

Designing for Moisture Management



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- Why the concern?
- Suggestions to address the concern
- Why *these* measures and not others
- Summary of suggestions



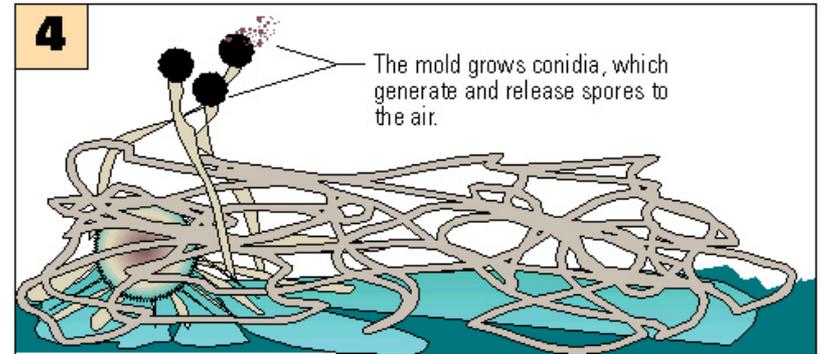
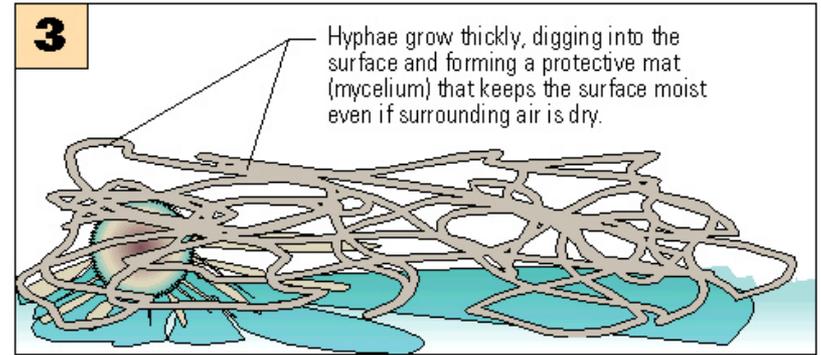
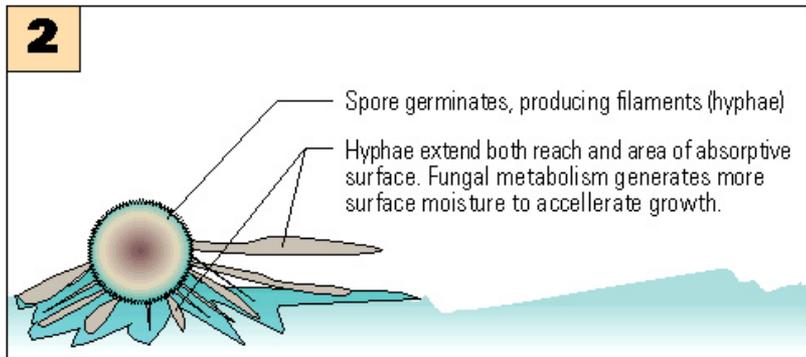
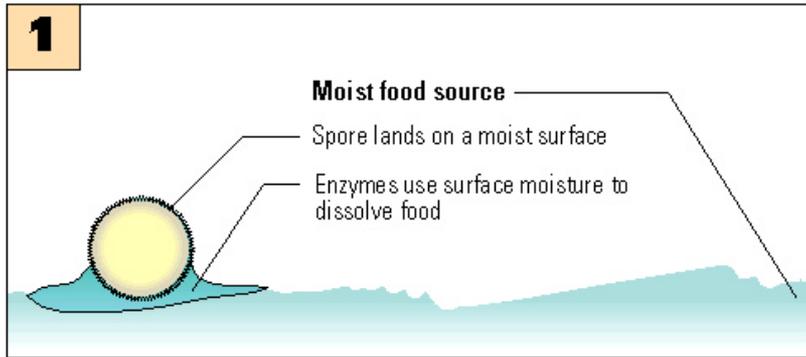
The mold concern is about the strength of buildings...



