



# ***Energy and Moisture Control in Hawai'i Buildings***

Building Science Applications

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## ***Key Ideas***

- Dry not cold
- Manage the outdoor interface
- The devil is in the details



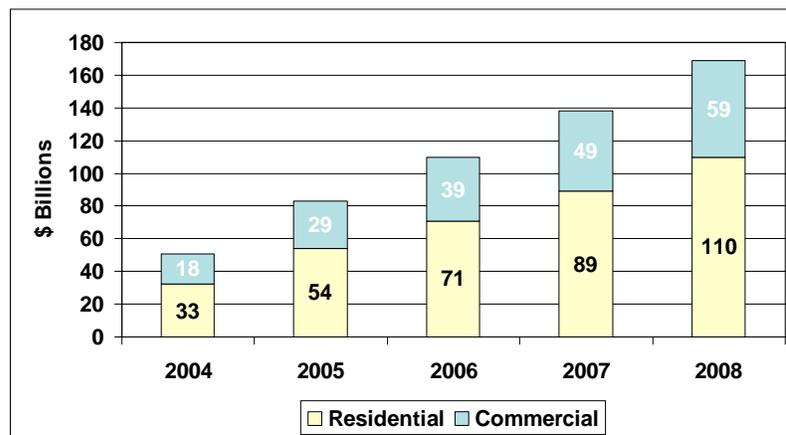
## Case Study: Hilton Hawaiian Village

- Kalia Tower, with more than 400 rooms, completed in 2001
- \$95 million building
- History of moisture control failure
  - ◆ Mold found early 2002
  - ◆ Tower closed June 2002
  - ◆ Tower reopened September 2003
- More than \$55 million in cost to Hilton



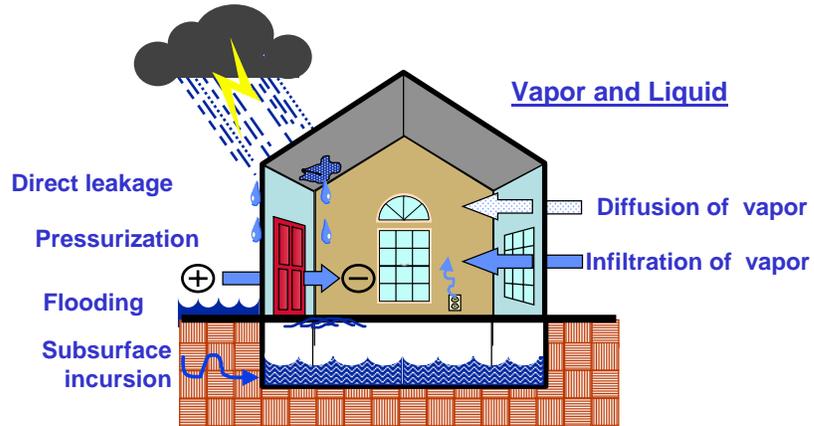
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## US Real Estate Assets at Risk for Moisture Related Failures

