SEMINAR 43 – IMPROVED INDOOR AIR QUALITY AND REDUCED MAINTENANCE UTILIZING CHILLED BEAM SYSTEMS

CHILLED BEAM IMPACT ON PRIMARY AIR SYSTEMS TO IMPROVE INDOOR AIR QUALITY

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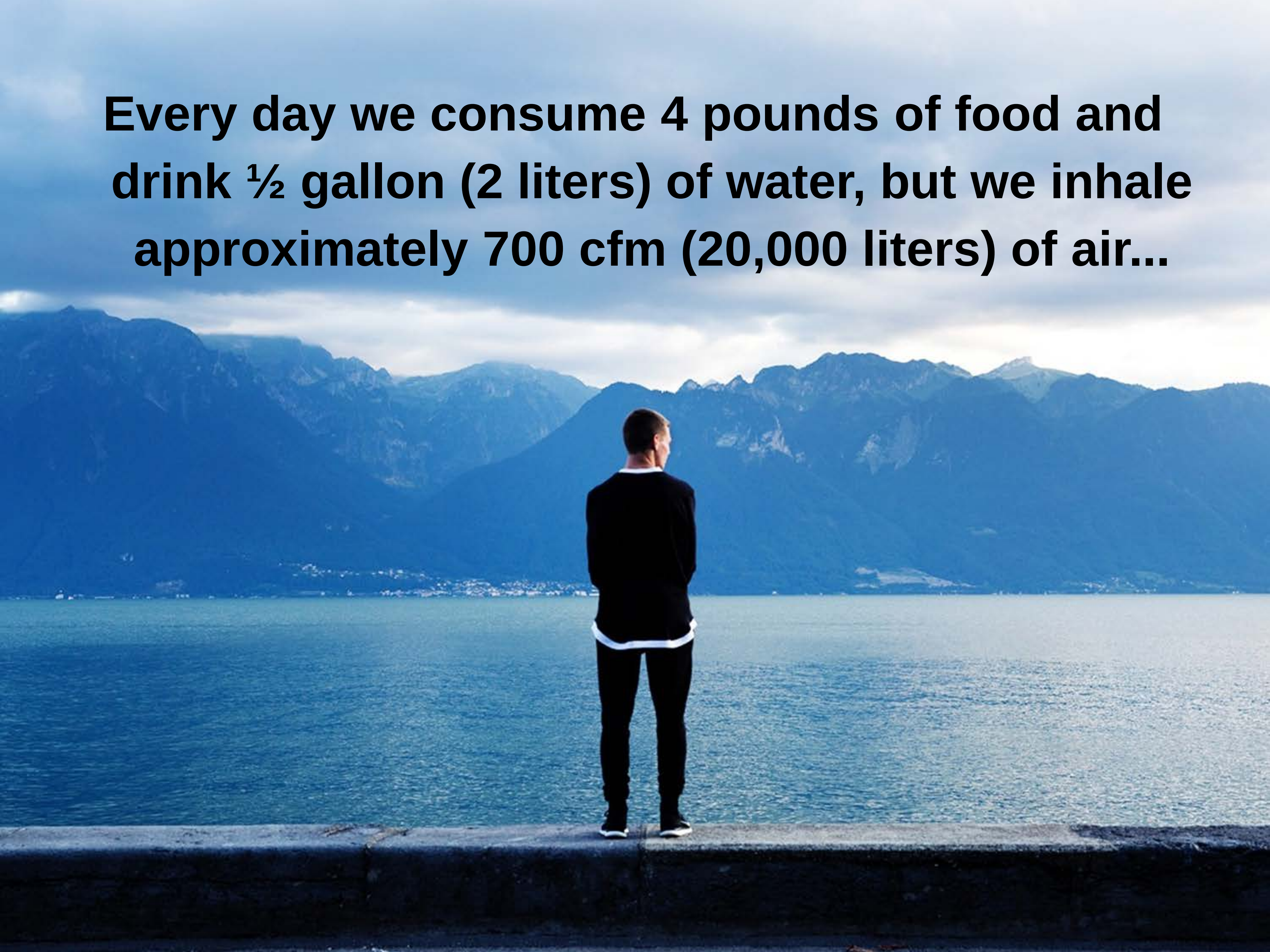
Learning Objectives

1. Establish steps for proper primary air design for chilled beams including considerations for ASHRAE 62
2. Describe application impact to maximize indoor air quality in four room types: open office, closed office, classroom and laboratory
3. Explain Maintenance and control requirements for proper operation to maximize upkeep
4. Describe the process to balance chilled beam systems with regards to air and water


Every day we consume 4 pounds of food and drink ½ gallon (2 liters) of water, but we inhale approximately 700 cfm (20,000 liters) of air...

