Controlling Moisture in Commercial Buildings

Part Load Problems

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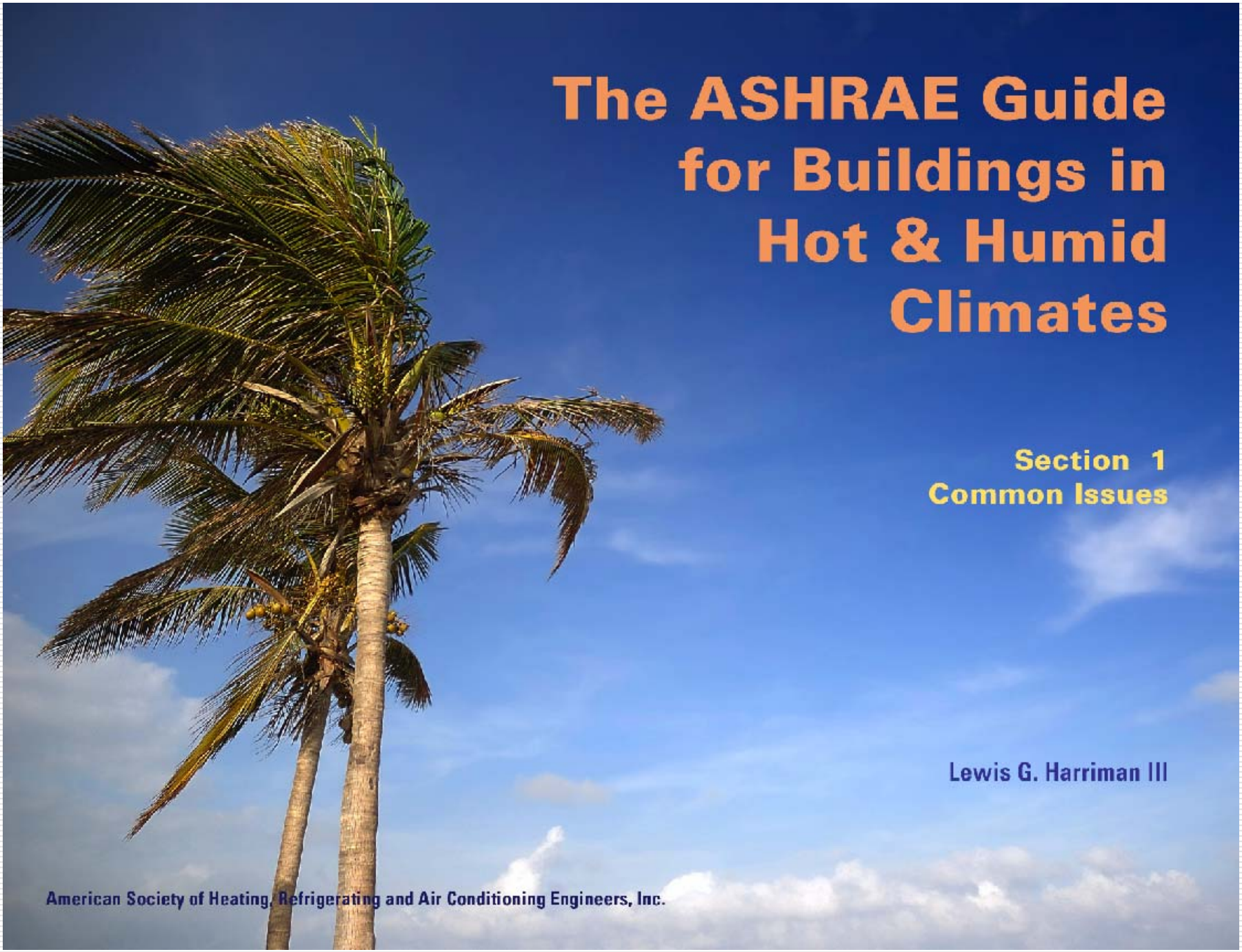
The Holmes Agency, Inc.

