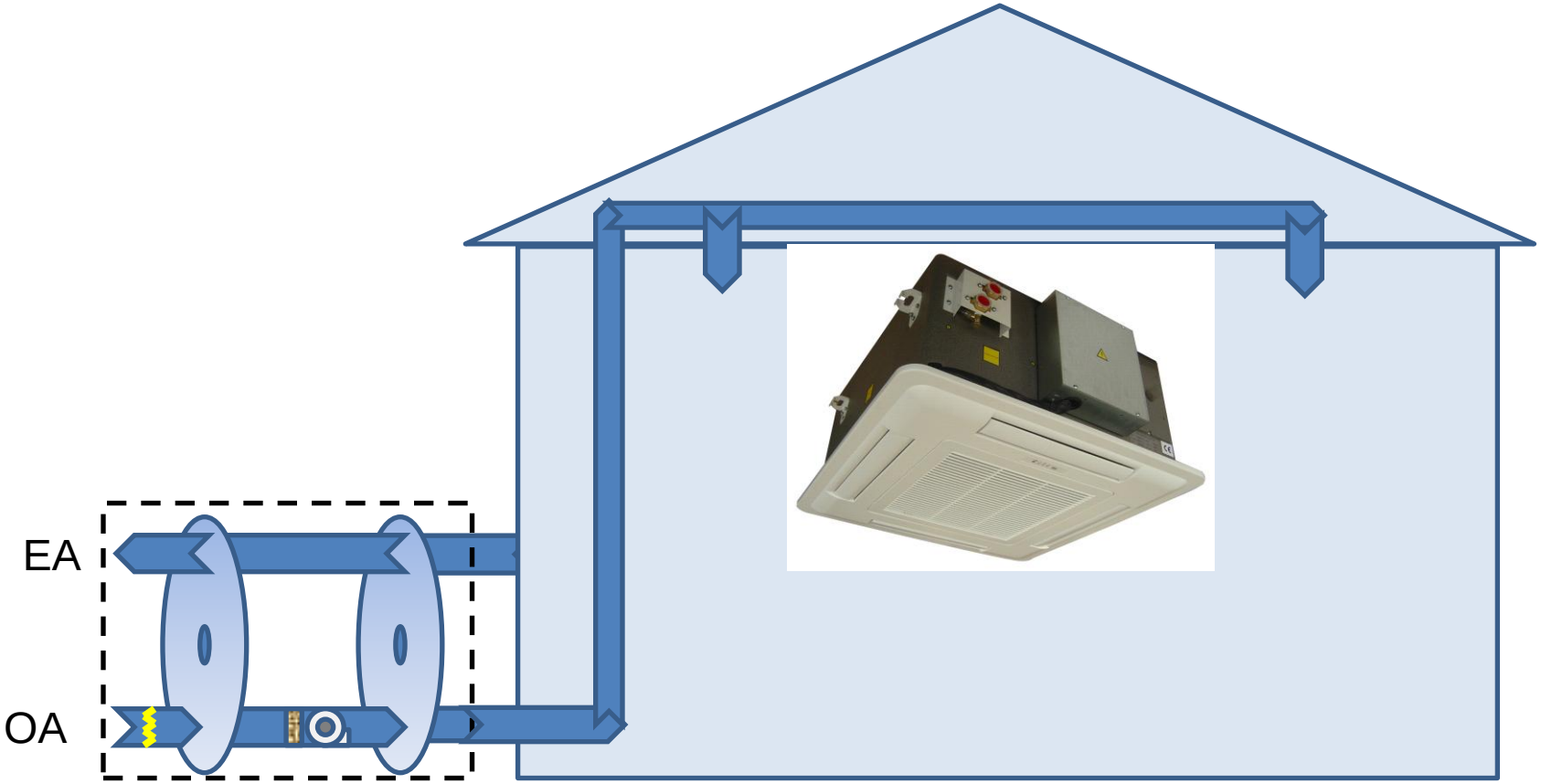


DOAS-VAV Parallel Arrangement

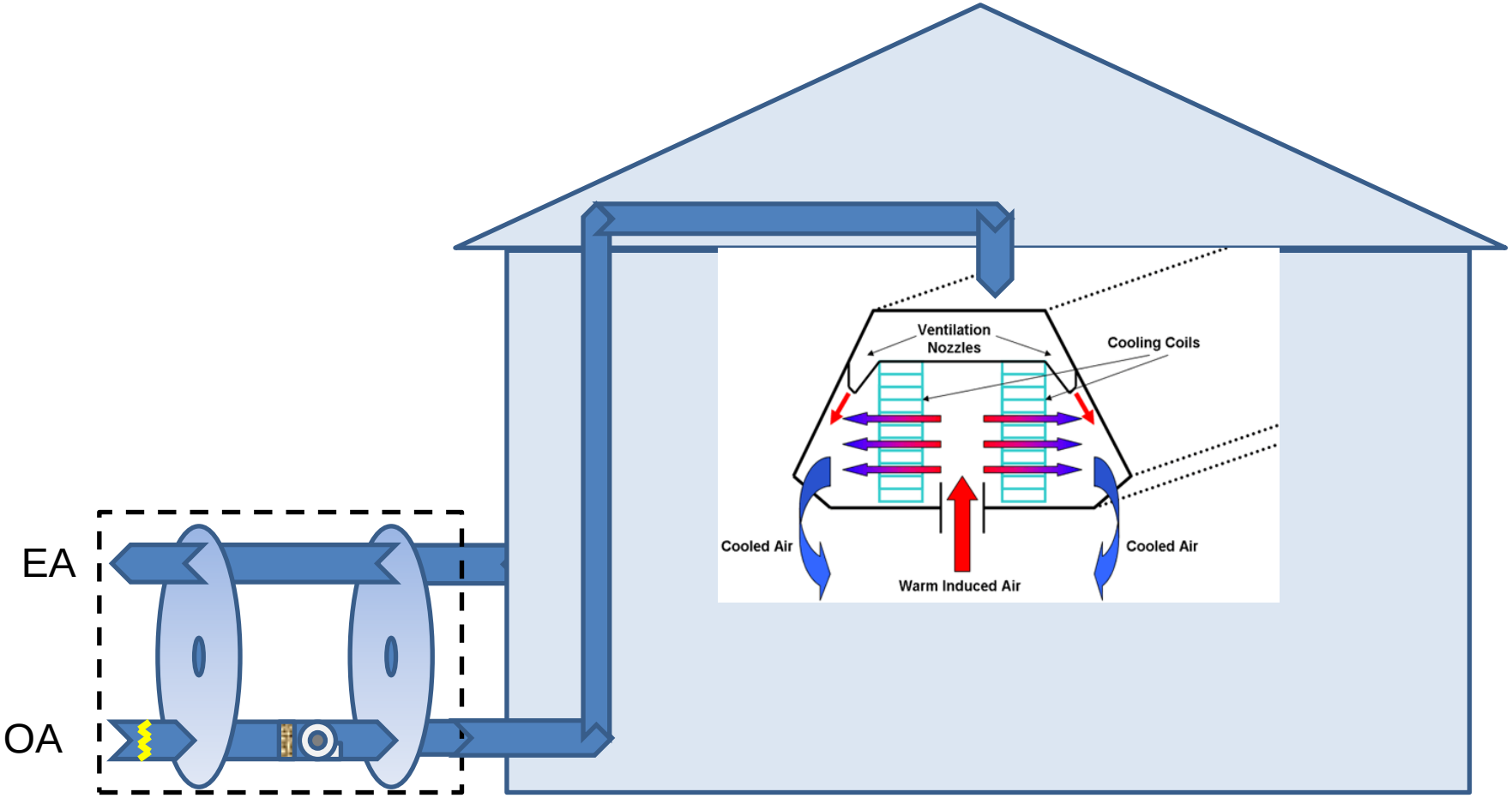
DOAS Systems Enable Other Sensible Cooling Options

- Opportunities:
  - Reduced HVAC ductwork requirements
  - Reduced energy consumption
    - Moving energy with hydronics more efficient than air
  - Simplified HVAC controls
  - Simplified zoning
  - Chilled water piping cheaper to install than ductwork
  - Reduced above-ceiling height requirements
    - Can be very advantageous, especially on retrofits