- **Fact 1 - Buildings don't fall down very often.. A good thing.**
- **Fact 2 - More often, buildings grow mold... a bad thing.**
- **Mold claims in commercial buildings between \$3 and \$12 billion in 2003**



Mold cannot grow without moisture



Typical mold growth sequence in buildings

- **1. Rain or ground water gets in through cracks**
- **2. Humidity gets in through cracks and ventilation**
- **3. HVAC system fails to dry the air**
- **4. Indoor moisture migrates into organic materials**
 - Capillary suction (from water leaks)
 - Condensation on cooled surfaces (from high dew point)
 - Sorption (from high dew point)
- **5. Then... mold grows wherever moisture collects**



WHY so many mold problems NOW?

- **Fragile building envelopes**
 - Lots of water on the exterior wall
 - Lots of cracks
 - Poor flashing or none at all

- **No second line of defense**
 - Walls can't get rid of moisture
 - No safe moisture storage capacity (wood)
 - HVAC systems often pull in excess moisture
 - HVAC systems don't dry the air

- **Ignorance during design decisions**
 - Assumption that the shape of building does not matter
 - Window and door flashing not understood to be critical
 - HVAC not understood to be a necessary line of defense
 - No laws or codes force better practices



Basic Strategy - Build fault-tolerant buildings, not fragile ones

- **1st principle: Design a dry building**
 - Architect - a building which sheds water (rather than collecting it)
 - HVAC designer - a ventilation system which dries the building (rather than adding moisture)
 - Builder - keep it dry during construction
- **2nd principle: When moisture gets in anyway... drain it out and dry it out, quickly.**
 - Architect - Walls which drain water outwards (rather than trapping it).
 - HVAC designer- HVAC system which pushes dry air into walls (rather than sucking in humid air)



Keeping rain off the walls



- **Rain lands on the edges, carried there by wind**
- **Higher wind = more rain deposition**
- **Higher wind speed at higher altitudes = more rain at the top of the building**
- **Solution**
 - **Cornices to create “wind bumper” which keeps rain-laden wind from contacting the wall**
 - **Overhangs and projections to force water OFF the wall**

