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INEXPENSIVE HVAC SYSTEM SOLUTIONS FOR HUMIDITY-RELATED IAQ PROBLEMS

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Humidity-Related IAQ Problems

- Fungi and bacteria find moisture and nourishment in HVAC system coils, ducts, and cooling towers.
- Excess space humidity allows microbial growth on ceiling tiles, wall paper and in carpet. Cleaning and replacement is costly.
- These agents can make you sneeze, trigger allergic reactions, cause rashes, watery eyes, hoarseness, coughing, dizziness, lethargy, breathing problems, and digestive problems.



Humidity-Related IAQ Problems

- Fungi and bacteria are so common that complete control over them seems unlikely.
- The number of people with asthma has increased significantly since 1979.

Sinusitis is the leading chronic disease in the U.S., affecting over 35 million people. Recent medical breakthroughs suggest that much of this disease burden may be caused by fungal infections. We suspect that common (and solvable) humidity-related IAQ problems may be responsible for much of this problem.

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Design Practices

- Much of the U.S. is outside of the hot & humid climate region.
- Required fresh air flow rates were greatly increased in 1989 to improve IAQ.
- Key HVAC system dehumidification practices date back to the late 1960's.
- Increased R-values and lighting efficiencies have reduced the sensible cooling load.
 - *For these and other reasons, HVAC systems can not always adequately dehumidify the space.*



Design Phase Warnings

1. Outside air fraction greater than 20%
2. Constant uncontrolled outside air flow
3. High efficiency lighting system
4. High R-value roof and windows, shaded site
5. Complex footprint with many joints
6. Numerous wall and roof penetrations
7. Large exhaust fans or exhaust hoods
8. Equipment oversized for rapid cool-down
9. Variable or unpredictable occupancy
10. Suspended ceiling used as return air plenum



The Dirty Dozen

1. Carpet that is not regularly steam cleaned
2. Ceiling Tiles that are wet
3. Condensate Drain Pans with standing water
4. Low Efficiency Filters and Filter Bypassing
5. Fresh Air Amount that is too little or too much
6. Fresh Air Intake near contaminant sources
7. Coils that are not regularly cleaned
8. Leaking or non-existent ducts
9. Ponding of rain water on roof or ground
10. The Cooling Tower
11. Dehumidification Capacity that is inadequate
12. Uncontrolled Airflow into Building

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9 of 12 are *HVAC Related*

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The IAQ-ENERGY-HVAC Link

- Excess Humidity leads to Fungal Growth
- Fungal Growth causes many IAQ Problems
- HVAC Systems *[should]* Control Humidity

The most energy efficient humidity control strategies cost 60-70% less to operate than the most common, least efficient method: reheat.



“Solutions” for Existing Buildings

REHEAT

Activated Carbon

Preconditioner

OZONE

Duct Cleaning

Desiccant Dehumidifier

Ionization

Electrostatic Precipitator

Filtration

Purge Cycle

Photocatalytic Oxidation

Ultraviolet Irradiation



Microwave Atomization

Space Pressurization

Humidistat

LPS Exhaust



Solving an IAQ problem ...

- o Which IAQ technology is best?*
- o What is the cause of the IAQ concern?*
- o What is the best way to find a solution?*

“Simply put, the best solution is the one that permanently solves the root cause of the IAQ or energy problem at the lowest possible cost.”