DOAS + Fan Coil Units



DOAS + Chilled Beams



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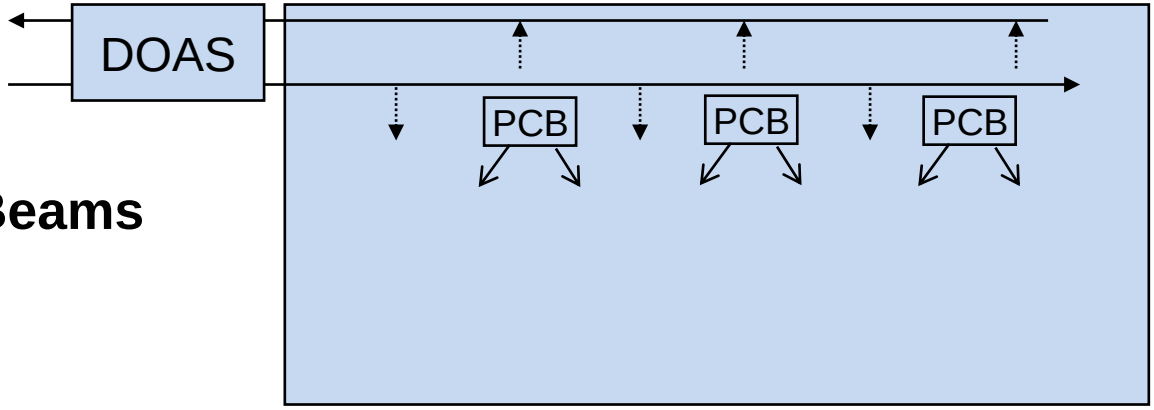
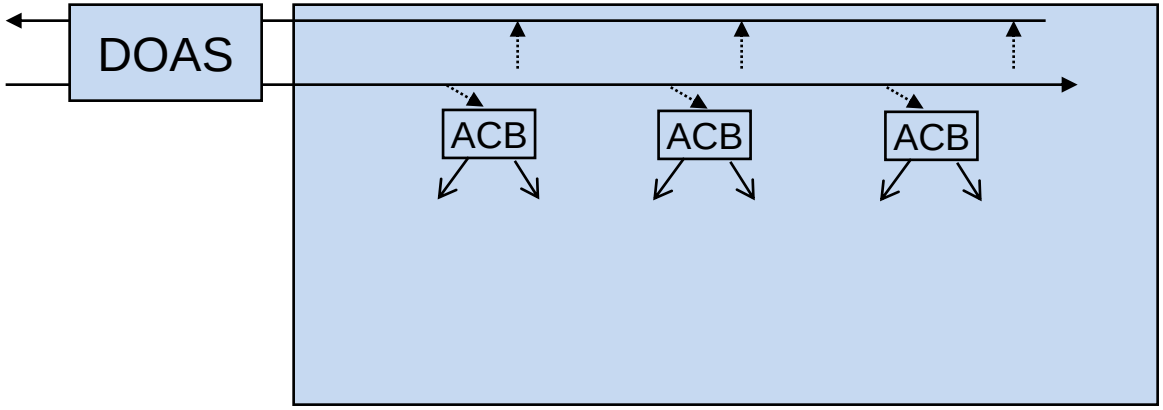
Chilled Beam Cooling System

