Help, it's running and I can't turn it off!

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ARCH 591 :: Winter 2010

Introduction

Chris Deel and his wife Colleen live in a two-bedroom, one-bath, 700-square foot apartment on the second floor of the Spencer View Apartments. The 272 units were built in the mid 1990s in a style common to the area.

Each unit is supplied with special instructions about controlling moisture problems and includes a timer-controlled fan. This led us to believe that the intent of the bathroom fan/timer system is to control mold/mildew growth by reducing humidity. The automatic timer runs the fan about 2 hours in the morning, and another 2 hours at night, plus any time the bathroom light is on.

In February, the average afternoon low RH in Eugene is 73% - a good time to study humidity conditions at their highest.

Hypothesis

The bathroom fan's automatic daily run-time is more than is required to control wintertime humidity in the apartment with 2 occupants.

Methodology

To test our hypothesis, we decided to record existing apartment conditions, then install a dehumidistat to run the fan when relative humidity reached a certain level.

Step One: Recording Existing Conditions
A log of temperature, relative humidity, and light was recorded using HOBO data loggers. Chris and Colleen kept a written log of fan run times, as well as the time and duration of activities likely to affect apartment humidity. This data was logged from Tuesday February 16 until Saturday February 20.

Step Two: Selecting a Set Point for the Dehumidistat
Ray Ranson's "Healthy Housing – A Practical Guide," recommends a RH range between 30% and 70%. We knew from our preliminary data that RH recorded by a HOBO near the ceiling was consistently about 5% higher than levels recorded by a HOBO placed four feet below the ceiling. To simulate a realistic installation, we mounted the dehumidistat at hand height (approximately 4 feet from the floor), and chose a set point of 65% in order to keep the ceiling (highest) humidity below 70%.

Step Three: Installing the Dehumidistat
Following safe electrical working practices, we disabled and removed the timer device and replaced it with a dehumidistat to control the bathroom fan. We added a temporary light fixture to the circuit and placed the bulb near one of the HOBO data loggers, creating an indicator to track fan run time.