Photos from Prof. John Straube
University of Waterloo, Canada



Even small overhangs make big improvements

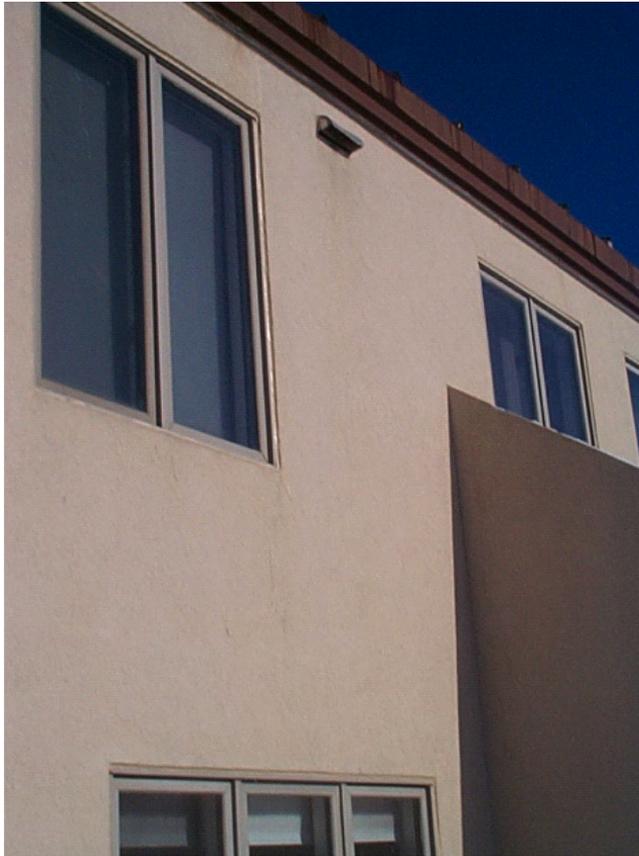


Lots of rain deposition

Zero rain deposition

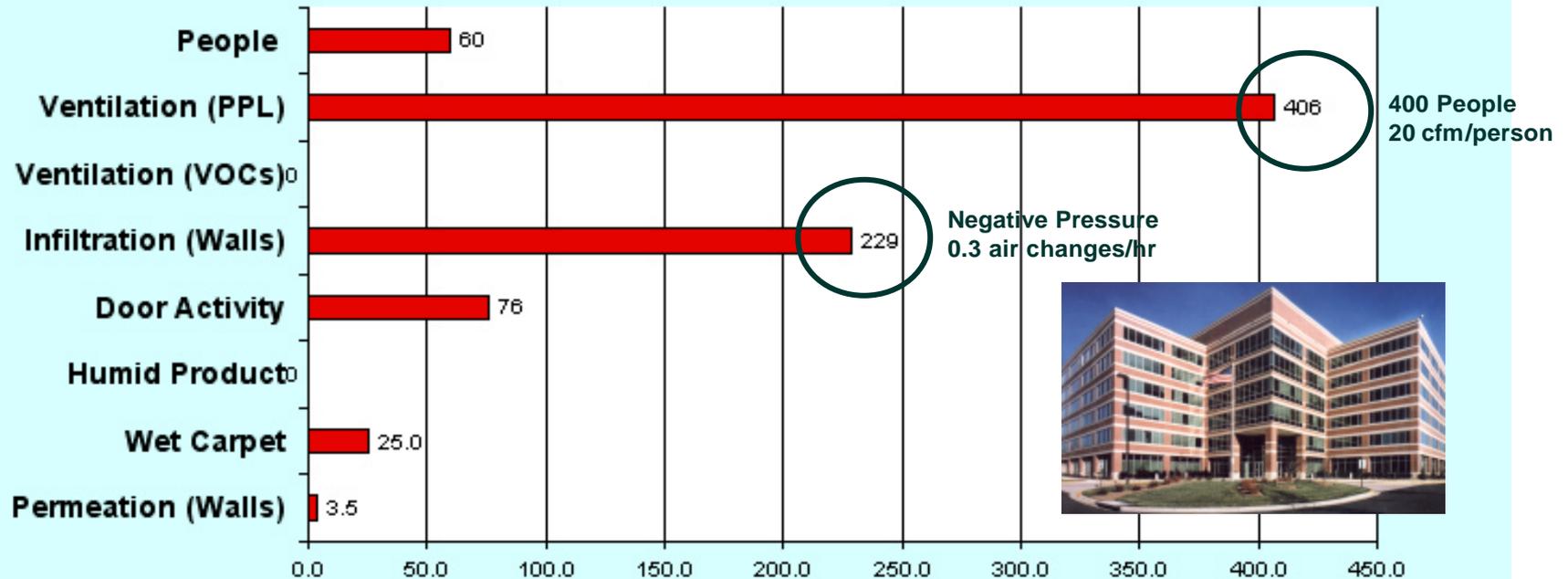


“If you want to save cash... flash” (Joe Lstiburek, Ph.D, P.Eng)