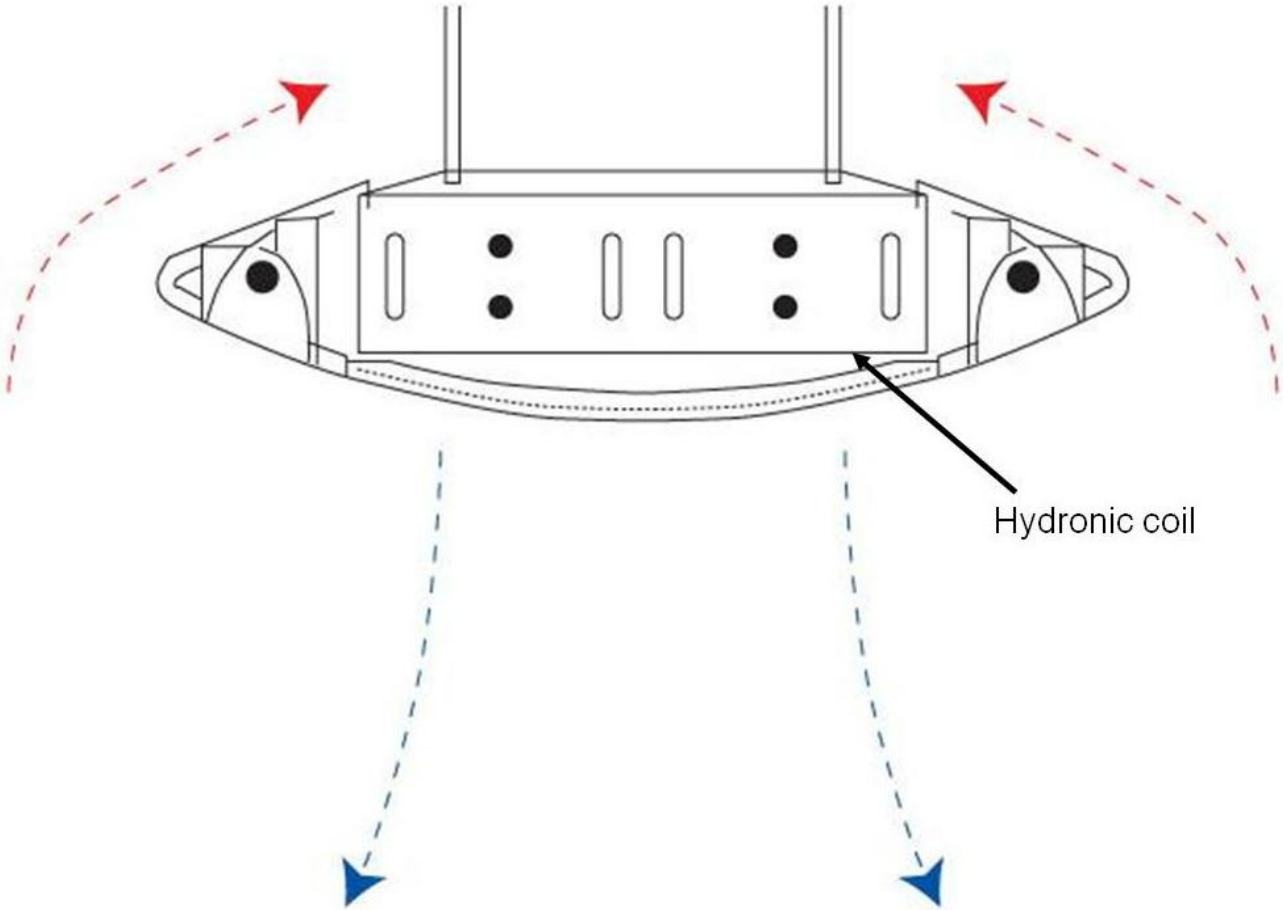


Passive Chilled Beams

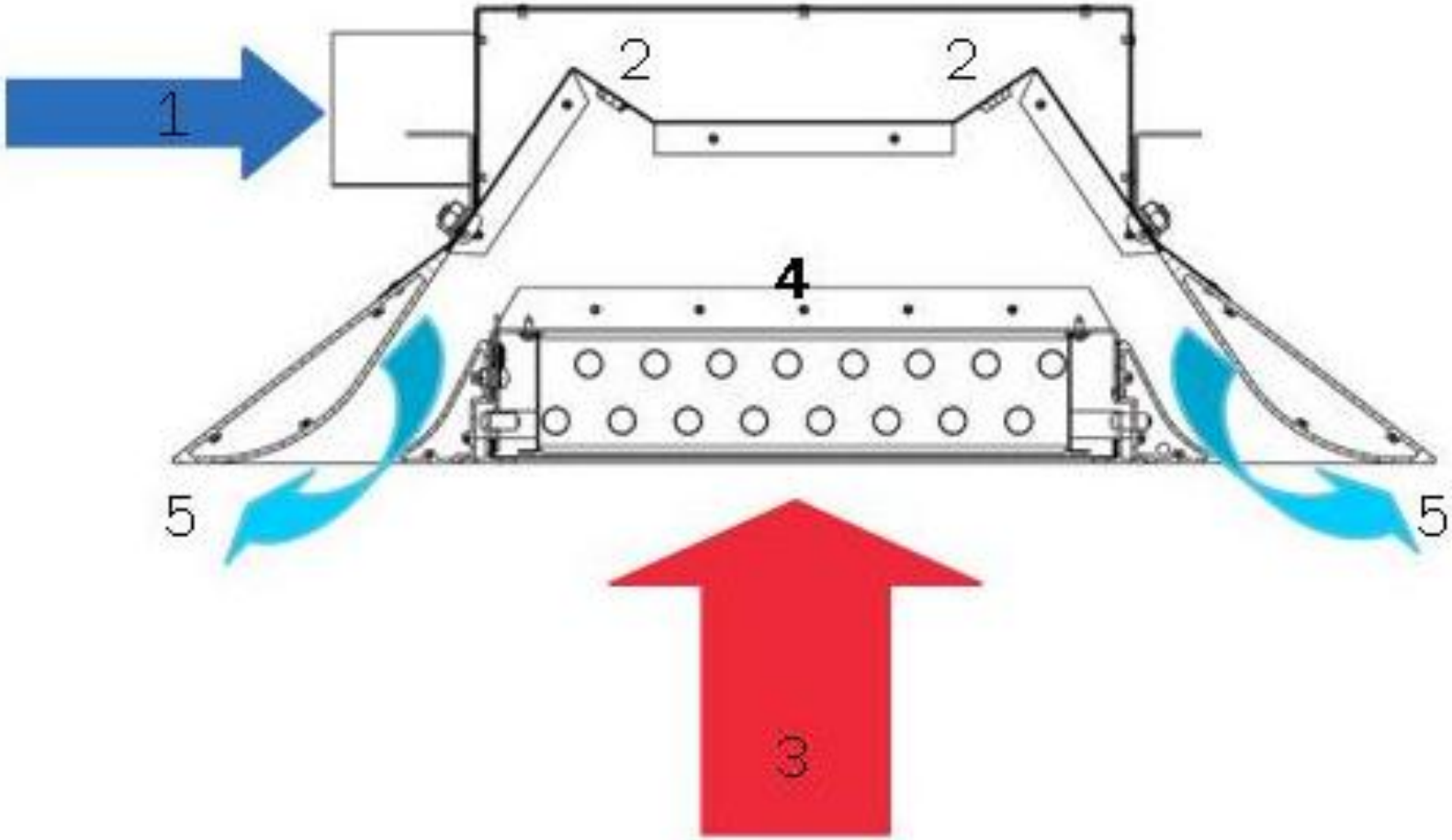


Active Chilled Beams

Passive Chilled Beam System