Types of Chilled Beams

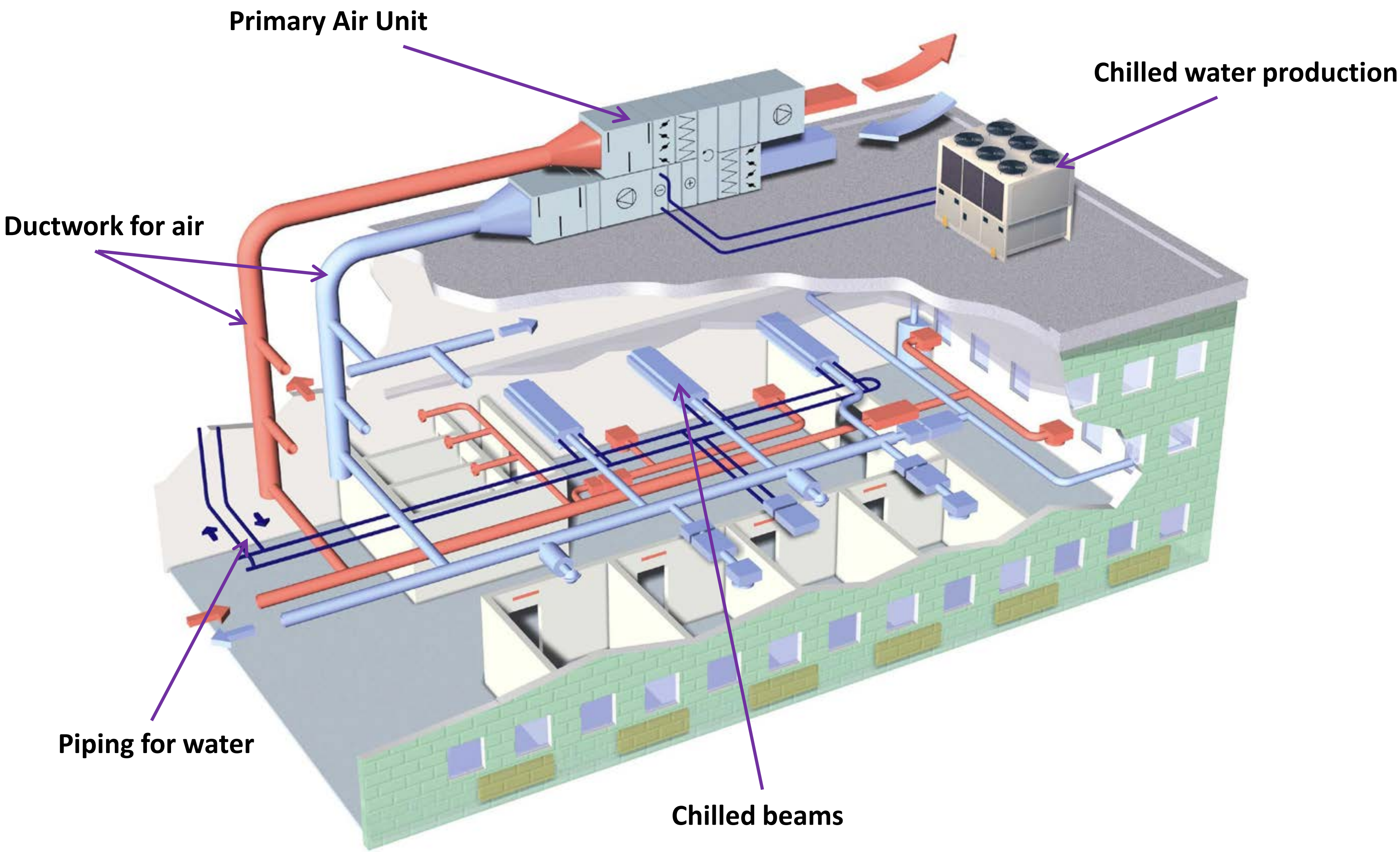
Passive Beam

Uses natural convection to circulate air

Active Beam

