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Multiple Complications in an Occupied Home



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Remediation contractors and those developing remediation protocols are often faced with unusual challenges deriving from the specifics of the building, the location and types of contamination, as well as from limitations placed on remediation procedures by building owners or by local building code regulations. This case study discusses the multiple challenges faced on one mold remediation project and how they were handled.

The building in question is a 12-story, 142-unit waterfront condominium complex on Florida's Gulf Coast. Built in 1980, it was one of the first post-

tension concrete structures in the area.

The building has had a variety of moisture-intrusion issues over the years ranging from envelope intrusion through deteriorated roofing and stucco walls to pinhole and major plumbing leaks. Due to the construction methods and materials used, low-volume envelope and plumbing leaks were seldom detected quickly, leading to microbial growth in wall cavities. Although high-volume plumbing leaks were generally discovered quickly, restoration procedures were seldom successful in returning materials to appropriate moisture content quickly enough to prevent microbial amplification. In 2004, an effort was started to address years of deferred maintenance and resulting moisture and microbial issues. During 2004 and 2005, the roof was replaced and stucco exterior walls were repaired and repainted. These procedures largely eliminated the roof and the exterior walls as sources of ongoing moisture intrusion.

The particular project being discussed in this case study is a penthouse unit about 3,000 square feet in size, with two bedrooms and three and a half bathrooms.

Its flooring materials are ceramic tile, marble and carpeting. The wall finishes include latex paint, mirrored walls (glued directly to drywall) and vinyl wallpaper. Mirror and wallpaper finishes are highly effective at both preventing evaporation from the wall interior, increasing the chance of microbial amplification, and at concealing any microbial growth that does occur. The perimeter walls of the unit are made of two layers of five-eighths-inch gypsum board. Multiple layers of drywall also tend to conceal conditions inside wall cavities.

Mold growth was found in numerous locations in this unit (*See Floor Plan 1, page 5*). The apparent source of moisture in most of these areas appears to be roof leaks over the years, primarily around exhaust stacks, plumbing vent stacks, building expansion joints and the points where air-conditioning refrigerant lines penetrate the roof. Since the integrity of the roof was the responsibility of the condominium association, they agreed to pay for necessary remediation.

Roof replacement in 2005 appears to have eliminated most

moisture intrusion in this unit. However, negative-pressure issues created by continuous exhaust ventilation, stack effect and other factors appear, in some locations, to have provided sufficient humidity for mold growth to remain intermittently active. In other locations in this unit, the mold growth had probably been dormant since the leaks were stopped and materials dried out.

Pre-Remediation Investigation

The following investigative methods were used in our preliminary survey of the building:

- visual inspection for indications of past or present moisture intrusion, along with thermographic and moisture meter mapping of moisture content of materials
- viable and nonviable air sampling
- surface tape lift sampling in areas of visible mold growth and of horizontal surfaces to determine degree of settling of mold contaminants
- viable dust sampling from carpet and upholstery to determine restorability of these items and materials and to acquire data on long-term microbial conditions in the unit
- semi-intrusive (disengaging of baseboard and wallpaper) and intrusive (access holes and bore scope inspection of wall cavities) techniques to determine the extent of microbial amplification in suspect areas

The investigation found that mold contaminants in the unit were primarily limited to wall cavities and that release of mold contaminants into the occupied

space had been minimal. This allowed greater flexibility in developing remediation plans. Mold growth was found in the areas shown on Floor Plan 1.

Challenges

The owners of the unit are a couple in their nineties. We explained that the remediation process would create noise and disruption for an extended period and that they would likely be more comfortable if they relocated during remediation. The owners decided to remain in the unit while remediation was being performed, against the advice of not only our company but also of the condo board and the remediation contractor. This required us and the remediation contractor to develop innovative remediation methods that would minimize noise and disruption and speed up processing, all while documenting that these high-risk occupants were not being exposed to contaminants during remediation. Since most of the work was performed during summer and autumn months, it also meant that, if possible, the HVAC system had to remain operational throughout the remediation process.