Consulting and Forensic Engineers

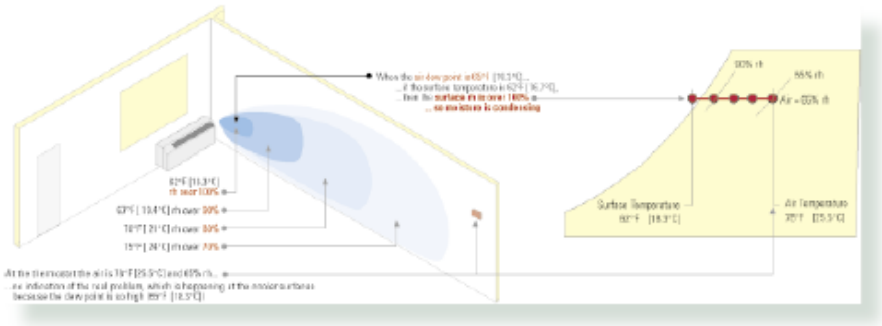
Historical Perspective

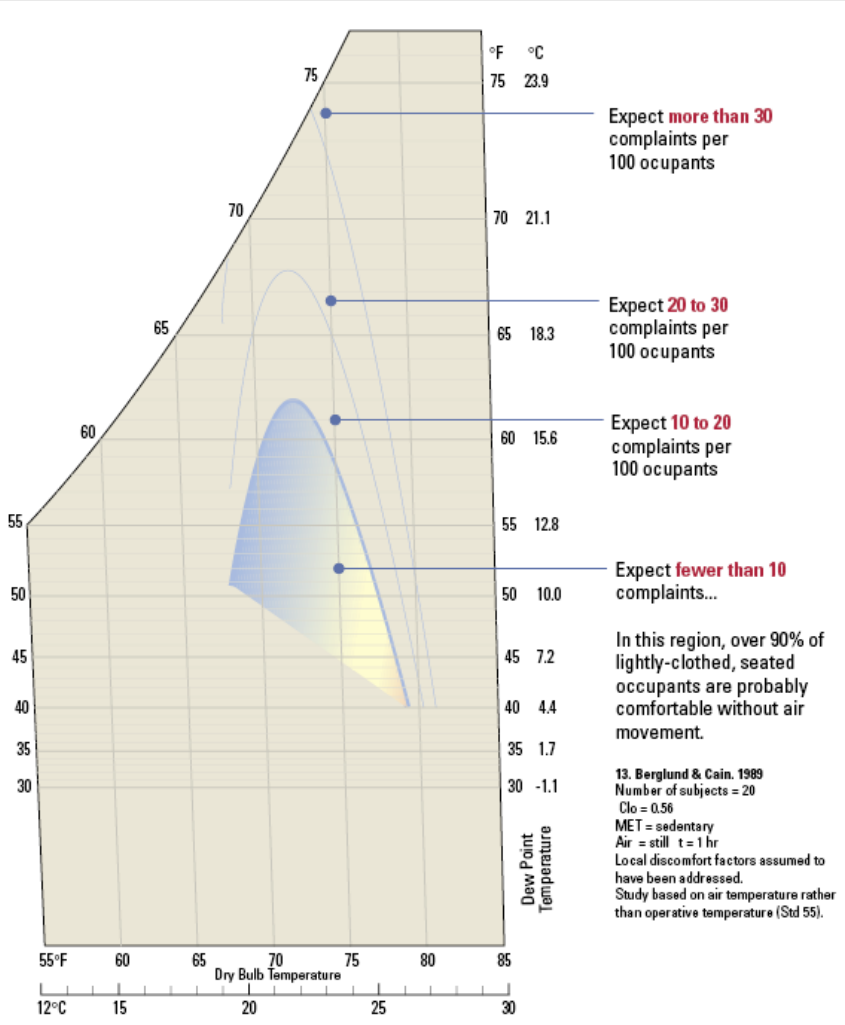
- ***Willis Carrier***

  "Air conditioning is the control of the humidity of the air by either increasing or decreasing its moisture content. Added to the control of humidity is the control of the temperature by either heating or cooling the air, the purification of the air by washing or filtering the air, and the control of air motion and ventilation"


The ASHRAE Guide for Buildings in Hot & Humid Climates
Section 1
Common Issues
Lewis G. Harriman III
American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.

Chapter 3. Managing Ventilation Air 28



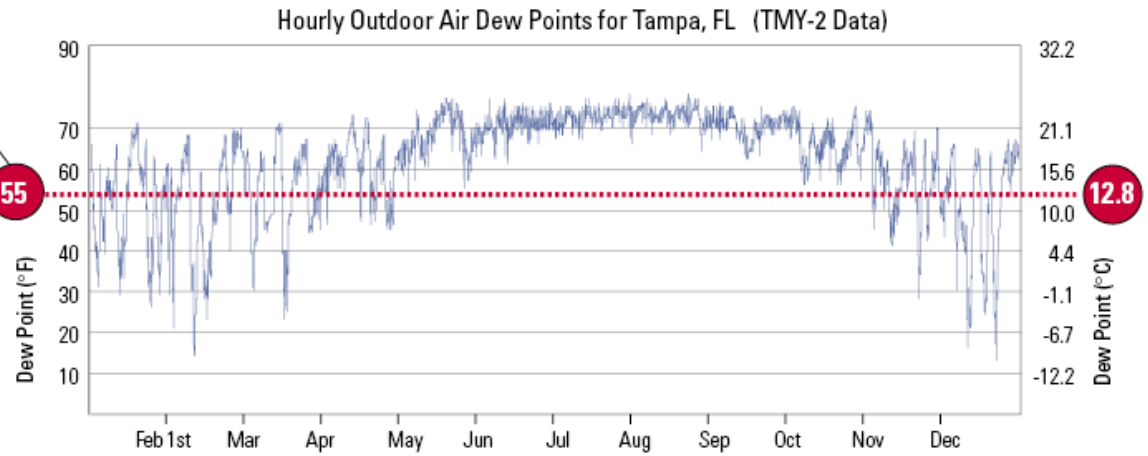


Comfort - Keep the dew point under control, and comfort happens at warmer, more energy-efficient temperatures

ASHRAE Std 62.1 - 2004
Ventilation for Acceptable Indoor Air Quality

Ventilation - If it's not dried… you're in trouble

Indoor vs. Outdoor Air Dew Points
In hot and humid humid climates, the outdoor air dew point can be very high even during "winter." So the system must dry the ventilation air in **all** seasons.

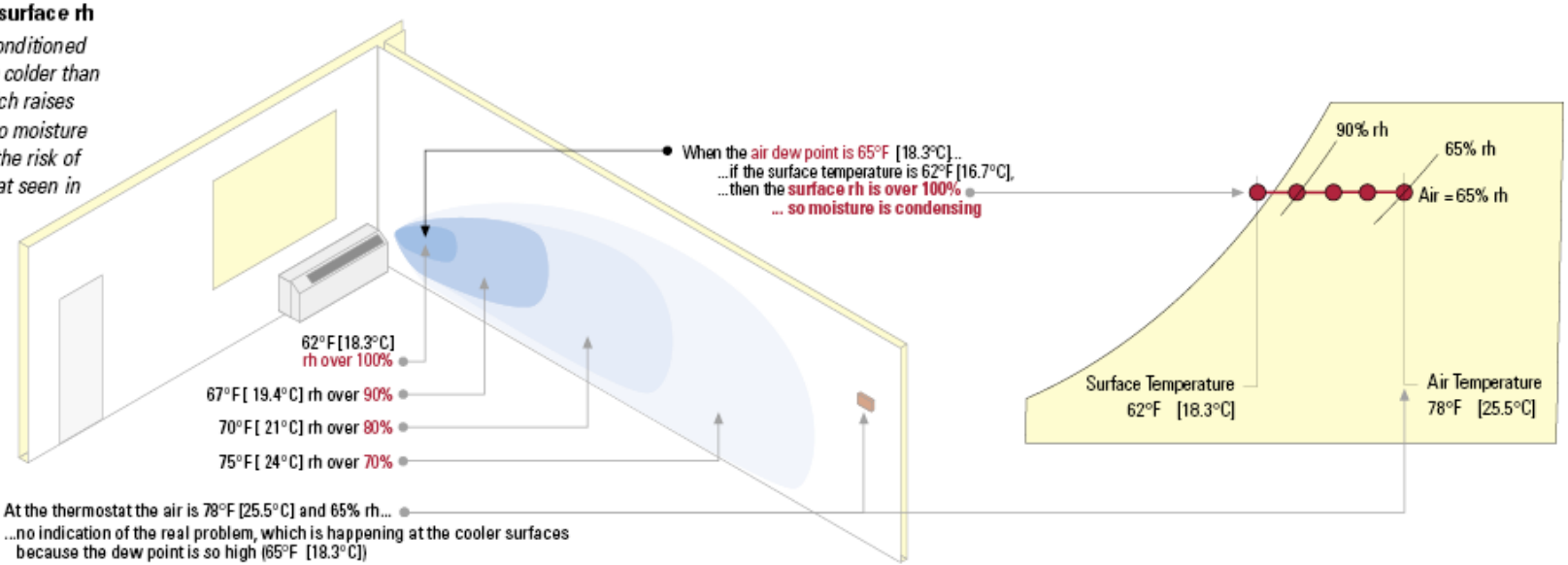


Mold - It's the surface rh that counts.. So keep the dew point down, and things go well

Fig. 5.5

Cold surfaces = high surface rh

The surfaces in an air conditioned building are often much colder than the surrounding air, which raises the local rh, and leads to moisture absorption and then to the risk of mold growth such as that seen in figure 5.6.