Uses primary air to circulate room air

Building Overview



Indoor Air Quality Considerations

Fresh air

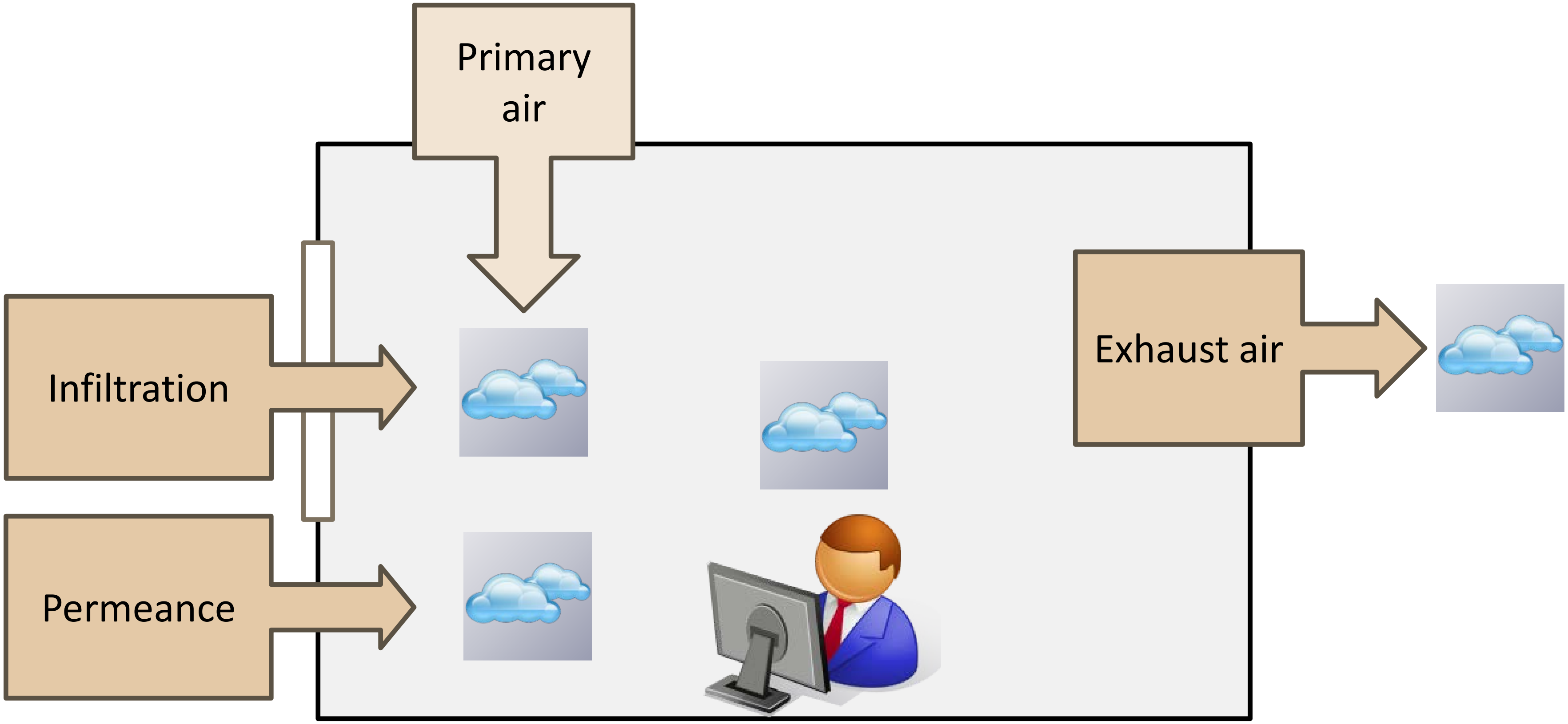
Low velocity
(No draft)