Building rules prohibited service workers on site except between 9 a.m. and 4:30 p.m. Monday through Friday. Work time was, thus, strictly limited, and every available moment had to be used with maximum efficiency.

Mold growth was found in several areas of the unit. If all areas were remediated simultaneously, the owners would have no access without passing through a contained work zone.

To allow the owners to have continued access to the master suite, in which they intended to spend most of their time, remediation was performed in three phases, with each phase completed and documented as returned to “normal” concentrations of mold before proceeding with the next phase. A consequence of this approach was that remediation took significantly longer to complete than would have been the case in an unoccupied unit.

Yet another complication was the owners’ request that remediation work in the kitchen be performed during a planned two-week cruise vacation in the month of January. This would require removal of all cabinets and flooring, remediation of affected structural materials, documentation of successful remediation, and reinstallation of cabinets, counters, flooring and appliances to be completed on a very tight schedule.

Mold Remediation Protocol and General Procedures

Working with the assigned remediation contractor, we developed the three-phase protocol discussed in this case study. It was generally adhered to and was completed successfully, although as on most projects many minor adjustments were required, and the scope of work had to be expanded on a couple of occasions.

Throughout the project, remediation procedures were extensively photo-documented by both our company and the contractor. Appropriate personal protective and respiratory equipment was used by

remediators, along with proper entry-exit procedures from containment. To avoid depressurizing the unit and creating excessive infiltration of humid outside air, air-filtration devices generating negative pressure in the work areas were vented back into uncontained areas of the unit. A laser particle counter was used regularly to document that the AFDs were filtering properly. A data-logging manometer provided a permanent record that proper negative pressure in work areas was maintained throughout the process. Temperature and humidity were regularly documented to ensure that excessive humidity did not contribute to renewed microbial growth.

Phase 1

Containment was established over the central hallway closet to remove a relatively small amount of mold growth. While this work was being done, the owners accessed the unit and the master suite through either the main entry door or the kitchen door (*Again, see Floor Plan 1*).

On completion of remediation in this area, IET performed a post-remediation evaluation consisting of visual inspection, non-viable air sampling and tape-lift surface samples. We used a microscope on-site to pre-screen the samples. If pre-screening indicated that additional work was required, we were then able to supervise the performance of this work and to obtain additional samples immediately upon completion, speeding the turnaround time for the post-remediation evaluation. Phase 1

pre-screening indicated successful completion of remediation. We forwarded the samples to an AIHA-certified laboratory on a rush basis. Upon receipt of laboratory results the next morning, we authorized the remediators to proceed to Phase 2. Sampling was also performed in areas outside the work zone to ensure that procedures had successfully prevented cross-contamination.

Phase 2

This phase included the majority of the work in the unit. It involved the nearly complete removal of drywall and flooring materials in the main entry, hall leading to the master suite, half bathroom near the entry, and the three-quarters bathroom off the living room (*See Floor Plan 2, page 5*).

The only access to the master suite is through a hallway, which was included in this phase of the work. To allow continued access to the master suite, we directed the contractor to cut through the back wall of the closet off the center hallway, which had been remediated in Phase 1, into the closet of the guest bedroom, then install a pre-hung door in the opening. Throughout Phase 2 remediation, the owners accessed their master suite through this temporary door, with access to the unit through the kitchen door.

Another complication was the location of the return for the HVAC system, above the front door in an area where extensive remediation was required. A return in this area created significant risk of cross-contamination to other parts of the unit, as well as challenges

with maintaining negative pressure in the work area. The contractor and we designed and installed an airtight return duct extension that extended across the work zone and through a containment barrier, allowing return air to be drawn from a non-contaminated part of the unit.