Step Four: Revisiting the Set Point
After logging data for several days, we determined our initial set point of 65% was incorrect, as the bathroom ceiling humidity was remaining above 70% for long periods. To address this, we lowered the dehumidistat to 60% and restarted data collection.
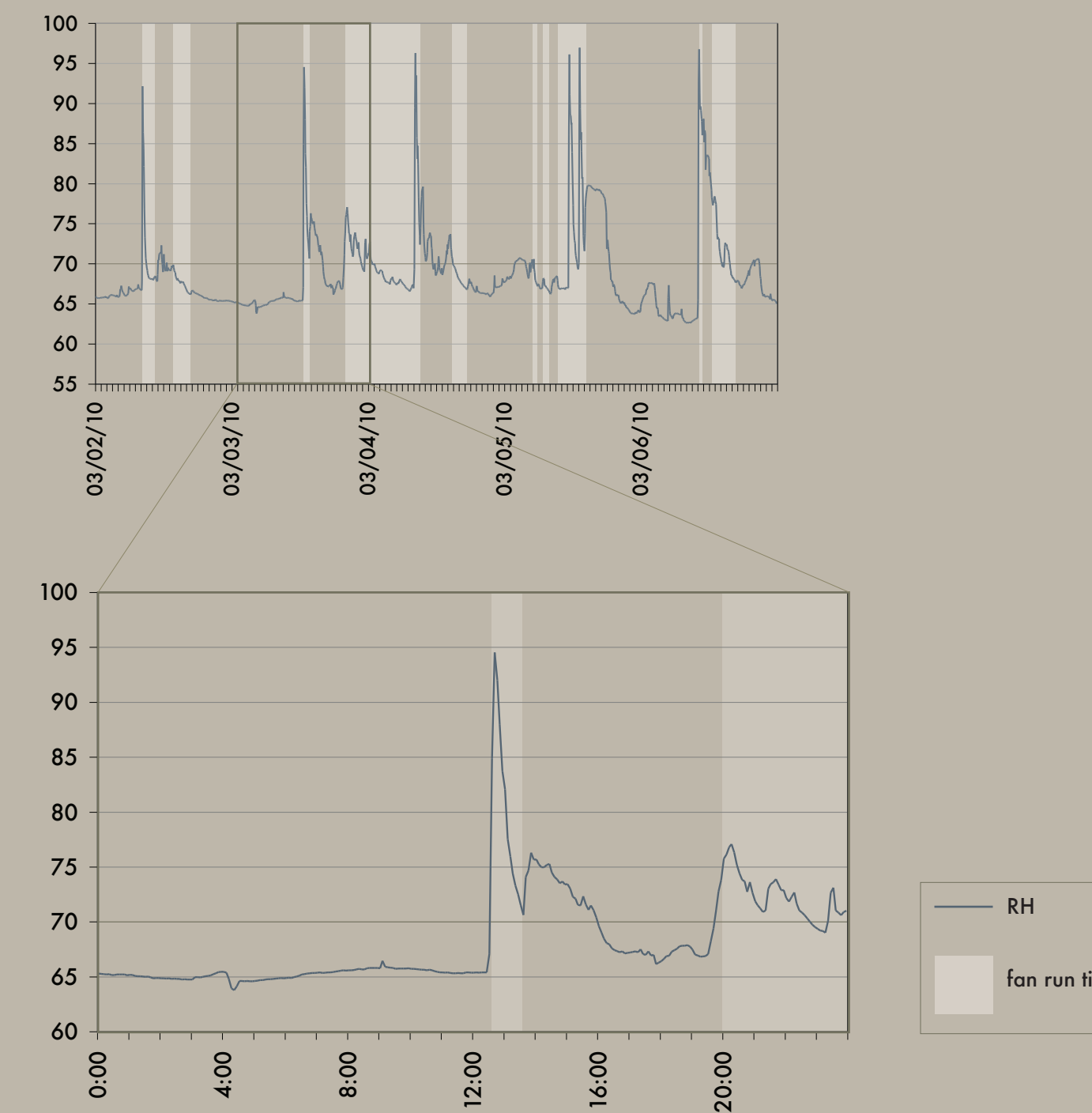
Step 5: Recording Modified Conditions
Data collection for the dehumidistat-controlled fan set to activate at 60% RH ran from Tuesday March 2 until Saturday March 6.
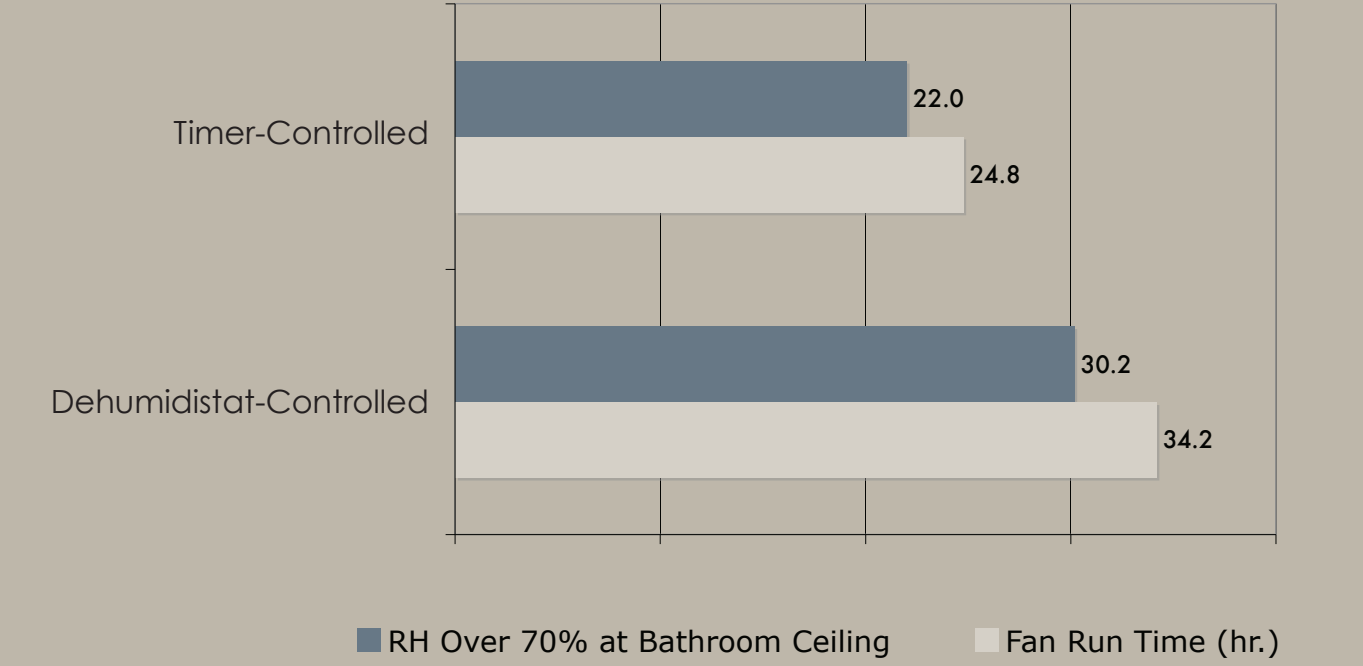
Timer-Controlled Fan