Low noise level

Desired air temperature and humidity

On average, we spend 90% of our lives indoors

Humidity consideration



- Humidity control a key component to chilled beam design

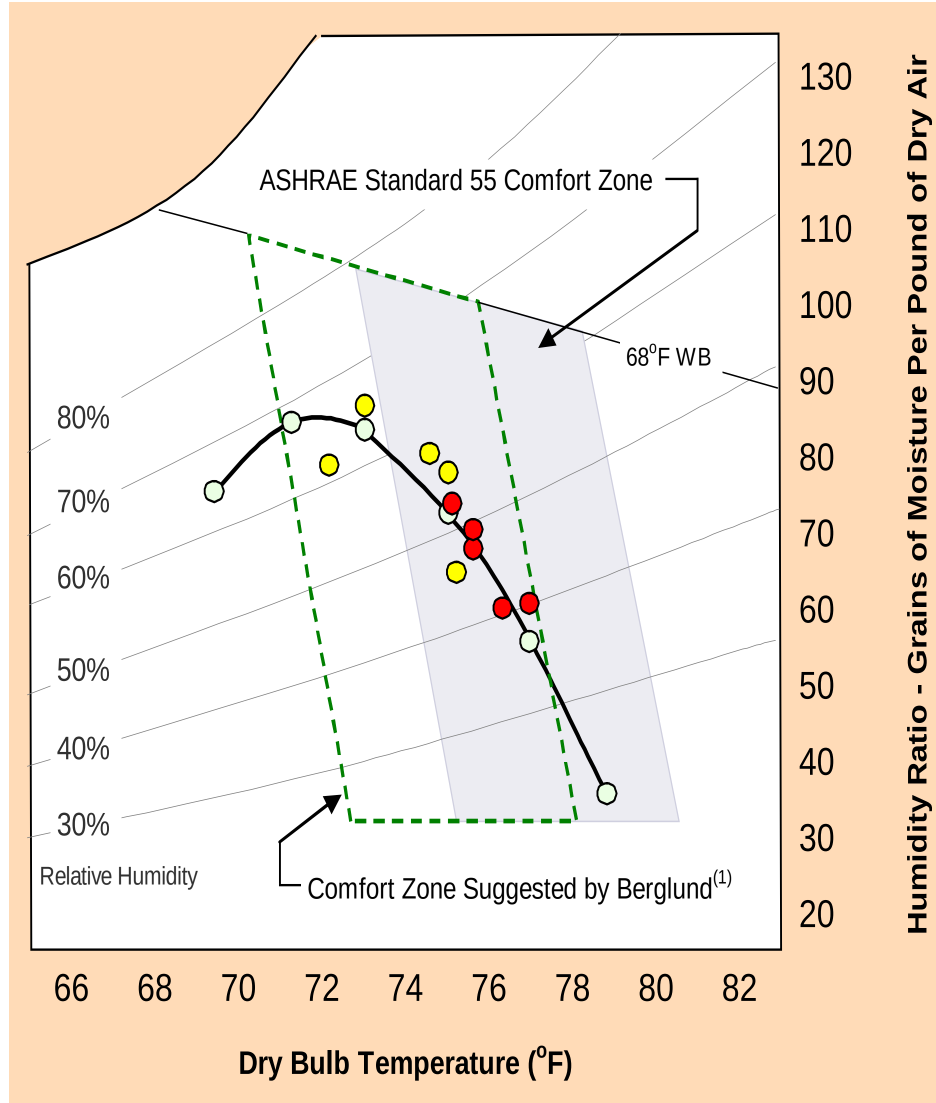
ASHRAE 62.1-2013 Regarding Mold

- 5.8 – Particulate Matter Removal
  - Filtration is not required on coils that are designed, controlled and operated to provide sensible cooling only.
- 5.9.1 – Relative Humidity
  - Standard allows for RH as high as 65%, but inherent within Chilled beam design is to maintain the space at 55 dew point that results in a 50-55% rh at 75/72 respectively
- 5.10 Drain Pans
  - Since the coils are designed to run dry, drain pans are not required
  - IBC 2015 has exempted chilled beams from requiring drain pans
- 5.14.2 – Condensation on Interior Surfaces
  - Water temperature higher than space dew point means condensation on piping, ducts and other surfaces is avoided except in the primary air system

No condensate
No Mold

Temp and Humidity Space Design For IAQ

- Typical space design
  = 75 db and 50% rh
- Dryer the space
  = comfort increases
- Dryer the space
  = warmer room temp
- Warmer room temp
  = more cooling capacity
- DESIGN CHALLENGE
  = 76 db and 42% rh



ASHRAE 62.1-2013 Regarding Ventilation

- 6.2.2.1 - Minimum Breathing Zone Outdoor Airflow (V_{bz})
  - Zone floor area, sq ft (sq m)
  - Zone population (number of people in the zone during typical usage)
  - OA rate required per person per Table 6.2.2.1
  - OA rate required per unit area per Table 6.2.2.1
  - Min OA = OA per person x zone population + OA per unit area x zone floor area