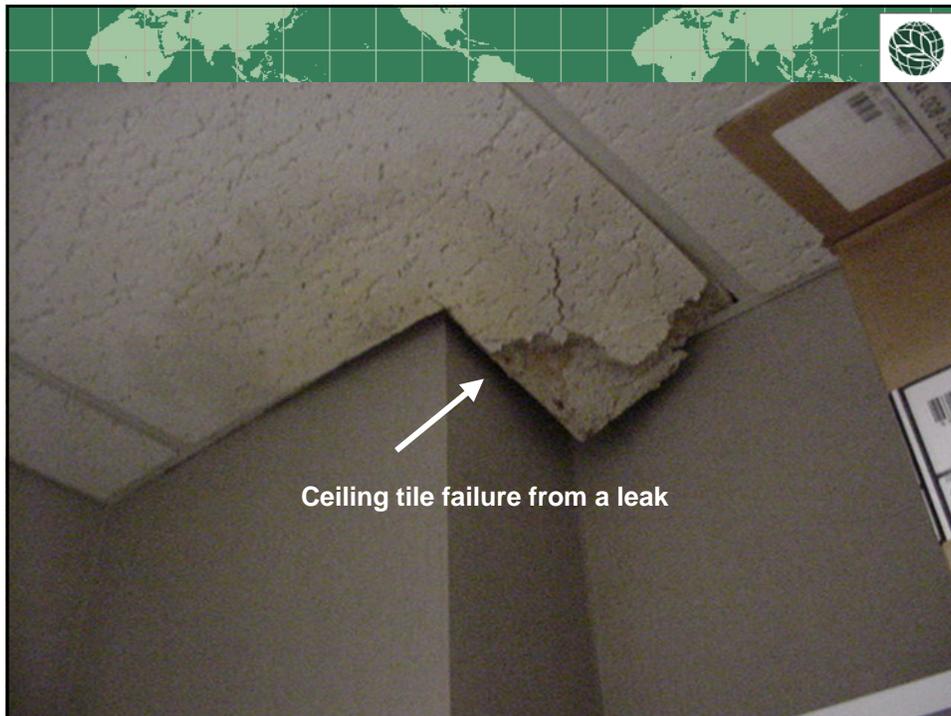


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## *Exterior Sources of Moisture*

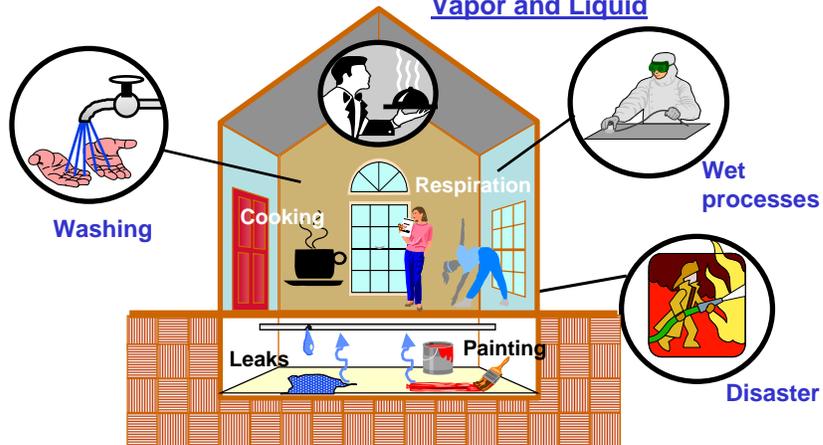


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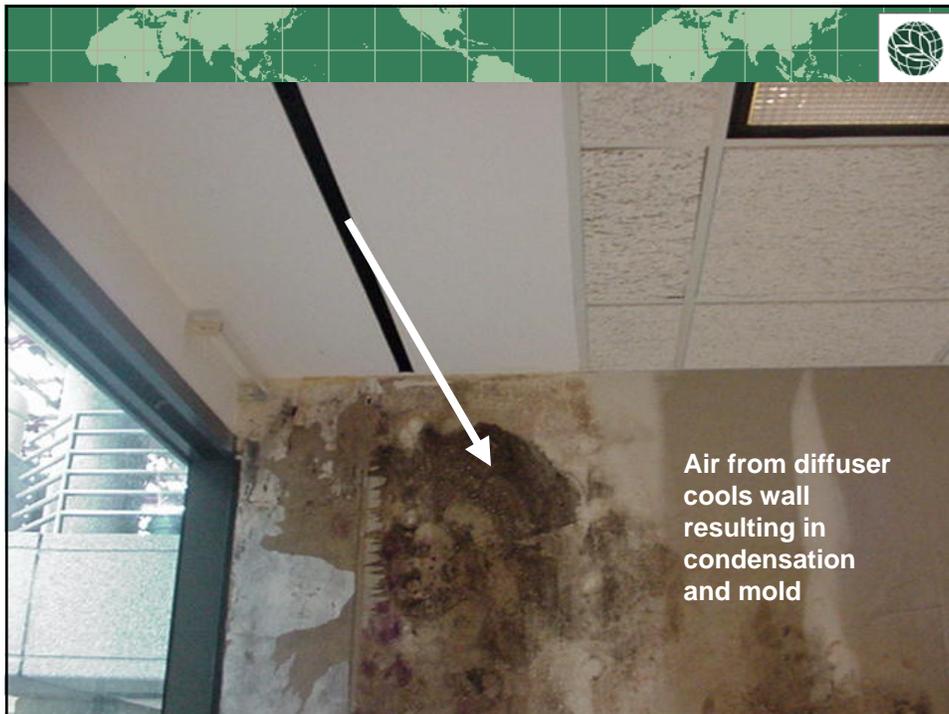


