Martin County Courthouse - The Untold Story

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Maintenance and Operation

The design of the Martin County Courthouse Complex called for the fan coil units to be placed above the ceiling in very limited space. As a result, the sides of air handling units were within 2 feet of solid walls. The placement of furniture, files, fixtures, and office equipment further obscured access to these units. This setup made service of the units and diagnosis of airflow problems difficult at best. Even when efforts to maintain the systems were stepped up, access problems made maintenance of the system a nightmare.

Initial maintenance on the facility was not adequate. Throughout the course of the investigation and the process of the trial, it became understood that the complex went without proper maintenance for extensive periods, or was maintained by inadequately trained workers. For example, these workers had problems changing the filters in the air handling units; the filters often were found next to the units, never installed.

Maintenance personnel changed water and airflow settings. Maintenance records also show that the outdoor air intakes to several units were shut off in attempts to bring the building under control. Under the guidance of health officials, toxicologists, and design engineers, the ill-fated decision to operate the system 24 hours a day was made. This continuous operation could only elevate relative humidity and worsen condensation in the walls. Because of poor system performance, less moisture was removed at the individual fan coils than was transported in the nighttime air. The idiosyncrasies of the system's flawed design, combined with the particular climate considerations for this location, conspired to make continuous operation a bad strategy in this case.

Failed Corrective Attempts

Table 2.1 summarizes some of the efforts made to bring the complex back under control. In the face of all these failed attempts, the basic premise is still worth repeating: The system was fatally flawed by design. Changes in the control system would have only exacerbated the conditions.

TABLE 2.1 ATTEMPTED CORRECTIONS AFTER THE ONSET OF PROBLEMS

ACTION	INTENDED RESULT	PROBLEM	ACTUAL RESULT
Operated cooling system continuously	Dry out building	• Reduced loads at peak hours • Prolonged outdoor air intake	• Reduced moisture removal • Added 590 gallons of water per day in summer to the building
Lowered cooling setpoint	Dry out building	• Condensation within wall assembly • Increased vapor pressure differential across envelope	Increased moisture incursion
Reduced airflow on certain fan coils	Improve moisture removal	• Defeated by improper water flow balancing to implement 10°F rise across coils • Standby pumps operated in parallel in attempt to improve inadequate flow caused by inadequate balancing	• Fan coil units deprived of adequete water flow, preventing proper moisture removal • Pump energy wasted
Outdoor air intake dampers forced closed	Lower relative humidity	Dilution ventilation reduced	Concentrations of odor-causing agents increased
Chemicals used to “clean up” and arrest mold and mildew	Reduce odors and visible growth	• Untrained application of chemicals • Favorable conditions for growth persisted	Quaternary ammonia, chlorinated compounds, even glycol introduced to indoor environment
Ducts cleaned and treated	Reduce odors and indoor air quality complaints	• Root causes unaddressed • Contaminants disturbed and spread • Outdoor air damper settings changed without test and balance	• Additional chemicals introduced to indoor environment • 50% of illnesses reported within 30 days of cleaning • Complaint rates skyrocketed
Control system programming modified	Reduce complaints	• Improper system sequencing • Improper fan coil unit interlock to outdoor air fans, introducing humid air at low load conditions	• Humidity control further disrupted • Supply of unconditioned air to inactive fan coil units
System testing	Identify and document problems	• Office Building not tested, no balancing performed	• Tests revealed serious air balance, water balance, and control problems • Results apparently not reviewed

Early Warnings Ignored

Upon review of the buildings’ records, it became evident that many red flags were ignored. These were early warnings that should have alerted the county that serious and immediate response was required. Martin County received good advice initially, much of which went ignored for too long.

- The original heating, ventilation, and air conditioning (HVAC) contractor suggested preconditioning outdoor air, bringing in a third-party engineer, and modifying fan coil units with face and bypass dampers.

- Florida's Occupational Safety and Health Administration representative suggested prechillers for conditioning outdoor air in 1990.

- Martin County's own personnel indicated in a 1990 memo that it probably was a mistake to eliminate prechillers on the buildings.

- A testing and balancing company recommended splitting the coils on the fan coil units in 1990.

- The Martin County Health Department recommended that an independent engineer be hired for design review (not done until 1993).

- An environmental firm called for control of humidity in 1991.

- A local engineer stated "any cleaning of the ductwork would be for naught if no HVAC changes were made."

- The State of Florida's Department of Health indicated that the fresh air was inadequate for the facility and there was an indication that smoking was continuing inside the building.

Design Modifications

Three separate letters from the original designers indicated that the system "was not designed to control humidity." In a later letter, an effort to explain the problems with the building, the original designers stated that occupancy and use were different from those anticipated.

In mid-1992, qualified engineering help was brought in, 3 years after the problems began. These engineers recommended pretreating the outdoor air, and made recommendations to modify the distribution of the outdoor air to the Office Building fan coil units. Pretreatment units were installed and activated. According to the design engineer of the pretreatment units, the units removed 900 gallons from the Courthouse outdoor air in the first day of operation. The relative humidity in the building fell to 55% that day, and the chilled water lines throughout the building stopped sweating. Maintenance personnel supported these statements in testimony during the trial.

But changes to the HVAC system were only completed in September 1992, just 3 months before the Courthouse was abandoned. No significant attempts to clean up visible mold or mildew appeared to be made after the outdoor air pretreatment units were activated.

Lessons Learned

Proper pretreatment and distribution of outdoor air is vital to control moisture and avoid microbiological amplification, particularly in hot and humid climates. Depressurized buildings draw moist air through the envelope imperfections, exacerbating moisture-control problems associated with inadequate HVAC systems and misplaced vapor retarders.

Successful building design requires engineering expertise on the relationship between the mechanical systems and the building envelope. It's important to try to recognize the need to augment engineering expertise before it's too late and failure is imminent. Use of identified, quantitative standards for building performance will help in recognizing and acknowledging the severity of problems.

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