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**Indoor Air Quality**  
**Case Study**  
Roof Replacement  
Chemical and Particulate Exposures

## IAQ Case Study – Roof Replacement – Chemical and Particulate Exposures

Edifice Rx was contacted by a utility data management company executive, requesting environmental testing and IAQ inspections related to adhesive odors and visible dust and debris stemming from a roof replacement.

The old roof was mechanically removed on the night of Monday, July 31, 2017. The air handlers were turned off at night during the re-roofing project. Computers overheating in the Computer Room brought the IT exec into the office, overnight, where she witnessed debris and particulate falling into the office space. Vibration from the roof was reported earlier in the day. The visible dust falling into the office space was most prevalent through the HVAC return slots and grilles. The ceiling plenum space serves as the HVAC return and is open to the underside of the roof deck. Demising (party) walls separate from the space from adjoining suites.



**Photograph 1:** Debris on top of ceiling tiles.

The new roof for this office was installed on Tuesday and Wednesday, August 1-2, 2017. The roof material is a membrane that was applied with an adhesive.

Employees reported headaches and dizziness and believed that their symptoms were attributed to the roof replacement. The adhesive odor was most prevalent on Tuesday and Wednesday, August 1-2, 2017 when the HVAC system was operating during the work day. Some employees were permitted to leave work due to their reported symptoms.

The adhesive used during installation of the membrane roof was Firestone Single-Ply LVOC Bonding Adhesive (W56-358-715L). The safety data sheet (SDS) lists the following ingredients:

1. Acetic acid, tert-butyl ester (25-50%)
2. Acetic acid, methyl ester (25-50%)
3. Toluene (2.5-10%)
4. Phenolic Resin (2.5-10%).

The company president stated that he would like to know whether the office provides a healthy working environment for his employees.

The IAQ study components included microbial screening, air and dust characterizations, volatile organic compounds by EPA TO15 method, real-time IAQ instruments, IAQ data logging with real-time alert notifications, HVAC inspection, and a general inspection of the office space.

The ceiling plenum inspection and bulk characterization of dust from the top of ceiling tiles indicated debris had penetrated the roof deck during the roof replacement process. Lab results indicated high percentages of plant matter/trichome and presence of tar, wood chips, rubber particles, glue pieces, and concrete chunks.

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## IAQ Case Study – Roof Replacement – Chemical and Particulate Exposures

### Particle Identification of Bulk Debris on Ceiling Tile

**Table 1:** Particle Identification of Bulk Debris Samples collected on 23 August, 2017.

Prestige # Sample ID Location	170825-11-067 17048-T1 Lunch Room	170825-11-068 17048-T2 New Collaborative	170825-11-069 17048-T3 Near John	170825-11-070 17048-T4 Near Jen	170825-11-071 17048-T5 Near Sam
Cellulose fibers	25%	10%	5%	2%	20%
Copper wire	-	-	-	5%	-
Fiberglass	10%	10%	Trace	15%	10%
Form particles	-	Trace	10%	-	-
Fungal matter	Trace	Trace	Trace	Trace	Trace
Glue particles	-	-	-	5%	-
Gypsum dust/mineral deposits	5%	5%	5%	3%	5%
Metal pieces	-	-	-	-	5%
Perlite	-	-	-	-	1%
Pine pollen	Trace	-	Trace	-	-
Plant matter/trichome	30%	35%	60%	5%	15%
Pollen	1%	-	-	-	-
Rubber particles	-	-	-	60%	-
Quartz/fine sand	2%	20%	1%	Trace	5%
Skin flakes	3%	Trace	Trace	Trace	1%
Synthetic fibers	5%	1%	Trace	-	-
Tar	5%	10%	10%	Trace	30%
Wood chips	10%	5%	5%	-	3%
Misc.	4%	4%	4%	5%	5%
Total %	100%	100%	100%	100%	100%

TO15 Results - chemicals found in adhesives, and elevated formaldehyde levels. Toluene and naphthalene have very potent odors. Toluene is an ingredient in the roof membrane adhesive that was used in the re-roofing project. Formaldehyde is a chemical of concern in indoor air. Formaldehyde was detected at the levels of 35-37 ppb, which are above the LEED recommended 27 ppb.

Following the IAQ investigation Edifice Rx was requested to provide remediation oversight and post remedial verification testing of the office space. In addition to a work plan review, onsite inspection and verification of HEPA air scrubber and vacuum performance, an internet of things (IoT) connected IAQ data logger was deployed in the office space for the duration of remediation. The data logger was moved daily following remediation work zones as the work progressed through the office (all remediation work was conducted after hours.) The IoT data logger provided real-time data for 9 IAQ analytes and real-time text message and email alerts if action levels were exceeded.



**Photograph 2:** IoT Multi-Analyte IAQ Dataloggers.

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## IAQ Case Study – Roof Replacement – Chemical and Particulate Exposures

### Recommendations:

1. Flush office space to reduce formaldehyde and tVOC levels by incorporating greater amounts of outside air (OA) through the air handling units. Economizer mode provides an energy efficient pathway to increase ventilation while taking advantage of the ambient air temperature outdoors to cool the office space with outside air when favorable.
2. Remove (bag) unnecessary insulation located on the top of ceiling tiles.
3. HEPA vacuum the top of ceiling tiles and their grid system, light fixtures, HVAC diffusers, and HVAC returns to remove debris from the ceiling plenum. Use proper remedial protocols.
4. HEPA vacuum work stations.
5. Steam clean carpet.
6. Upgrade air handling unit filtration from MERV 8 to MERV 13 (if the units can handle the increase in static pressure), coordinated with balancing of outside air (OA) to a calculated minimum ventilation rate based on occupant density in each HVAC zone or use the default combined outdoor air rate of 17 cubic feet per minute per person (cfm/person) in an office space as recommended by ANSI/ASHRAE Standard 62.1-2016, Ventilation for Acceptable Indoor Air Quality. Edifice Rx recommends consideration of an option to exceed this ventilation rate by 30%, in line with LEED EQ credit options.
7. Review current cleaning practices and make improvements as needed.
8. Implement a Construction IEQ Management Plan for use with any future construction project work affecting occupied locations.

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