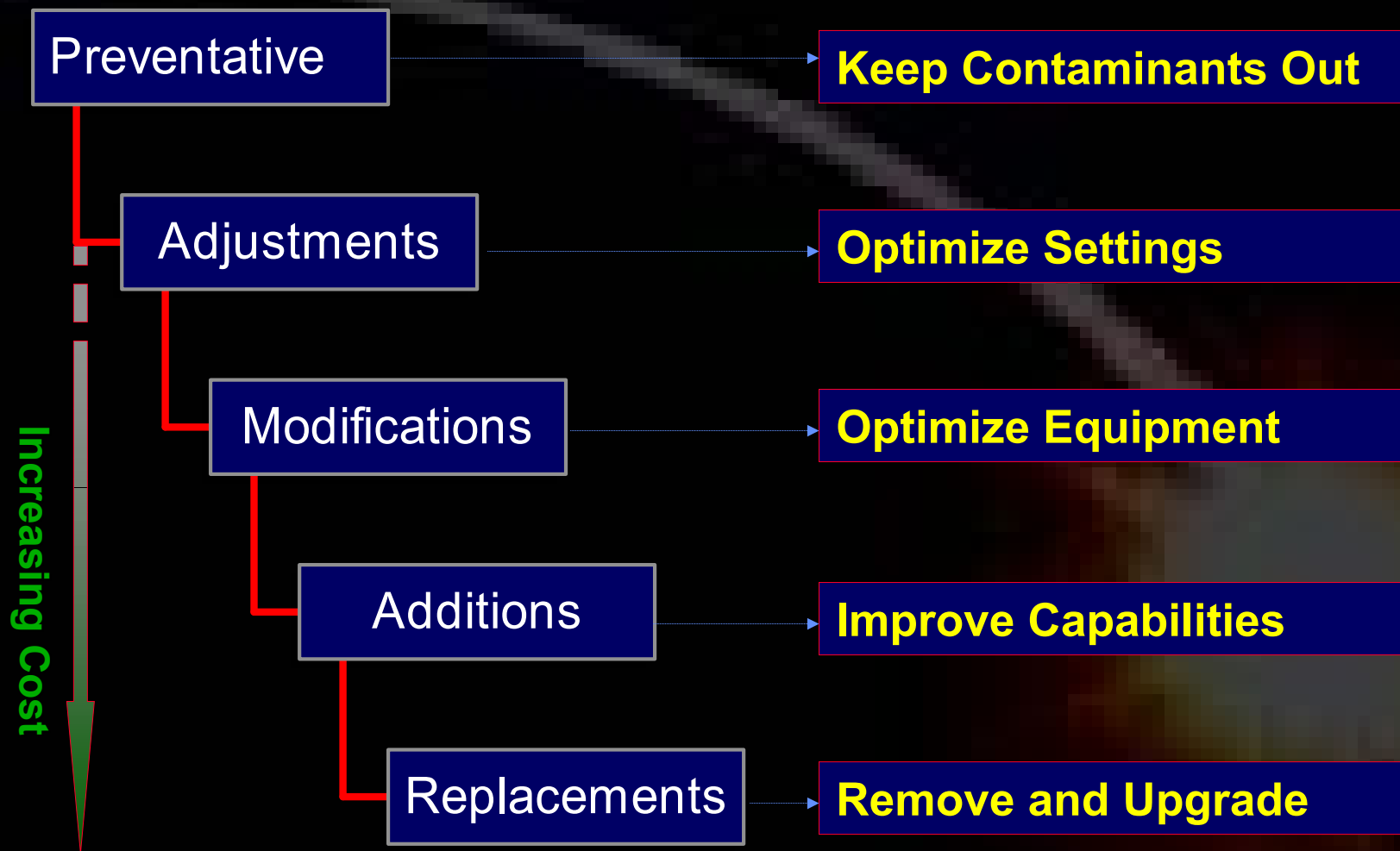
Phased Diagnostic Approach

- **Classification of Solutions into a five-level system**
- **Lowest cost measures are the first to be considered**
- **Most expensive options are treated as a last resort**

“...provides the framework for a consistent, cost-based method of developing and ultimately implementing the best solution from among numerous mutually exclusive possibilities.”



Five HVAC Solution Levels



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Symptomatic *vs.* Real Solutions

- Problems often worsen or resurface following symptomatic treatments.
 - Carbon Filters to reduce odors
 - Portable Dehumidifiers or Space Heaters
- Identification of the *Root Causative Factors* usually leads to a permanent solution.
 - Begin with an investigation to determine the source of contaminants, amplification/incubation sites, and pathways to the occupants.



Case Studies

- Case Study #1
 - Facility: Health & Fitness Center
 - Location: Orlando Area
 - Problem: Mold Growth on Ceiling Tiles

- Case Study #2
 - Facility: County Library
 - Location: Tampa Bay Area
 - Problem: Employee Illness