Mold Growth

- Enzymes on mold spore combine with surface moisture to dissolve food source… paper, wood, ceiling tile
- Osmotic pressure causes liquid nutrients to diffuse across spore wall allowing spore to absorb the nutrients
- Spore germinates producing filamentous hyphea
- Hyphea grows quickly creating mycelium mat
- Mold grows conidia which generates and releases spores into the air

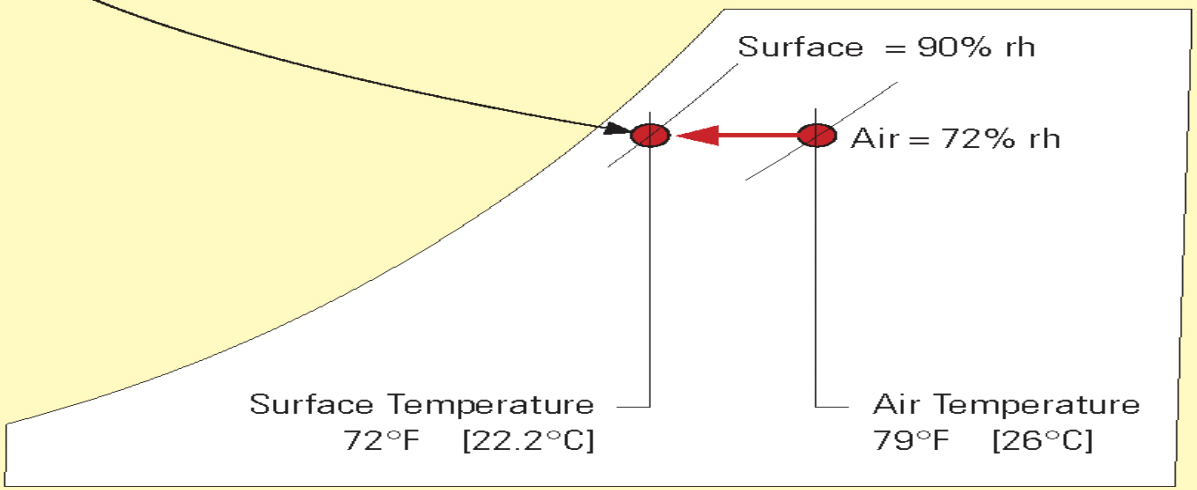
Water Activity

- Water activity indicates how much water is biologically available to fungus in its food source.
- Water activity of 0.8 refers to the amount of water absorbed into a material when the surrounding air is at 80% RH
- Water activity of a material is very different from the relative humidity of the material
- Mold growth is a risk when surface relative humidity stays above 85% for extended periods

Moisture Content and Surface Relative Humidity

At this cool surface, the RH is about 90%...

...even though the RH in the air is only 72%.



Uncontrolled air flow

- Buildings which have never reported relative humidity above 65% still may have mold growth

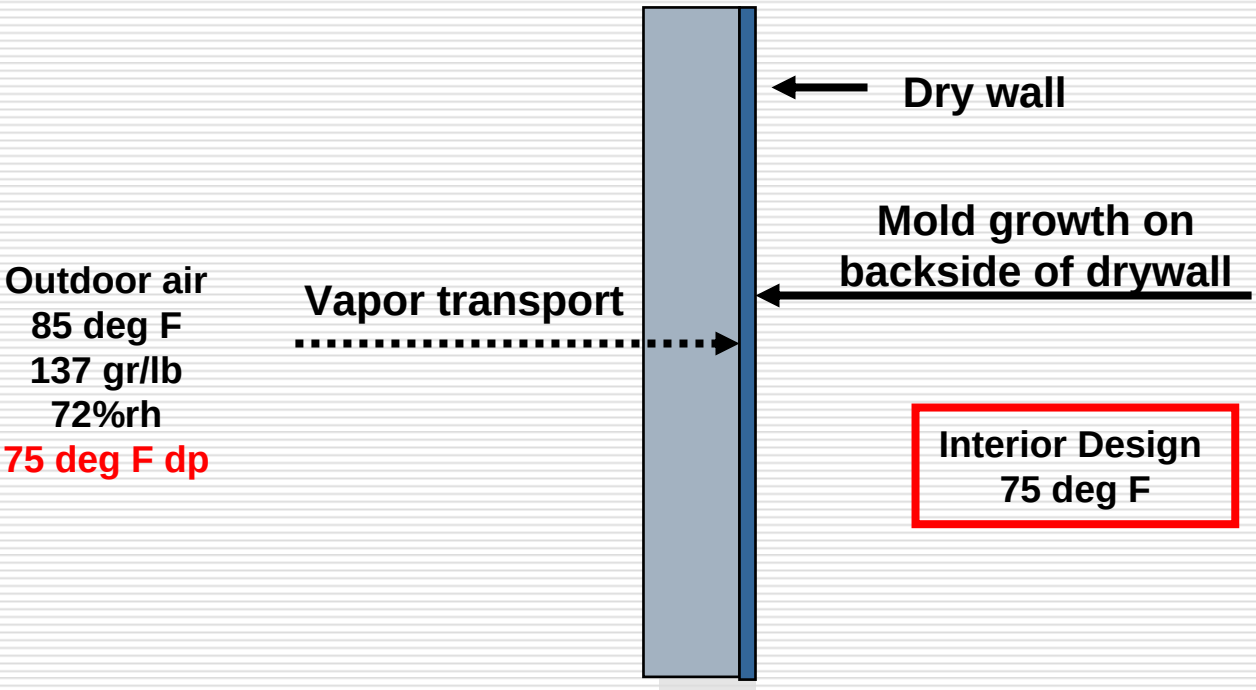
THE MOISTURE PROBLEM

- Highest enthalpy occurs at peak dew point.. NOT peak dry bulb
- ASHRAE 2005 Fundamentals lists
  - Extreme DB with MCWB ….example Kansas City, MO (1%) 93db/75wb (107 gr/lb) 68dp
  - Extreme DP with MCDB (.4%) 75dp/85db (137 gr/lb) (78wb) …….. …poor performance at part load!!