The importance of dedicated ventilation dehumidification

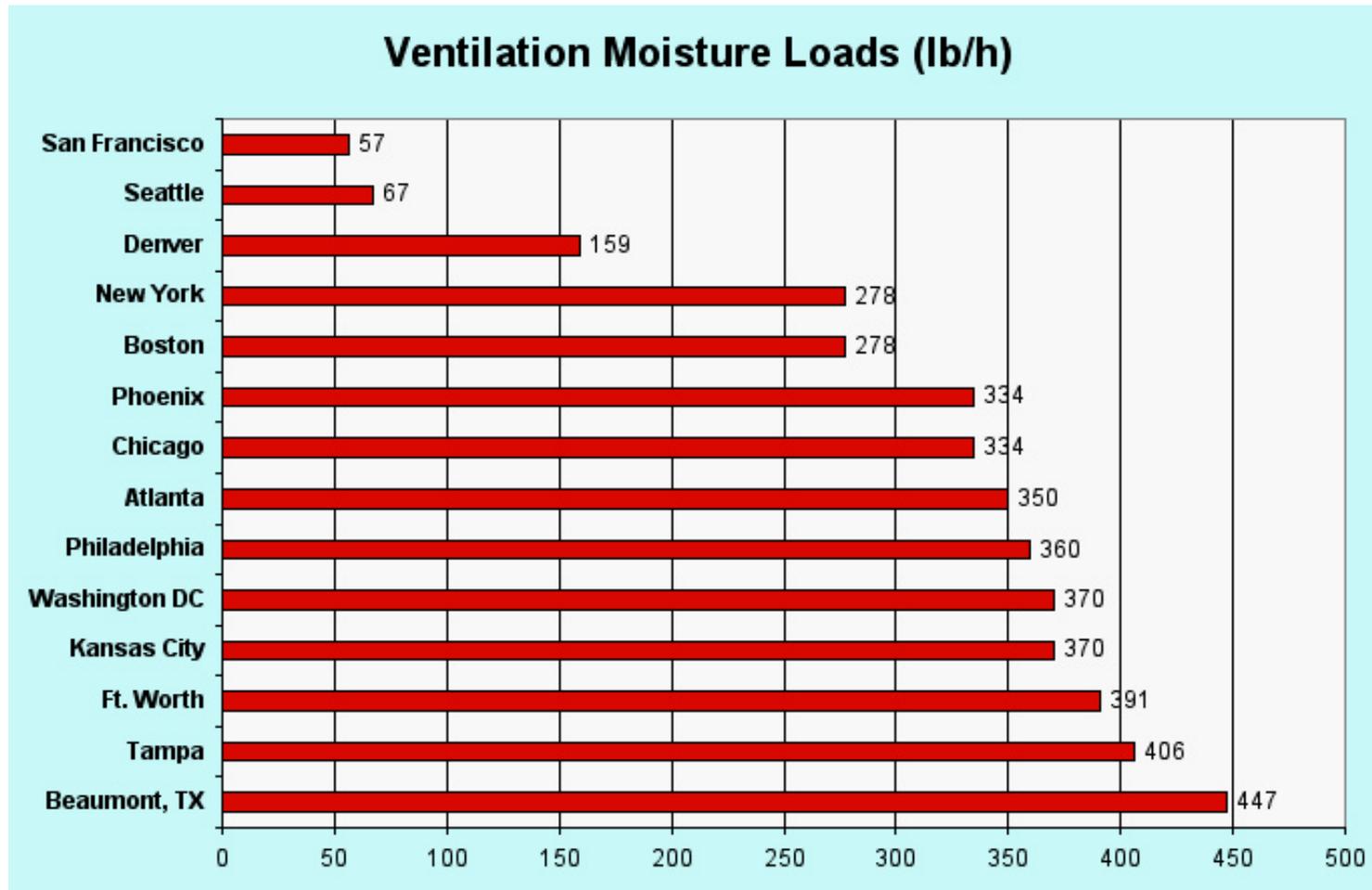
Miami 6-Story Office Moisture Load Estimate (lb/h)