## *Interior Sources of Moisture*

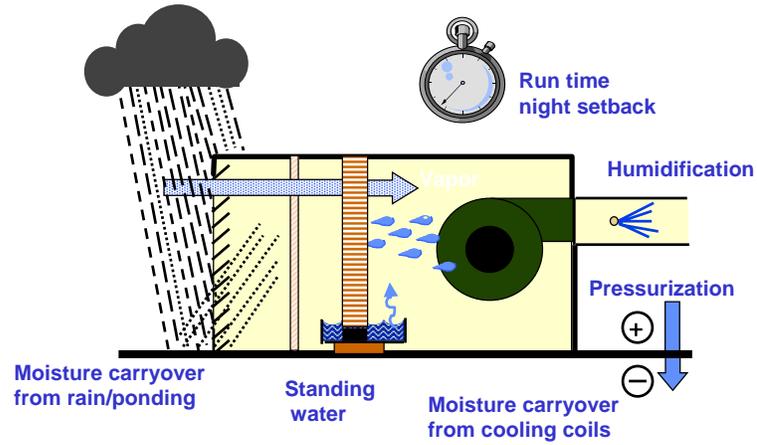
Vapor and Liquid



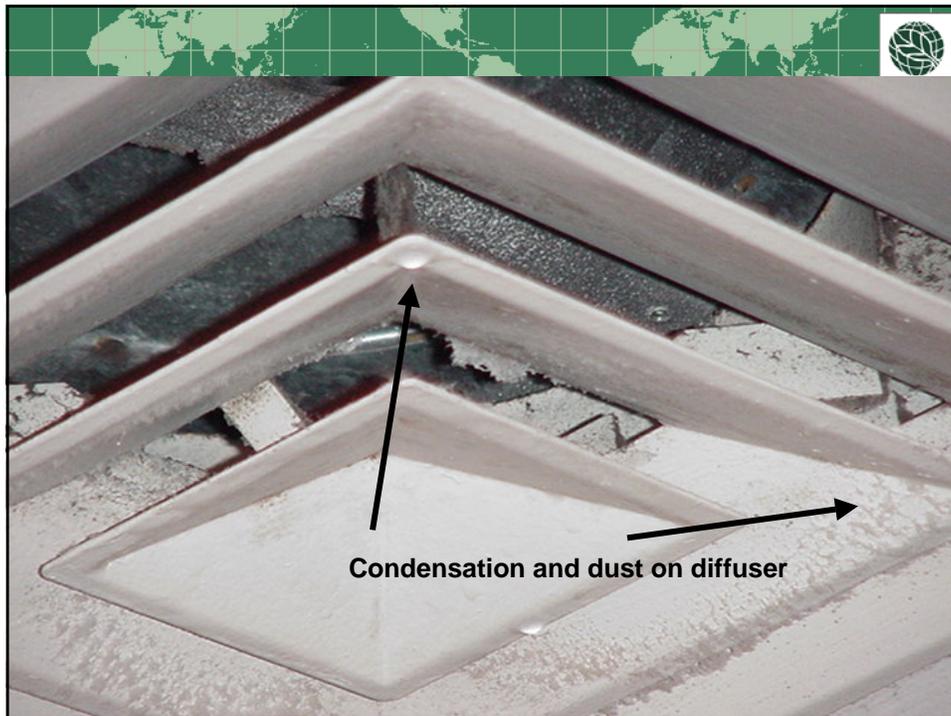
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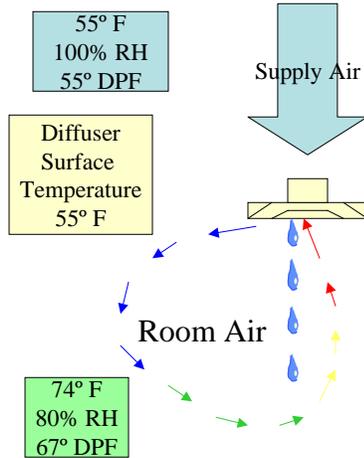
## *HVAC System Sources of Moisture*



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## Who'll stop the rain?