- Classroom example
  - 900 square foot classroom
  - 30 kids, 1 teacher
  - OA rate per person = 10 cfm/person = 310 cfm
  - OA rate per unit area = 0.12 cfm/sq ft = 108 cfm
  - Min OA = 418 cfm

- Office example
  - 1200 square foot open office
  - 24 workers
  - OA rate per person = 5 cfm/person = 120 cfm
  - OA rate per unit area = 0.06 cfm/sq ft = 72 cfm
  - Min OA = 192 cfm

ASHRAE 62.1-2013 Effectiveness and Efficiency

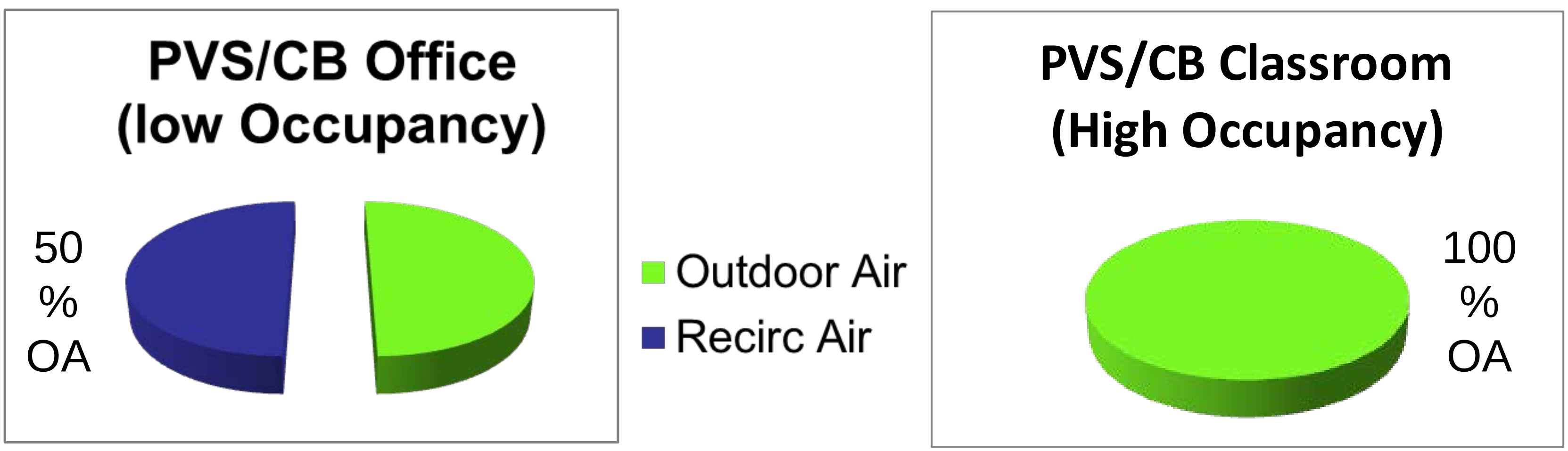
- 6.2.2.2 – Zone Air Distribution Effectiveness
  - Ceiling supply of cool air = 1.0 effectiveness
  - Ceiling supply of warm air > 15° of space temp = 0.8 effectiveness
  - Ceiling supply of warm air and floor return = 1.0 effectiveness

- 6.2.4 – 100% Outdoor Air Systems
  - Total OA Flow = sum of all zones x OA rate adjusted by distribution

- 6.2.5 – Muliple zone Recirculating Systems
  - Calculate OA fraction by dividing OA by total circulation
  - Use table 6.2.5.2 to determine ventilation efficiency
  - OA intake must be adjusted by the ventilation efficiency by dividing Total OA Flow divided by Ventilation effectiveness