TOTAL LOAD = **799** lb/h, or... **96** gallons/hour



Representative peak hour ventilation moisture loads in U.S. locations



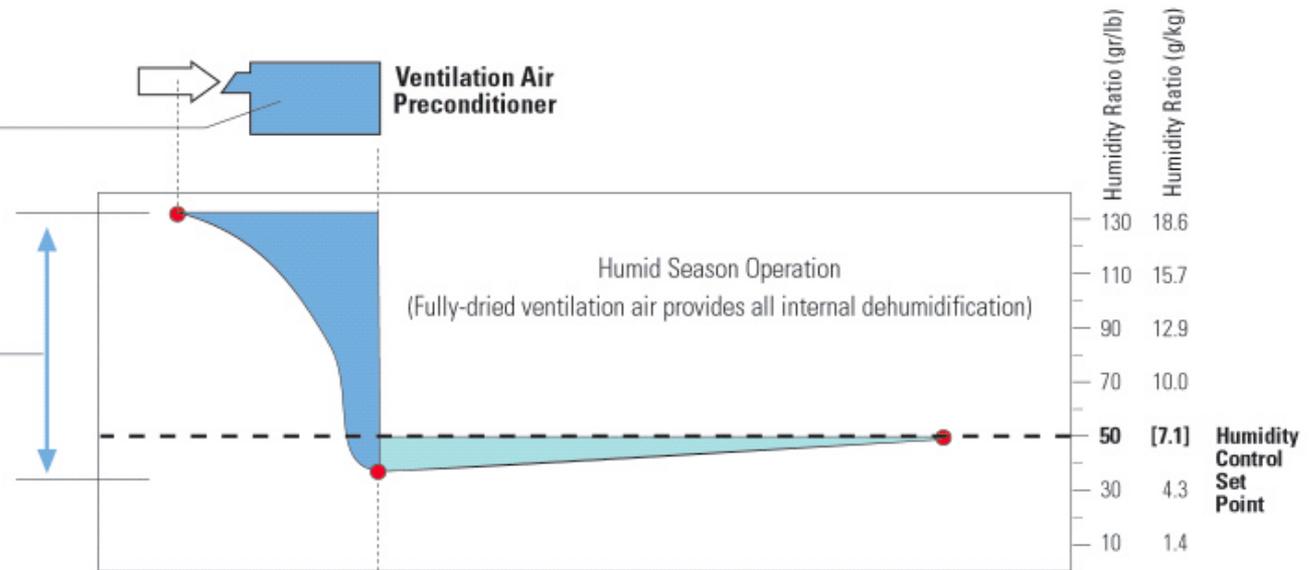
Dedicated ventilation dehumidification

1. Moisture Removal Capacity

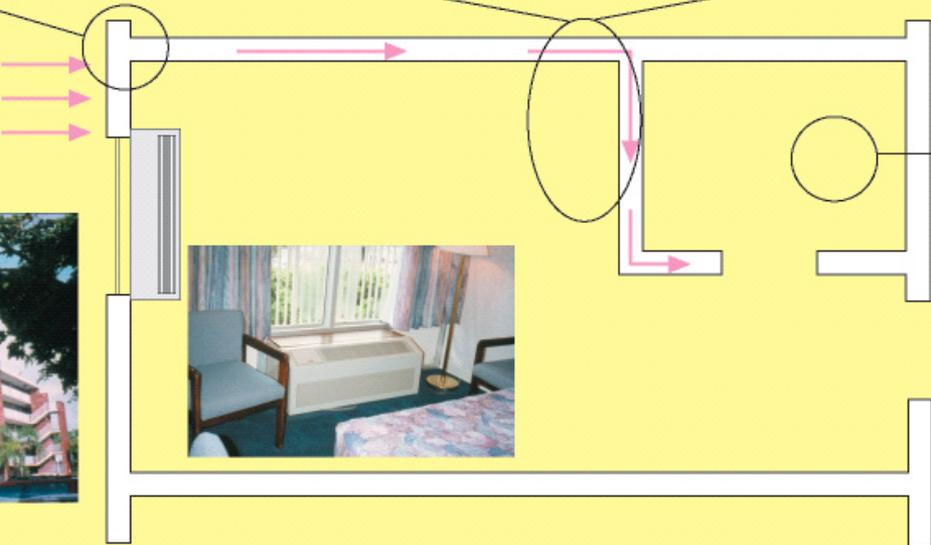
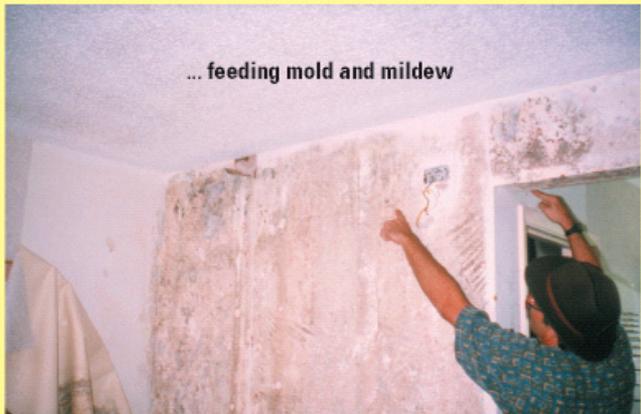
Dehumidification capacity of the pretreatment unit must be quantified at the peak dew point design condition.