THE MOISTURE PROBLEM

- **ASHRAE 2005 Fundamentals lists extreme DP with MCDB….example Orlando, FL (0.4%) 83db/77dp (142 gr/lb) (79 wb) …….. …again poor performance at part load!!**

TYPES OF MOISTURE PROBLEMS



Building Envelope with poor vapor barrier

Ventilation - If it's not dried… you're in trouble

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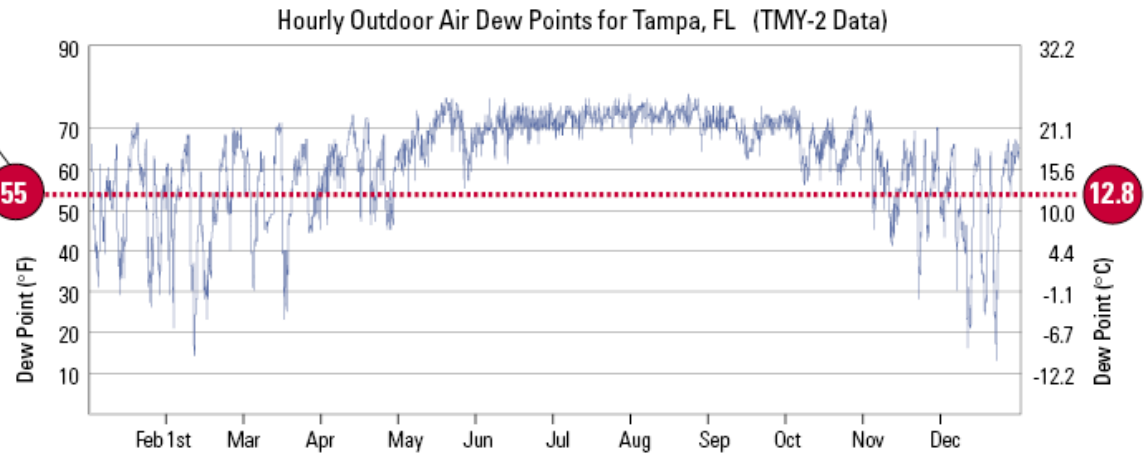
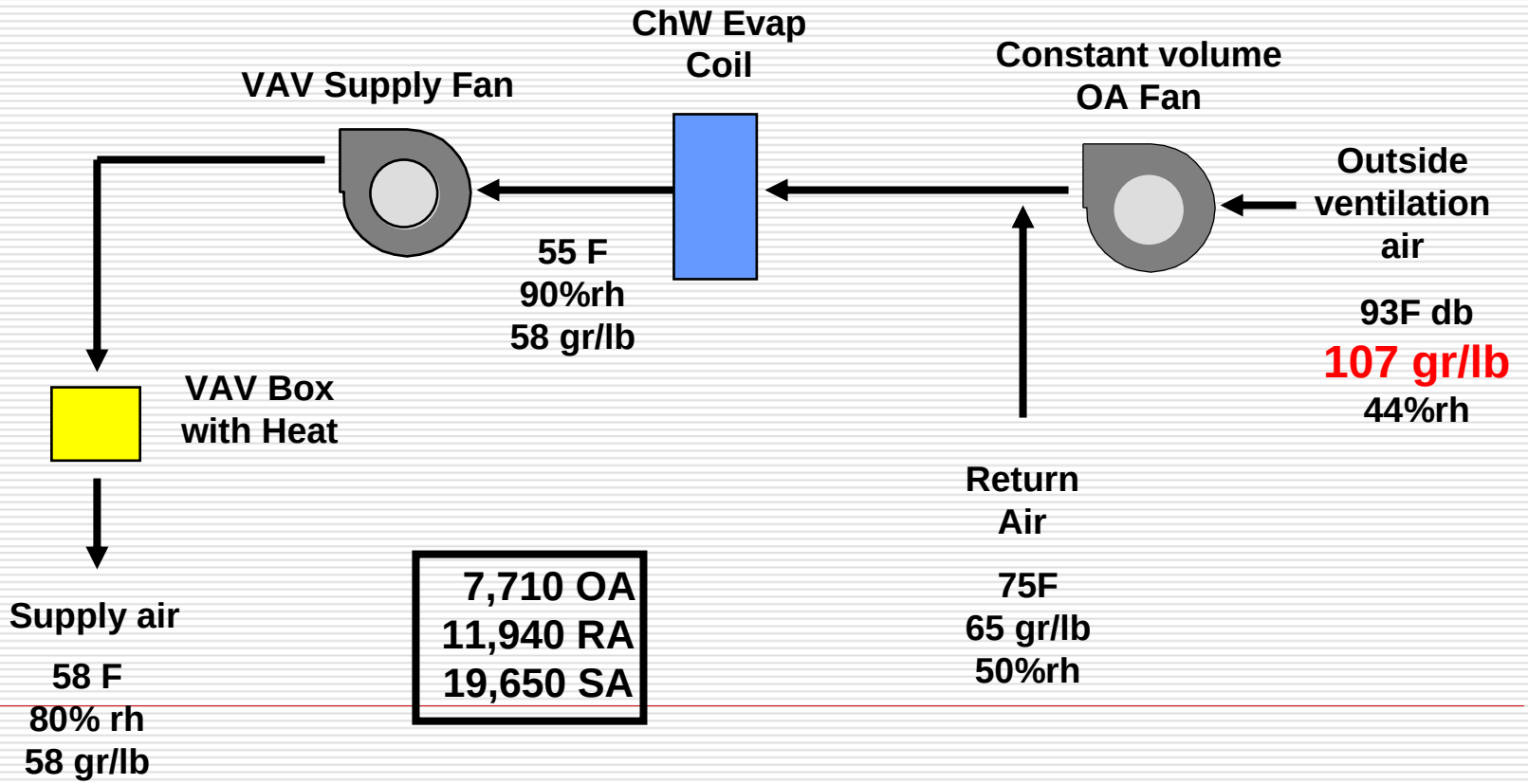