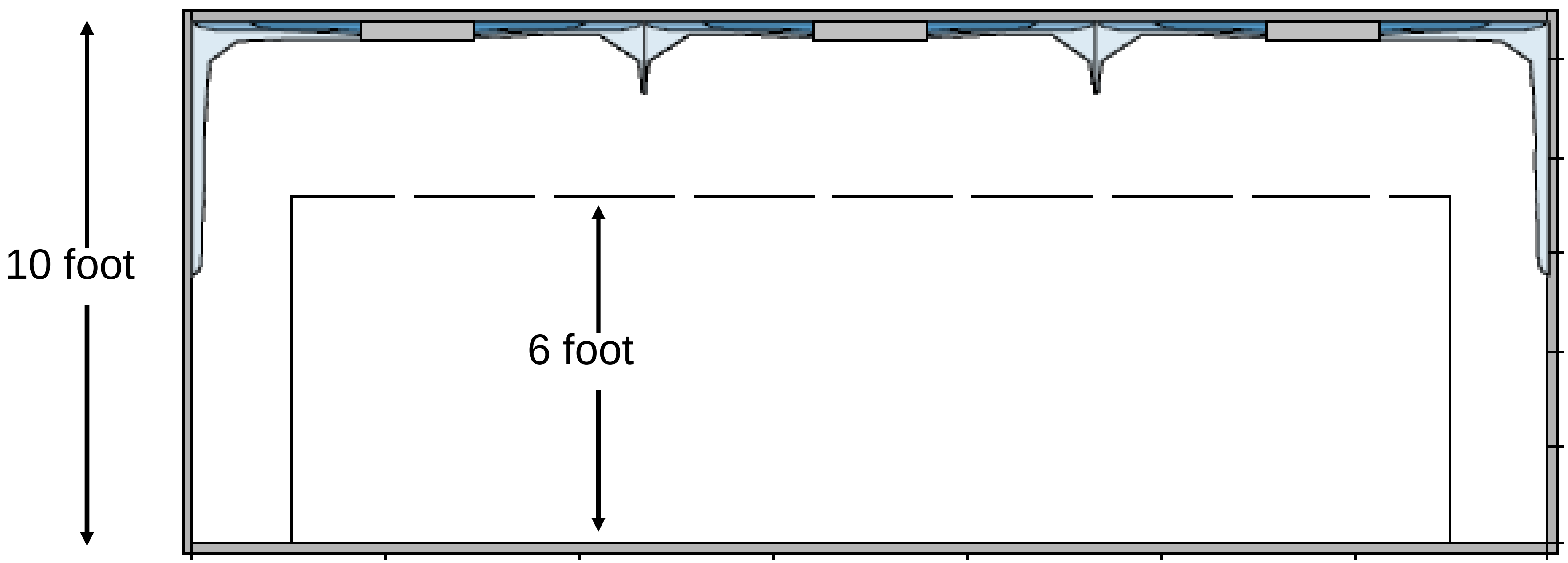
Conventional versus Chilled Beams

Chilled Beams require ½ the airflow of a traditional VAV system design



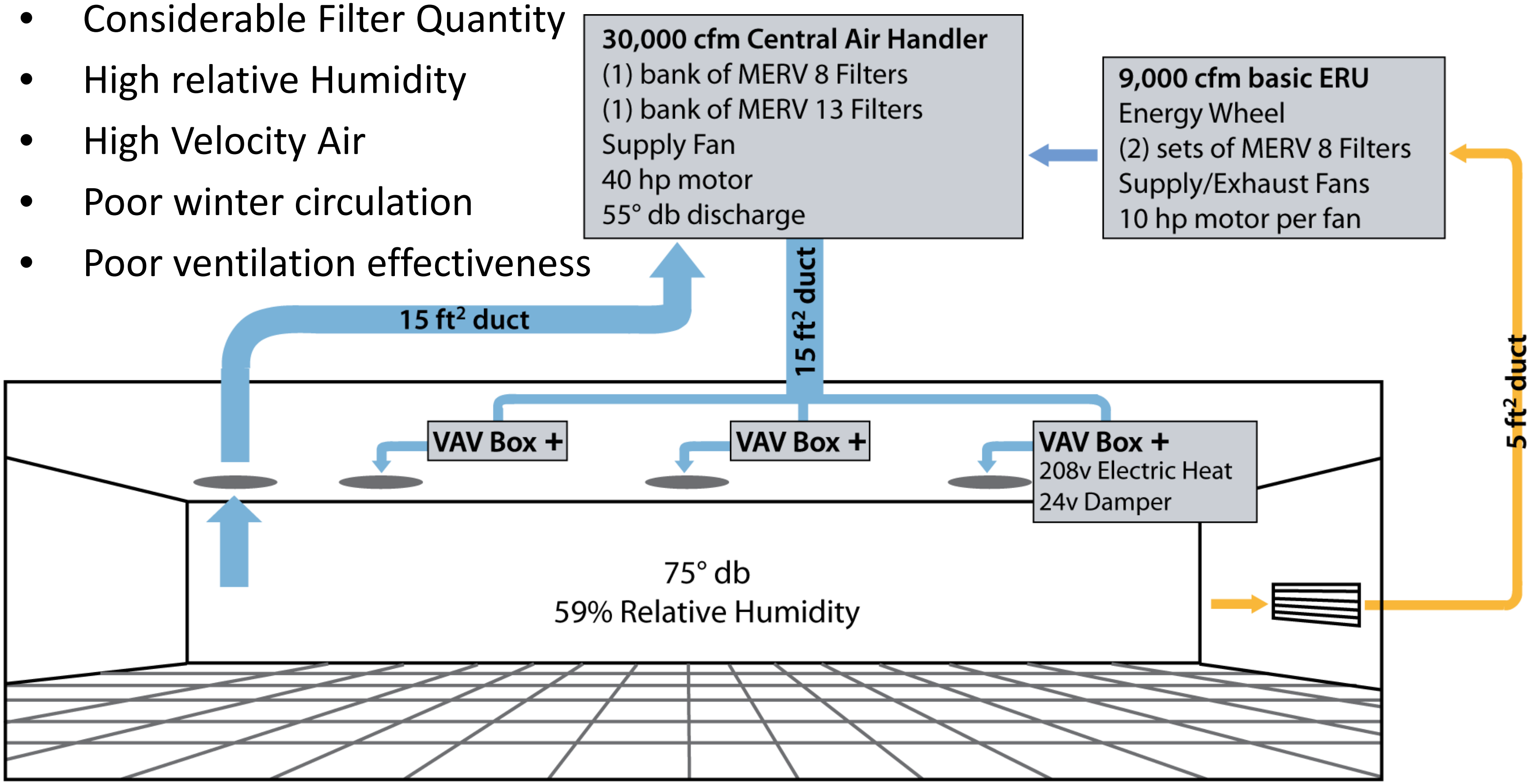
Beam placement and Air Distribution