2. Drying Ventilation Air Deeply

Avoids Additional Equipment Cost



Duct leaks cause mold?... YES!

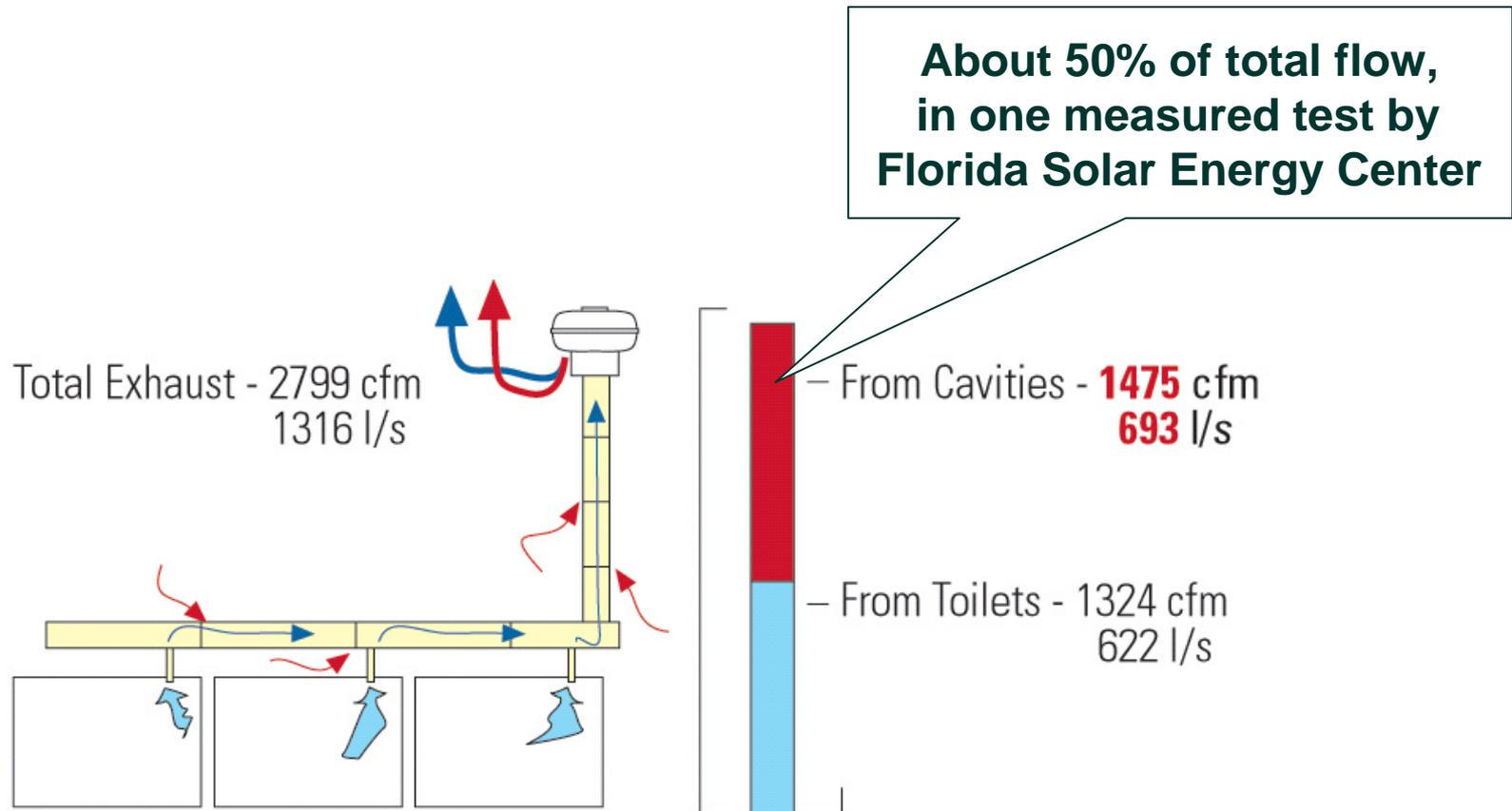


All because leaking exhaust duct connections create suction inside building cavities



The importance of sealing ALL duct work

(How much air could really be infiltrating?)



The Federal Government is Being Proactive...

Chapter 5 of the P-100 Facility Standard now requires:

- **1. Dedicated ventilation system which dries air to 50°F dew point, all the time**
- **2. Positive internal air pressure (until outdoor temperature falls below 37°F).**
- **3. 24-7 dehumidification (at reduced air volume during unoccupied hours)**