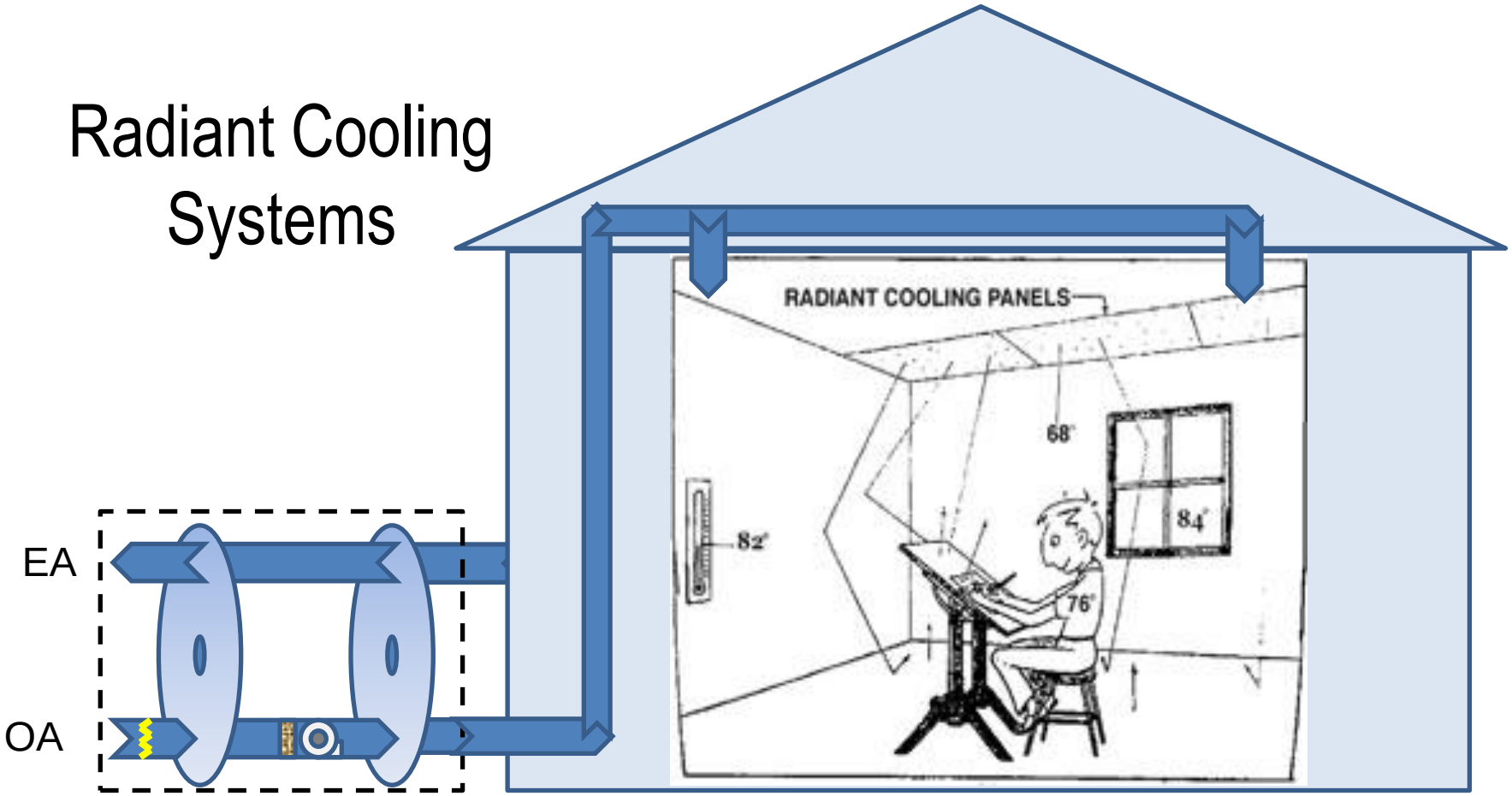


Active Chilled Beam System



DOAS + Radiant Systems

Radiant Cooling Systems



Radiant Heating/Cooling System

Two-side cooling mat detail with water feeding (or water return)

~ 25 Btu/sq.ft. capacity

Installation of capillary radiant heating / cooling system on pre-finished surface