Flow pattern



Conventional System

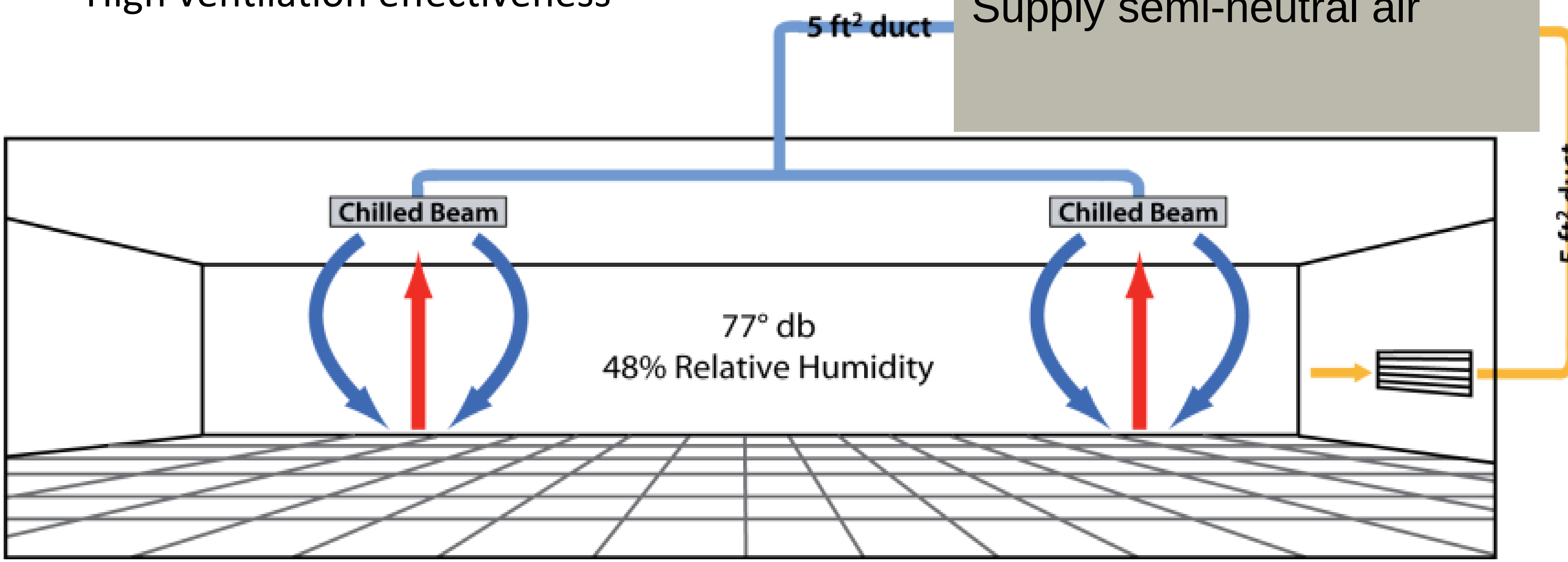
- Low temp water
- Considerable Filter Quantity
- High relative Humidity
- High Velocity Air
- Poor winter circulation
- Poor ventilation effectiveness