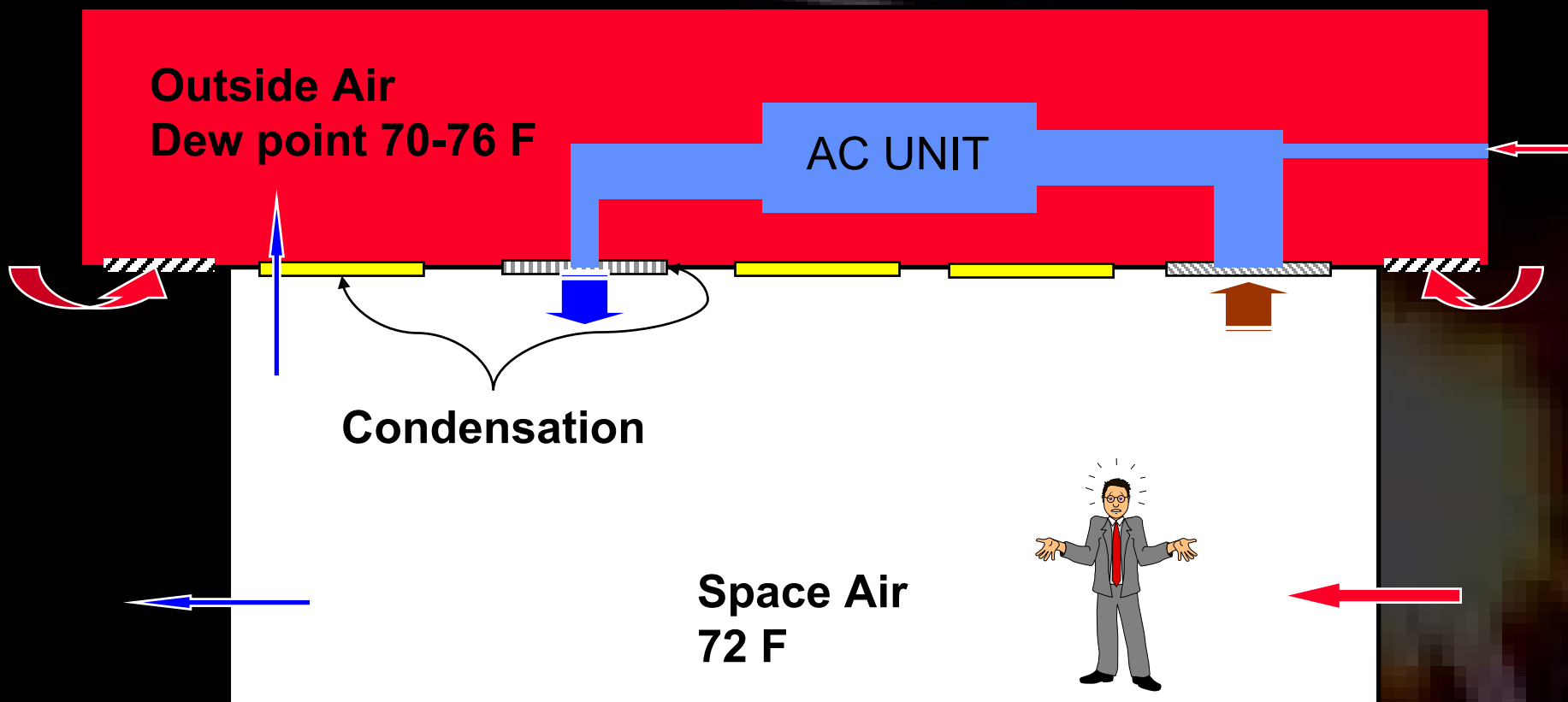


Case Study #1: Fitness Center

- Symptoms included:
 - Mold growing on ceiling tiles
 - Sagging ceiling tiles
 - Water dripping from light fixtures
- Symptomatic “solution”:
 - Tile contractor installed a large exhaust fan to “vent humid air out of the attic space” above the suspended ceiling.