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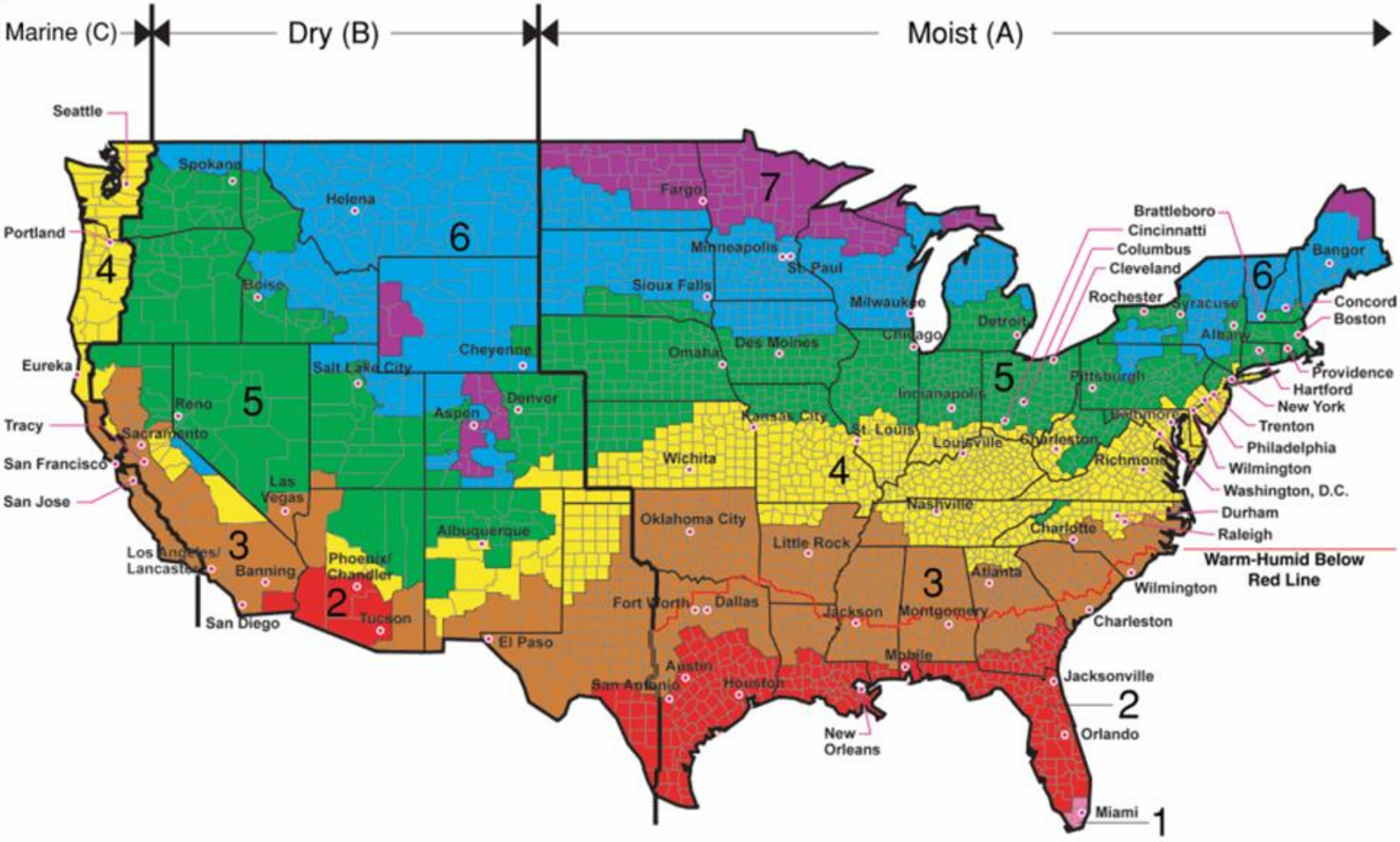
Energy Impacts of DOAS Systems

1. Energy recovered from exhaust air stream
2. Avoiding “all-air” HVAC systems yields significant fan power reductions
3. Moving energy through piping much more efficient than through ducts
4. More occupants perceive comfort at warmer temperatures when room RH is lower

Where is DOAS Applicable?



All of Alaska in Zone 7 except for the following Boroughs in Zone 8: Bethel, Dellingham, Fairbanks, N. Star, Nome North Slope, Northwest Arctic, Southeast Fairbanks, Wade Hampton, and Yukon-Koyukuk

Zone 1 includes: Hawaii, Guam, Puerto Rico, and the Virgin Islands

DOAS FAQs

1. Can you recover energy from toilet exhaust?
2. Can DOAS systems recover heat from laboratory exhausts
3. If DOAS is combined with a radiant cooling system, how do you avoid condensation problems?
4. . . . .

Great References

1. DOAS & Desiccants, Stanley A. Mumma, Engineered Systems, Aug 2007.
2. http://doas.psu.edu/

   Dr. Stanley Mumma, Prof Emeritus, Penn State U.