VAV AIR CONDITIONING

Full Load



ASHRAE PSYCHROMETRIC CHART NO.1

NORMAL TEMPERATURE

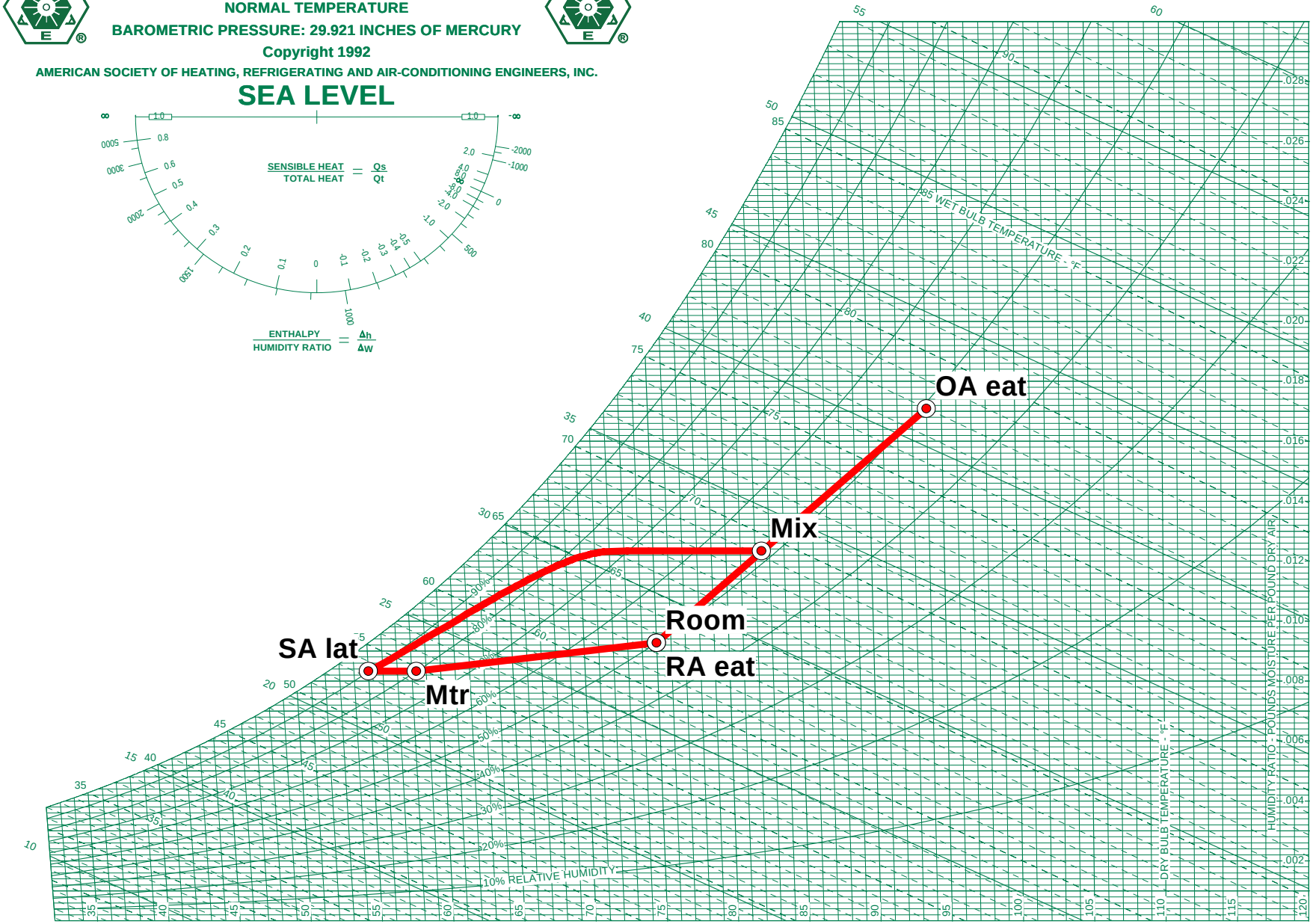
BAROMETRIC PRESSURE: 29.921 INCHES OF MERCURY

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

SEA LEVEL

$$\frac{\text{SENSIBLE HEAT}}{\text{TOTAL HEAT}} = \frac{Qs}{Qt}$$

$$\frac{\text{ENTHALPY}}{\text{HUMIDITY RATIO}} = \frac{\Delta h}{\Delta W}$$



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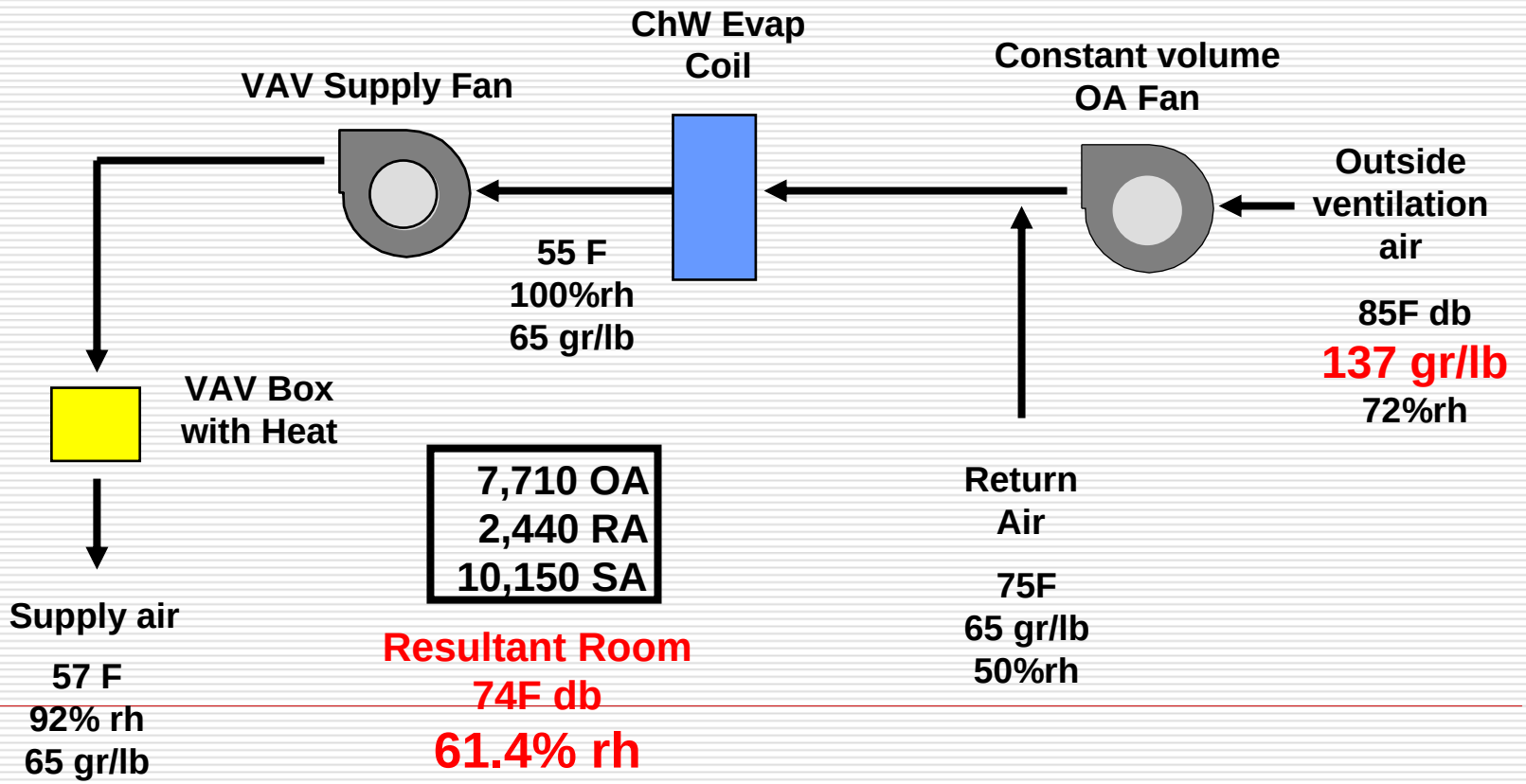

NEW Note # 1 Here...