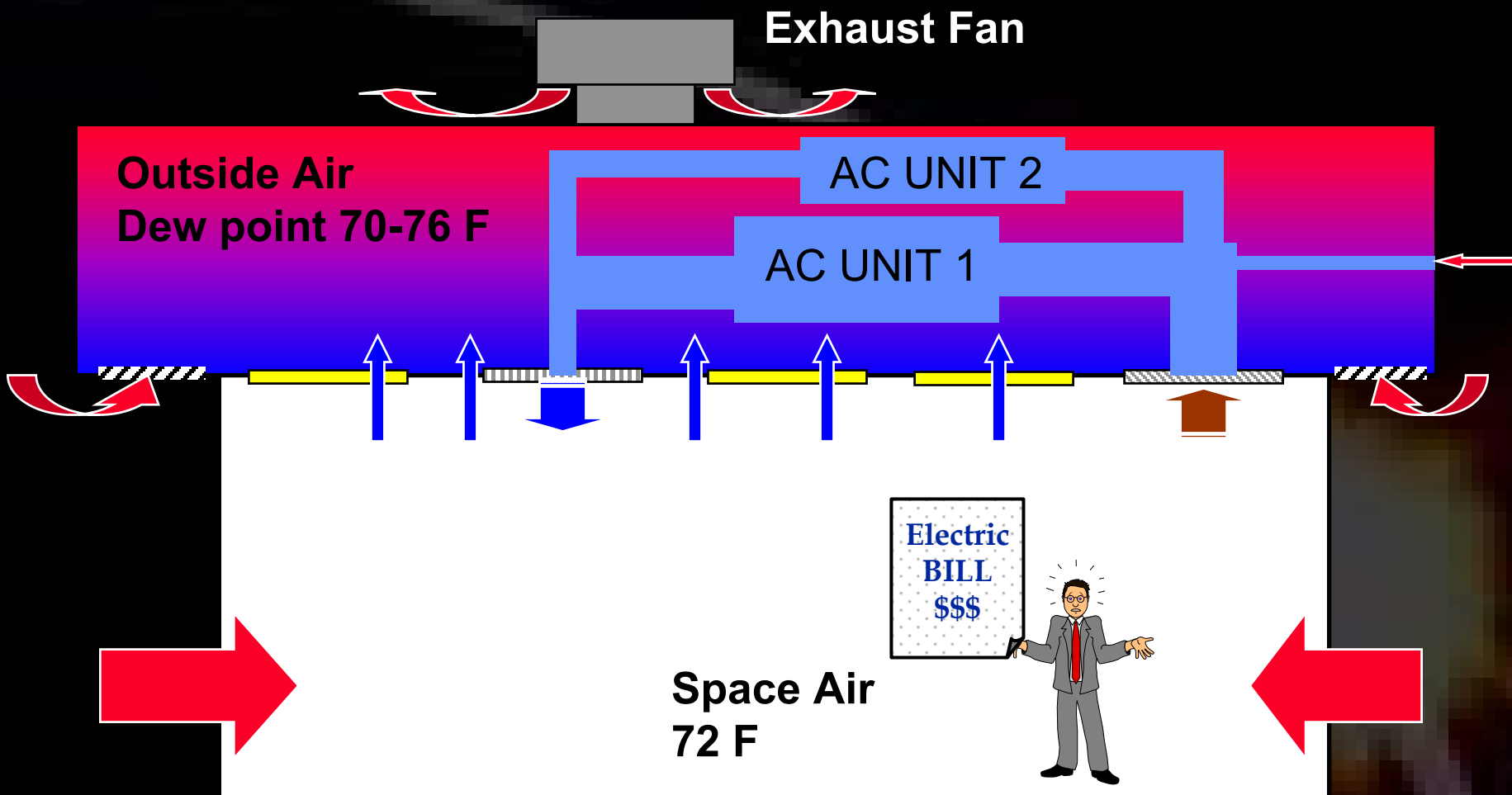


Case Study #1: Fitness Center





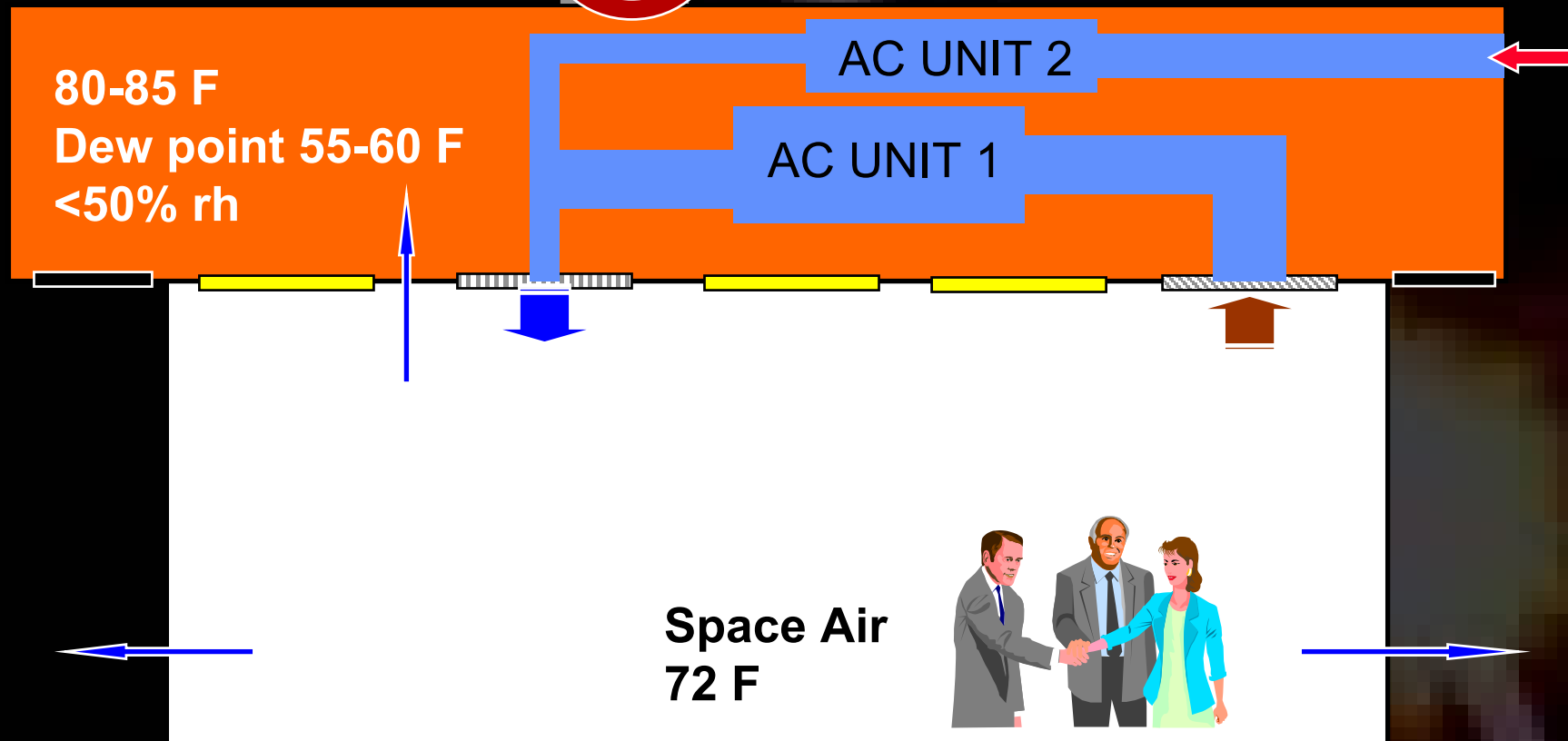
Case Study #1: "Poor Solution"





Case Study #1: SOLUTION

Outside Air
Dew point 70-76 F



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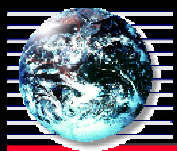
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Case Study #2: County Library

- Symptoms Included
 - Humidity levels of 70-90%rh
 - Mold Growth on Books
 - High Incidence of Worker Illness
- A phased diagnostic approach was used to develop solutions at each cost level.



Case Study #2: County Library

- Findings:
 - Ceiling return plenum vented to outdoors
 - Mold growth on tiles and roof trusses
 - Thick fungus growing in cooling coil
 - Low-efficiency filters
 - Air bypassing filters -- filters too small
 - Excess, contaminated outside air flow rate
 - Glue fumes from bookbinder
 - Low dehumidification capacity



Case Study #2: Moldy Ceiling Tiles



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Case Study #2:

Moldy Return Plenum above Ceiling



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Case Study #2: Moldy Cooling Coil



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Case Study #2:

Mold Near Fresh Air Intakes



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Case Study #2: Mold in Roof Ponds



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Case Study #2: Cooling Tower Near Intakes



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Case Study #2:

Tower Water Contaminated