All mirrors, cabinetry, wallpaper, drywall, marble flooring and carpeting were removed in the Phase 2 work zone. During processing, two expansions of scope were needed:

- It was determined that the shower in the three-quarters bathroom also had to be removed.
- Extensive mold growth was found on the back side of common corridor wall drywall in the half bathroom near the entry. Fire code regulations prohibited removing both sides of this wall at the same time. The wall cavities and exposed drywall surfaces were thoroughly cleaned, and the drywall was coated with an antimicrobial encapsulant product. After completion of reconstruction in the unit, containment was erected over this wall from the corridor side and the contaminated materials were properly remediated.

Phase 2 work included thorough detailed cleaning of all surfaces and items throughout the unit, including the comparatively unaffected areas in which extensive remediation was not being performed, parts of which were occupied by the owners. The HVAC mechanicals and ducts were also cleaned at this time. The goal was to ensure that all these areas were at a “normal fungal ecology” concentration of mold before proceeding further with the project.

Upon completion of processing in Phase 2, we performed a PRE using procedures similar to those described for Phase 1. The entire unit was included in this evaluation. However, in this case pre-screening with an on-site microscope indicated that slightly elevated levels of water damage indicator molds such as *Chaetomium* species and *Penicillium/Aspergillus* species were still present in some areas. We therefore directed and supervised additional detailed cleaning throughout the unit. The large quantity of contents present added to the challenge of detailed cleaning. Pre-screening of our third round of sampling indicated successful completion of remediation.

We forwarded the samples to an AIHA-certified laboratory on a rush basis. Upon receipt of laboratory results, we authorized disassembly of Phase 2 containment barriers and the start of reconstruction in the Phase 1 and 2 work zones.

Phase 3

This phase did not begin until about two months after completion of the other two

phases. As discussed above, the owners requested that the contractor complete Phase 3 during a two-week period when they would be on vacation. The contractor developed a very tight schedule to accomplish this, and requested that we do everything possible to quickly turn around post-remediation evaluation data.

Moisture intrusion in this area was primarily through a building expansion joint on the west wall behind the kitchen cabinets. It had caused significant mold growth in wall cavities and on the back of wall and base cabinets, as well as water damage to these and other materials (*See Floor Plans 1 and 3, page 5*).

The Phase 3 work zone was isolated from the remainder of the unit by critical barriers. To ensure no cross-contamination to the remainder of the structure occurred, negative pressure was maintained in the Phase 3 work zone throughout remediation.

Cabinetry, counters, appliances and flooring were removed and replaced, as the owners decided to upgrade these components as part of the process.

Upon completion of the remediation phase of the work, we performed a quick-turnaround

post-remediation evaluation in this area, using the procedures described for the previous two phases. We inspected at about 4 p.m., and by noon the next day, after receipt of laboratory results, the contractor was given the go-ahead to proceed with reconstruction.

To document thoroughly the return of the environment to “normal” concentrations of mold, we at this point obtained samples from throughout the unit, using procedures similar to those described above for the pre-remediation investigation.

Despite everyone’s best efforts, the two-week deadline for remediation and reconstruction of the kitchen area was not met, and reconstruction was not completed until about five days after the owners returned. With the benefit of hindsight, they agreed that relocating during remediation would have been a good idea, but they were generally satisfied with the service they received.

The multiple challenges overcome on this project illustrate that even complex projects can be successfully completed with good teamwork between the environmental consultant and the remediation contractor.

**Floor Plan 1:
Areas of Mold Growth
Phase 1 Remediation**



Legend

- Mold growth
- Air filtration device
- - - Critical barrier
- - - Containment entry
- ↔ Occupant access

**Floor Plan 2:
Phase 2 Remediation**



Legend

- Air filtration device
- - - Critical barrier
- - - Containment entry
- ↔ Occupant access
- AC return extension

**Floor Plan 3:
Phase 3 Remediation**



Legend

- Air filtration device
- - - Critical barrier
- - - Containment entry
- ↔ Occupant access