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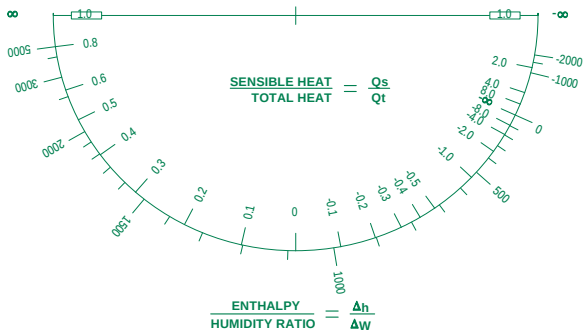
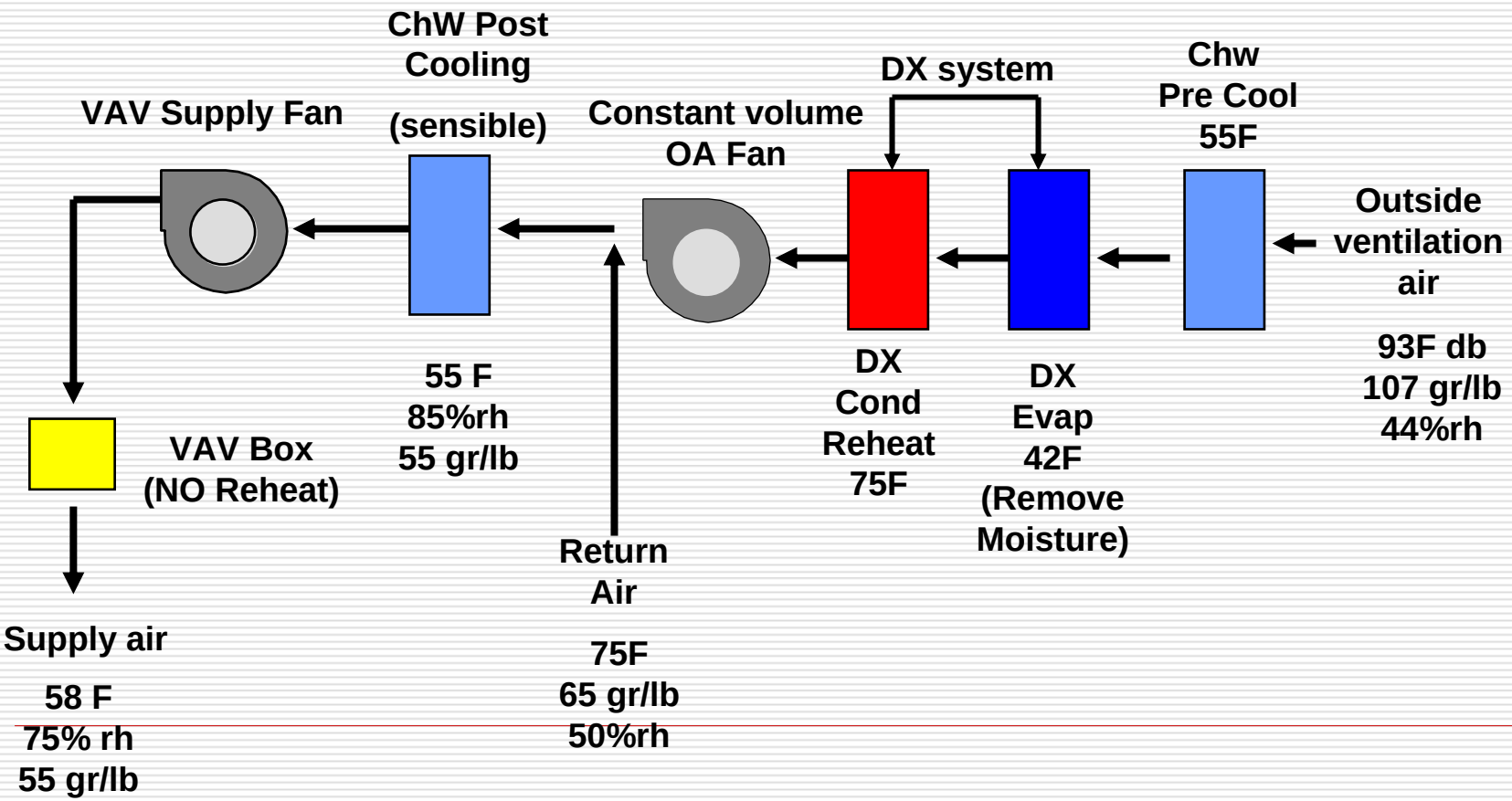


OA Pre Treatment with Post Cooling

Full Load



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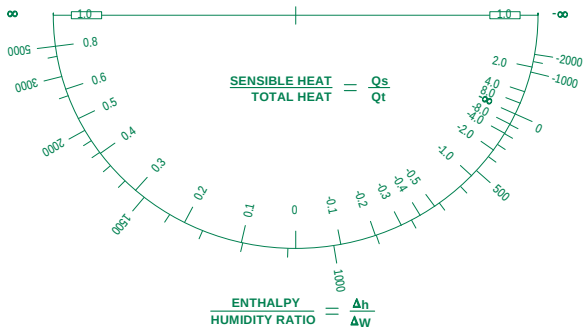

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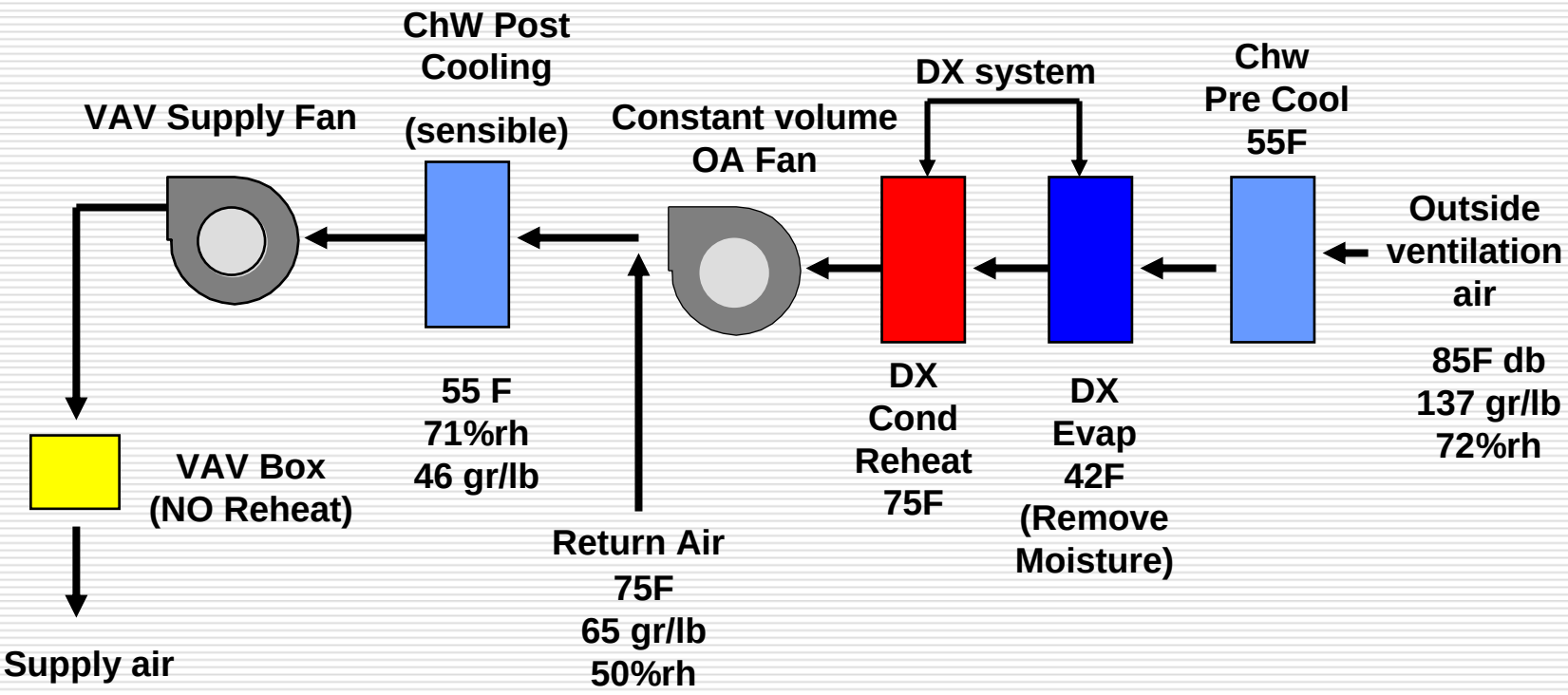