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Case Study #2:

I. Preventative Measures

- Sealed return plenum from outdoors
- Cleaned and sanitized coil and AHU
- Cleaned roof and cooling tower
- Installed 60%-efficiency pleated filters
- Repaired exhaust fan over bookbinder
- Books cleaned or replaced

RESULT:

- + Humidity levels dropped to 55-80% rh (from 70-90%)
- + Fewer complaints

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Case Study #2:

II. Adjustments

- Set outside air flow to proper amount
- Reset TXV superheat setting
- Reduced fan speed to design spec

RESULT:

- + Humidity levels dropped to 50-70% rh
- + Fewer complaints and no new mold growth

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Case Study #2:

III. Modifications

- Installed automatic damper on outside air intakes to close when unoccupied
- Installed occupancy sensors to control bookbinder and rest room exhaust fans
- Installed transfer grilles between binding, office, and stack areas

RESULT:

- + Humidity levels dropped to 50-60% rh
- + Complaints subsided



SUMMARY

- Excess Humidity leads to fungal growth.
- The cost range of humidity control strategies is wide.
- There are now many solution options.
- The best solution permanently solves the root cause of the IAQ problem at the lowest possible cost.
- A phased diagnostic approach to identifying the best solution works well.
- Symptomatic solutions are rarely permanent ones.
- Real solutions often provide the added benefits of lower energy costs and increased productivity.