### Problem:

- ♦ As long as diffuser surface temperature is below room dew point, it will rain
- ♦ Dirt and mold accumulate on the diffuser

### Solutions:

- ♦ Reheat supply air to room dew point
- ♦ Reduce room air dew point to below supply air temperature

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## Architectural Hotspots

- Leaks, drainage, wind-driven water intrusion
  - ♦ Design and construction of flashings and penetrations is a critical factor in both moisture and energy management
  - ♦ Maintaining the building envelope saves energy as well as preventing dampness and mold
- Condensation points
  - ♦ Outdoor-indoor interface in an "open" design
  - ♦ Insulation and vapor barriers in mechanically cooled buildings
- Materials selection
  - ♦ Why modern buildings have more moisture problems

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## ***Mechanical Issues***

- Dehumidify
  - ◆ Deliver air with a dew point temperature of less than 55° F
- Ventilate
  - ◆ Deliver at least ASHRAE Standard 62-2001 amounts of outdoor air, clean and dry
- Pressurize
  - ◆ Keep a slight positive pressure on the building envelope

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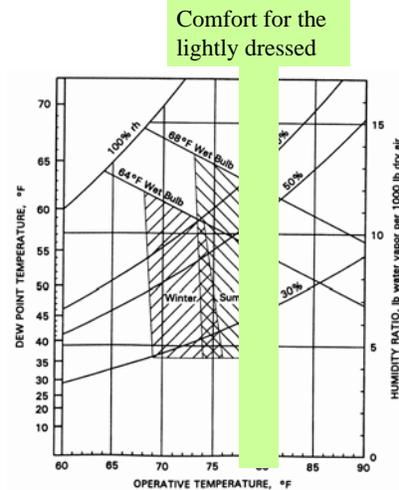
## ***East to say... hard to do...***

- How can I ventilate, pressurize *and* meet dew point temperature of less than 55° F and not bust the energy budget?
- How can I control the outdoor interface and meet occupant expectations?
- How can I attend to any more details in building operations?

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## Solution Set #1

- Deliver dry air rather than cold air
  - ◆ Reheat or desiccant dehumidification in central systems
  - ◆ Apply to mixed natural and mechanical
  - ◆ Shoot for 78° - 82° F, 30 – 60% RH, or 50° - 55° F dew point



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## Active Dehumidification

- Control to dew point rather than relative humidity
- Separate latent load (humidity) from sensible load (temperature) for control
- Use desiccants for energy efficiency
- Can be integrated or stand alone

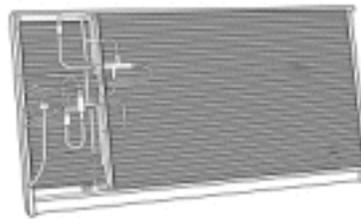


Modular Dehumidification Unit

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## ***Package Rooftop Dehumidifier Option***

- Uses refrigerant cycle to subcool and reheat
- Control on interior space humidity or dew point
- Sustains energy efficiency



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## ***Solution Set #2***

- Manage the outdoor interface to minimize dew point conditions
  - ◆ Deliver dry, ambient temperature air to interface areas
  - ◆ Choose stone and non-porous surfaces at interface
  - ◆ Avoid vapor barrier creation on adjacent interior surfaces

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## Surface Dew Point Control

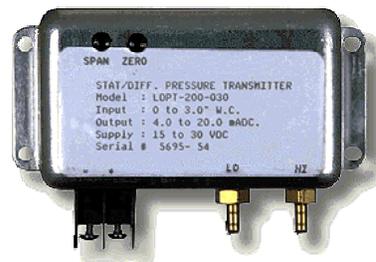


- Measure the dew point at critical surface points
- Manage temperature and humidity to keep ambient temperature  $> 10^{\circ}$  F above surface dew point

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## Pressure Management

- Reduce moisture intrusion
- Control cross-zone contamination
- More flexible space use



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## ***Instant Winners – Energy Losers?***

- Keep coil face velocity below 550 fpm
- Keep chilled water coil at 10° F below dew point
- Do not set up CHW temperature
- Do not duty cycle
- Operate systems 24/7

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## ***Take Away Ideas...***

- Dry not cold
- Manage the outdoor interface
- The devil is in the details

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