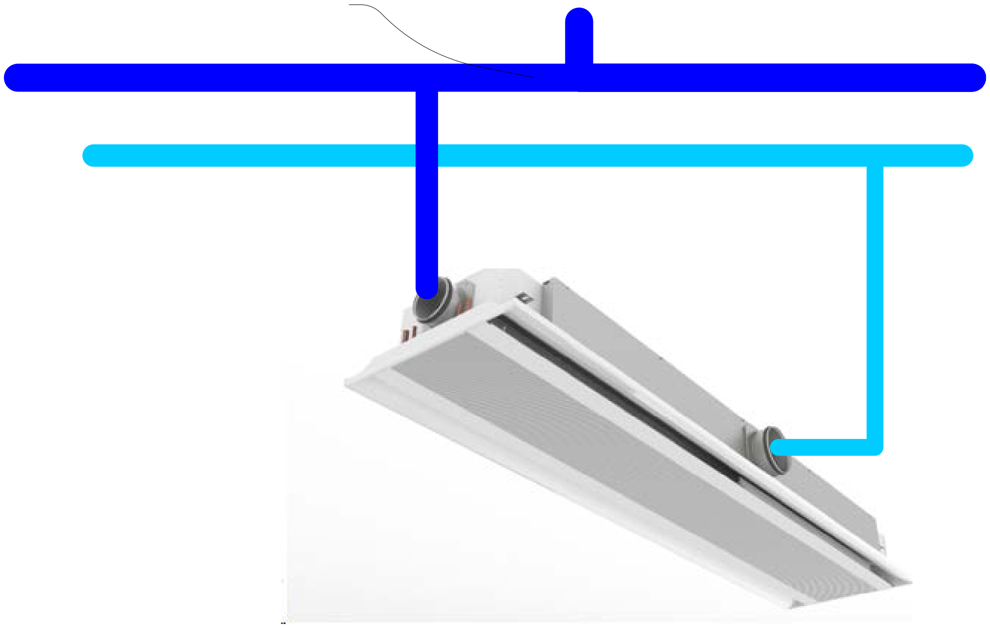
School or Laboratory Chilled Beam System Design

- Low temp water ONLY in DOAS
- Filtration ONLY in DOAS
- Lower relative humidity
- Low velocity/high volume air movement
- Equal winter/summer circulation
- High ventilation effectiveness

100% DOAS with Recovery
Only Filters in the building
Only Fans in the building
Supply semi-neutral air



Open or Closed Office Design



Primary Air Considerations

1. ASHRAE 62 Minimum Ventilation Requirement
   - 100% Outside Air

2. Minimum to satisfy space latent load
   - Depends on primary air discharge dewpoint
   - Depends on occupancy of the space

3. Minimum to satisfy space sensible load
   - Depends on space loading (computers, window load, etc)

4. Make-up air requirement*
   - *Lab exhaust, kitchen exhaust, etc.

Classroom Example:

- **30 kid and 1 teacher – 900 sq ft**

1. 418 cfm ventilation required

- **6,200 btu latent (31 x 200 btu)**

2. At 45 dewpoint 456 cfm required (6200 btu / 0.68 / 20 grains)

- **19,440 btu sensible**

3. Four Beams at 114 cfm ea satisfies (70% of load is on coils)

4. Make up requirement not applicable for this example


Thank You!
Questions?