Dehumidistat-Controlled Fan

Legend: RH ; fan run time
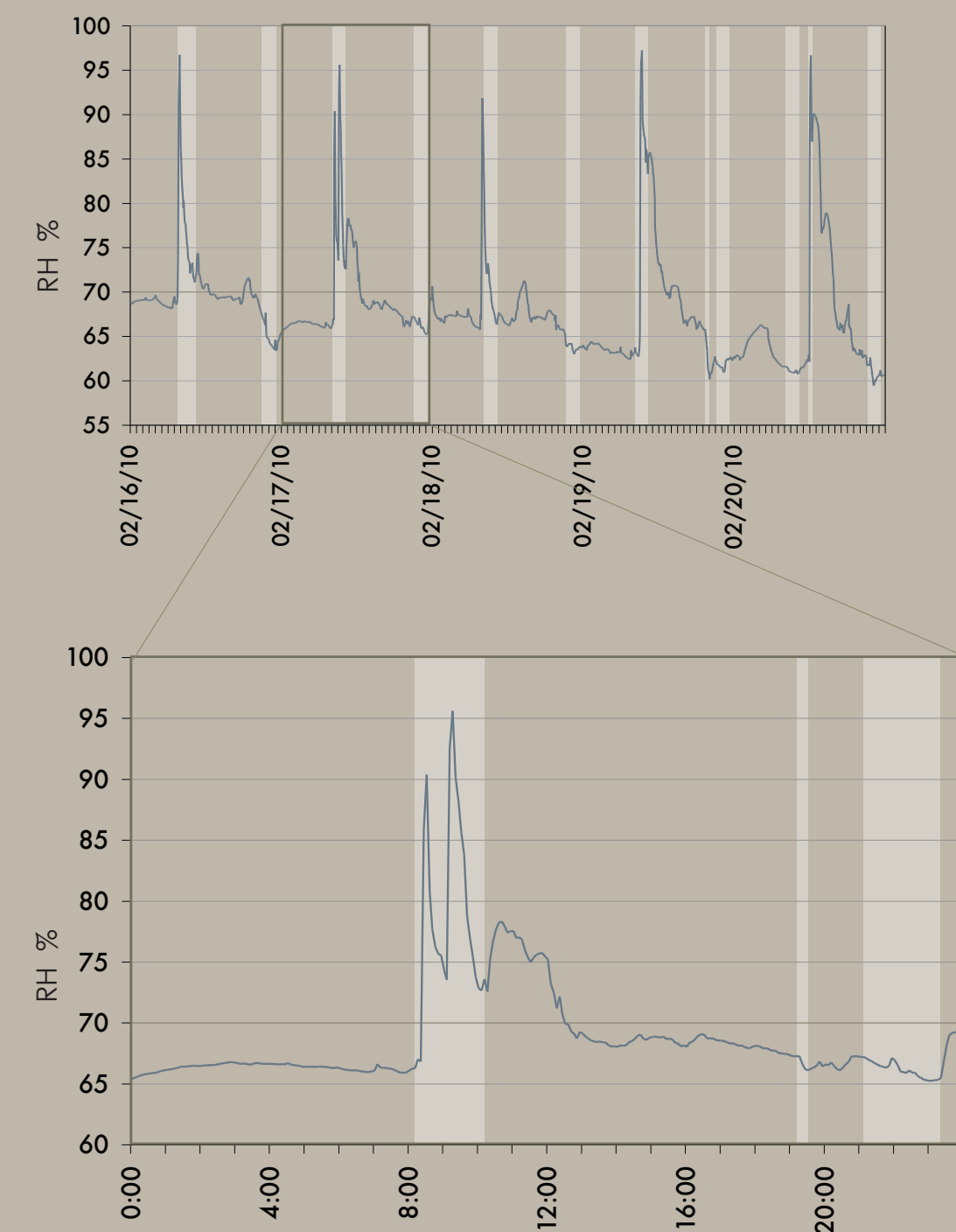
Fan Run Time and RH over 70%

	RH Over 70% at Bathroom Ceiling	Fan Run Time (hr.)
Timer-Controlled	22.0	24.8
Dehumidistat-Controlled	30.2	34.2

Conclusion

After measuring the conditions with the timer-controlled fan, we determined that fan run time did not always correlate with humidity events in the apartment.

The dehumidistat-controlled fan disproved our hypothesis by significantly increasing run time. This additional fan use may have caused the bathroom relative humidity to remain above 70% for more time.

Additional research points out that the dewpoint at cold surfaces (such as a toilet tank) causes condensation and results in mold growth. Therefore controlling the dew point and surface temperatures (rather than simply RH) may be the key to preventing mold problems.

Design Lessons

Ventilation: Ventilation can improve air quality and reduce humidity. However, the dehumidistat experiment does not clearly show that an exhaust fan reduces indoor humidity.

Envelope: Spencer View Apartments are designed with a tight envelope. The bathroom fan's large capacity is intended to improve air quality in the entire apartment. Without an intake for fresh air, how can running the bathroom fan improve air quality in the apartment?

Heating: Since cold surfaces can cause condensation, and lead to mold growth, a further step could investigate surface temperature and dew point in the apartment. Even though temperatures are comfortable to energy conscious occupants, might heating be required to prevent mold growth?

Outside Events: In the close quarters and closed system of the apartment, the kitchen is a significant source of humidity. How can the kitchen be designed to encourage adequate ventilation?

Shower
RH % - Wednesday February 17, 6:00 - 10:00 AM
- kitchen
- living room
- bathroom low
- bathroom high

Cooking and Baking
RH % - Wednesday March 3, 6:00 - 10:00 PM
- kitchen
- living room
- bathroom low
- bathroom high

HOBO Data Loggers