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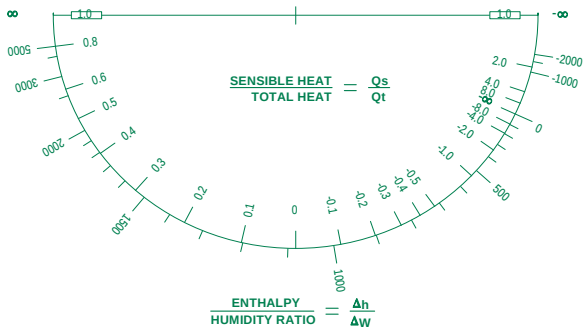
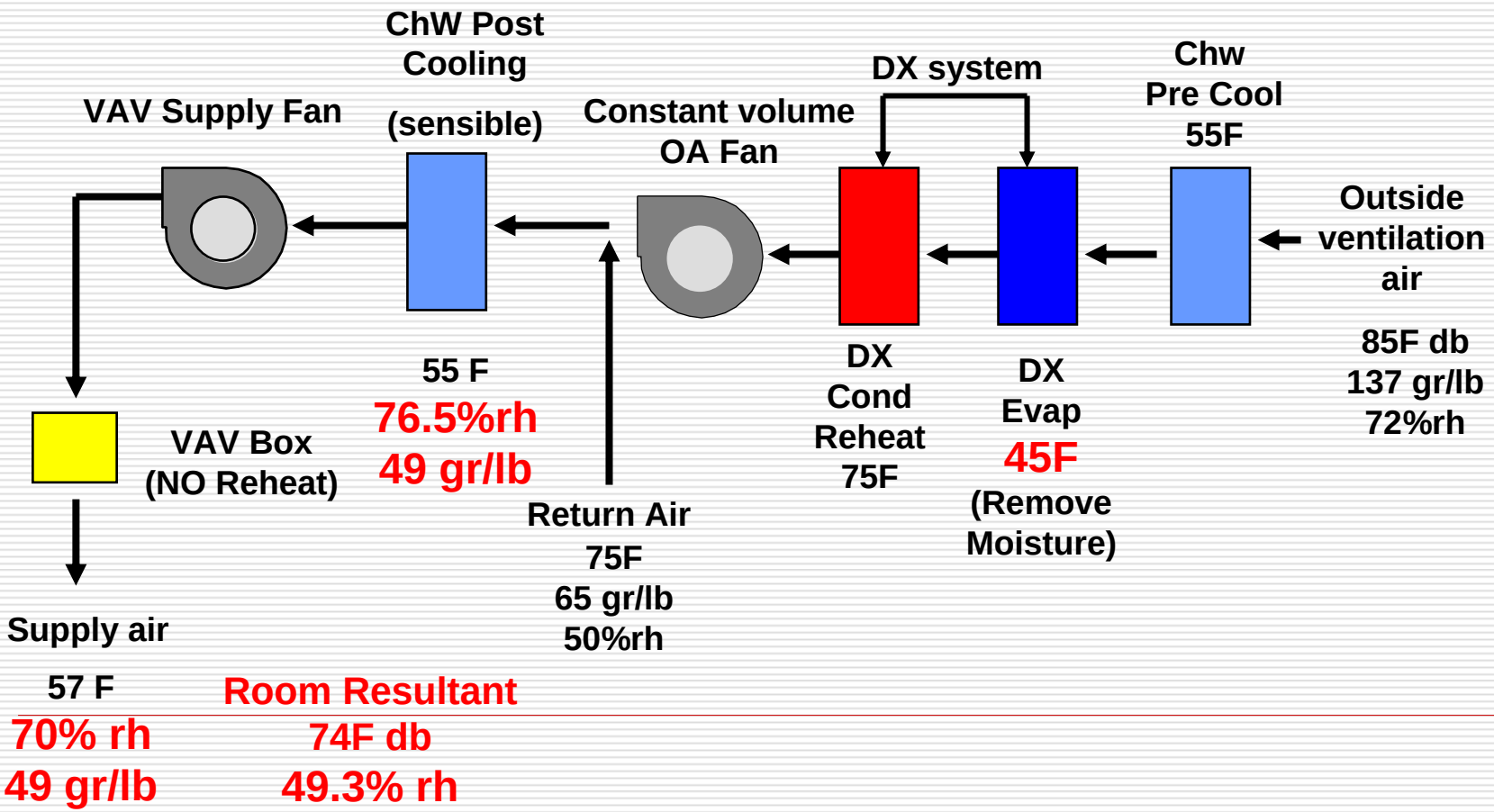