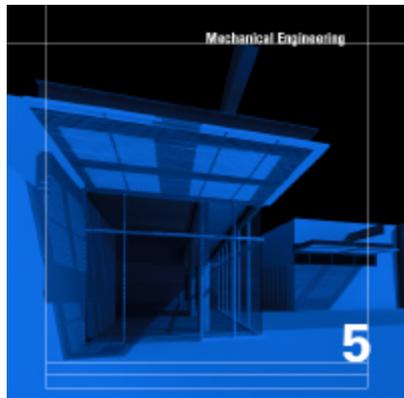
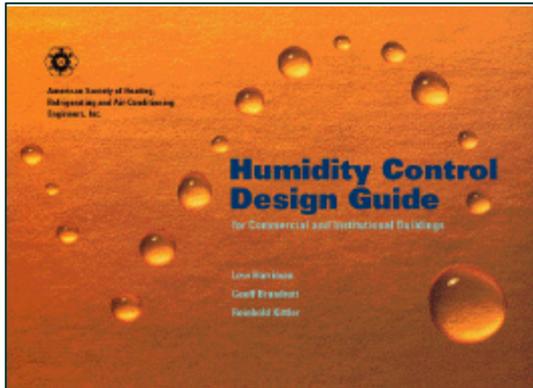


Summary - Architect & Engineer

- 1. Keep rain off the walls
- 2. Keep water away from the foundation
- 3. Make the flashing effective
- 4. Dry all ventilation air, all the time
- 5. Think positive
- 6. Seal all air duct connections



Information Resources



- **ASHRAE Humidity Control Design Guide (\$125.00 Purchase at www.ASHRAE.org)**
- **ASHRAE Electronic publication “Mold & Moisture Management in Buildings” (\$45.00 PDF only - purchase and download at www.ASHRAE.org)**
- **Federal Facility Standard (P-100 Chapter 5) - Search internet using:**
 - **“P100 Federal Facility Standard”**