OA Pre Treatment with Post Cooling

Part Load – reset DX



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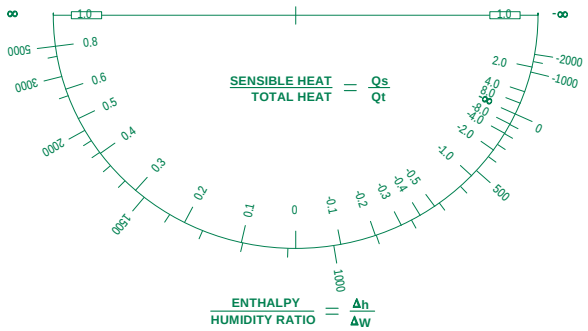
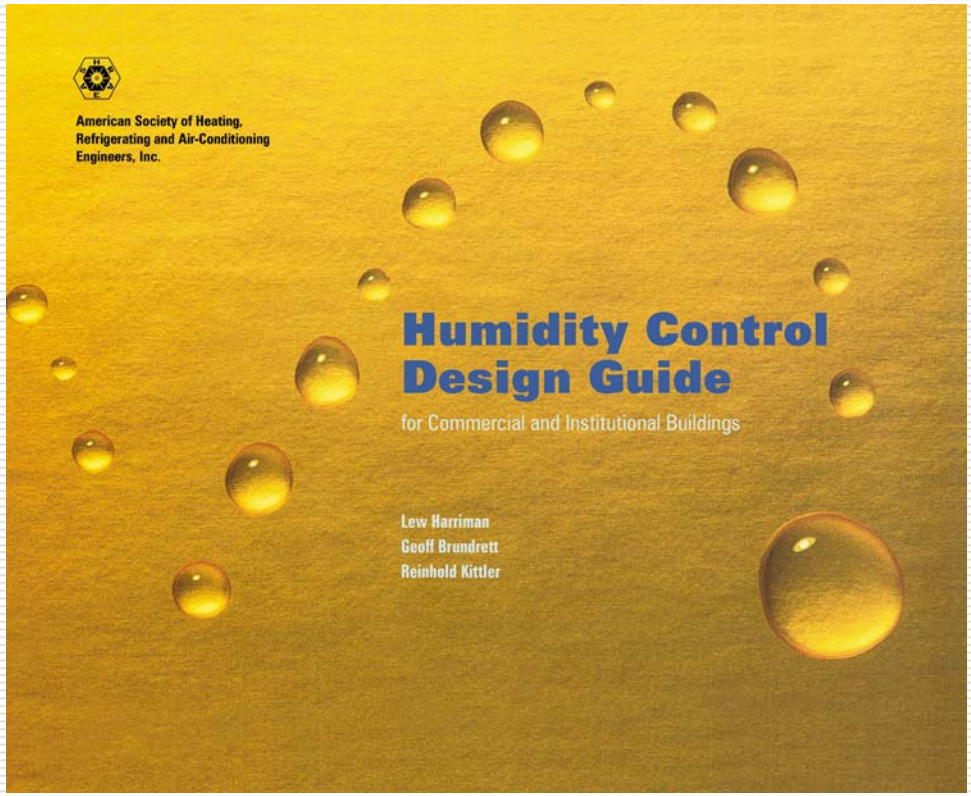


Design Considerations

- It's a system… not just a unit
  - The habitable space is a plenum
  - Uncontrolled air flow – ASHRAE Journal
- Don't operate in a vacuum… it's a team effort
- Sequence of operation
- ***Control outside air at the source***
- Control condensation

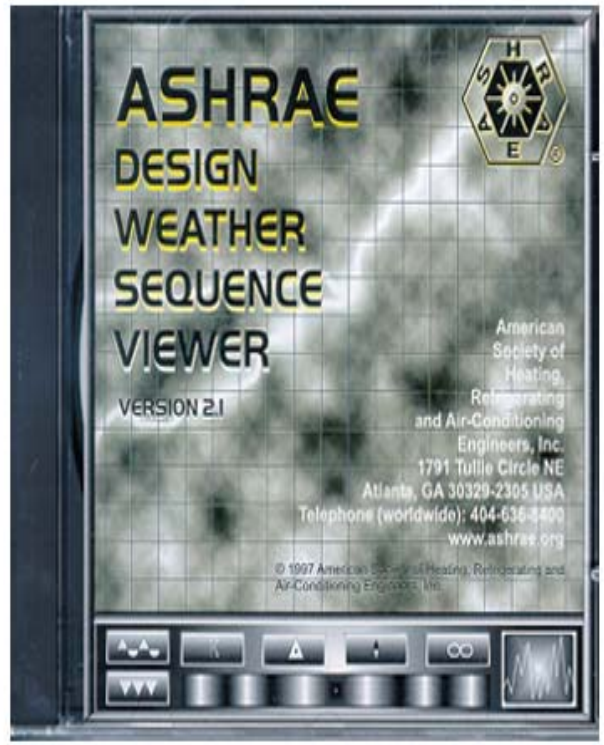
ASHRAE Standards and Publications

- Available from ASHRAE in Atlanta,
- **Humidity Control Design Guide**
  For Commercial and Institutional Buildings



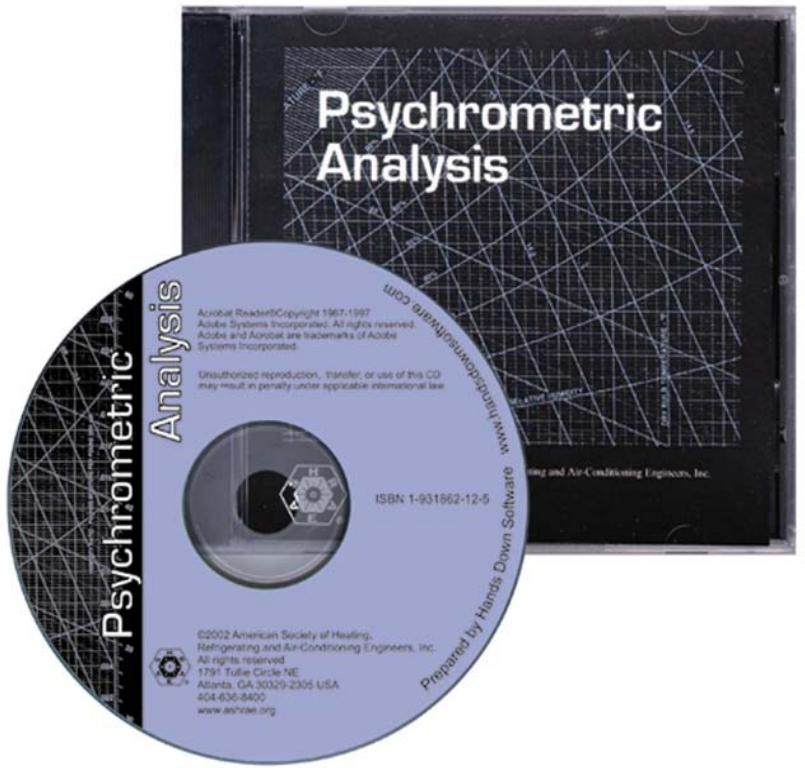
ASHRAE Standards and Publications

- Available from ASHRAE in Atlanta
- Design Data for Weather
- Weather Data Viewer
- ASHRAE Design Weather Sequence Viewer



ASHRAE Standards and Publications

- Psychrometric Analysis CD
- Available at ASHRAE Book Store Long Beach, California



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