Forensic Analytical

ENVIRONMENTAL HEALTH CONSULTANTS

Indoor Environmental Quality Assessment

Riverside Community College
Math Science Building
4578 Saunders St.
Riverside, CA 92501

September 5, 2012

Prepared for:

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FACS Project #PJ16961

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Introduction

Forensic Analytical Consulting Services, Inc. (FACS) was retained by ASCIP to perform an indoor environment quality assessment at Riverside Community College's Math Science Building located at 4578 Saunders St., in Riverside, CA. The request was made on behalf of Riverside Community College, due to employee complaints of ill health effects and poor building conditions, which they attribute to potentially poor indoor air quality.

The purpose of the investigation was to 1) in general, identify and evaluate potential explanations for the symptoms and concerns of occupants 2) provide information for consideration in assessing risk to occupants; and 3) provide recommendations for additional investigation and/or corrective actions as necessary.

Site Characterization

The subject building is a four story structure located on campus at Riverside Community College (RCC). The building houses the Math and Science department on campus, which includes laboratories, classrooms, teacher office spaces, a chemical storage room, restrooms, conference rooms and auditorium.

History

Based on conversations with various parties, the following history was developed.

- The LEED certified building began occupancy in February 2012.
- May 10, 2012: FACS performs an initial limited indoor environment quality assessment of the 4th floor. Following the walkthrough, FACS provided a report that included findings and recommendations (see FACS report dated June 8, 2012).
- June 18, 2012: FACS returned on site for a meeting with key players (i.e. HVAC engineer, architect and school representatives) and an additional walkthrough of the building, which included additional floors (1-3).
- June 22, 2012: FACS returned on site to perform a pilot noise assessment survey in laboratory 404, to evaluate the implementation of remedial work to the exhaust ventilation system (noise source). Following the pilot study, FACS provided a report that included findings and recommendations (see FACS report dated June 25, 2012).
- June 25, 2012: FACS created and submitted an anonymous online occupant survey to RCC representatives. RCC representatives forwarded the survey request to all teachers and staff that reside in the Math Science building. Completed surveys were sent to FACS directly and a list of issues were compiled and provided to key players. Based on the online survey, the key complaints appeared to be related to inadequate ventilation in the building, temperature control issues, and noise.
- August 31, 2012: FACS returned on site following the implementation of recommendations provided by FACS in previous assessments and occupant survey responses. The assessment included the collection of indoor air quality comfort parameter data (carbon dioxide, temperature, & relative humidity) and performance of a limited noise survey,

Scope of Work

In the course of this project, FACS conducted the following scope of work:

1. Development of a site characterization and history (see sections above).

2. Distribution and review of occupant surveys.

3. Visual inspection of accessible areas of the building.

4. Measurement of sound pressure noise levels in selected laboratories.

5. Measurement of typical indoor air quality parameters, including carbon dioxide levels, temperature and relative humidity, using a direct reading instrument.

6. Review of LEED certification documents provided by school representatives.

The data collected in the course of the investigation is presented in this report as follows:

- Appendix A--Materials and Methods
- Appendix B—Noise Sound Level Meter - Summary Table of Direct Readings
- Appendix C—IAQ Comfort Parameters - Summary Table of Direct Readings

The types, numbers, and locations of monitoring data were determined based on historical information, inspection observations, and project management considerations. Materials and methods for collection are provided in Appendix A.

Findings

May 10, 2012

General Findings

On May 10, 2012, FACS arrived on site to perform a limited indoor environmental quality assessment of the subject building, specifically the 4th floor, following occupant complaints. The investigation included a limited walkthrough of complaint areas and interviews with occupants present at the time of the assessment. At the time of the assessment, FACS observed an inconsistency in air being supplied to the subject floor. There appeared to be a large volume of air being supplied to some areas (i.e. hallways) however, there appeared to be a lower volume or none at all in some instances, being supplied to other locations (i.e. office spaces).

Based on the initial walkthrough of the 4th floor, FACS recommended that further evaluation of the air handling system serving the 4th floor be performed in accordance with the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) Standard 62.1-2010. See FACS Limited Indoor Environment Quality Assessment Report dated June 8, 2012.

June 18, 2012

General Findings

On June 18, 2012 FACS returned on site for a meeting with key players (i.e. HVAC engineer, architect and school representatives) and an additional walkthrough of the building, which included additional floors (1-3). The purpose of the additional visit was to gather information on the design and function of the building's HVAC system, along with documentation of actions that had occurred to date in regard to the addressing and correcting of issues identified in the May 2012 limited assessment. Based on the meeting, it was confirmed that FACS would return on site to conduct a noise survey during remediation activities to take place in one of the complaint laboratories.

June 22, 2012

General Findings

On June 22, 2012 FACS returned on site to conduct a pilot noise assessment in laboratory Room 404. The purpose of the assessment was to characterize noise levels at the exhaust registers (noise source) and various areas of the classroom, measure noise levels following implementation of remedial changes to the system with comparison to applicable standards and guidelines. Area noise monitoring was conducted during for the following scenarios:

1. Before any changes to the system were made (i.e., original noise levels).
2. Following replacement of the original 14" round supply register with an 18"x18" square neck register.
3. Following the addition of flex duct to the new register.
4. Following the addition of a fourth exhaust register to the classroom.

Monitoring Findings

Based on sound level measurements, the largest attenuation in noise level (> 10 decibels) was observed following the replacement of hard duct work with flex duct (scenario 3) when collected directly at the register. No significant changes in noise levels were observed following the implementation of other scenarios tested.

Based on assessment findings it was concluded that ambient noise levels were attenuated by approximately 3-5 decibels following the implementation of the abovementioned exhaust air system adjustments. Additionally, the results of the area monitoring in all locations and scenarios monitored indicated acceptable equivalent noise levels when compared to current occupational exposure limits.

It was concluded that although noise level measurements did not exceed any applicable occupational exposure limits and/or guidelines, occupants in the subject building have complained of distractions, irritations, etc., which they attribute to the exhaust HVAC air system (unwanted noise source); therefore, it was recommended that all laboratories exhibiting similar situations be evaluated for potential attenuation resulting from implementation of similar changes to the system (specifically the addition of flex duct at terminal end of system). See FACS Noise Assessment Report dated June 25, 2012.

August 31, 2012

General Findings

On August 31, 2012 FACS returned on site for a post remedial work indoor environment quality assessment to confirm that all previous FACS recommendations were adequately addressed. The assessment included the collection of indoor air quality comfort parameters (carbon dioxide, temperature, and relative humidity) and sound level measurements in various areas of the building.

Monitoring Findings

Temperature and Relative Humidity:

The combination of temperature and humidity in a building is the primary driver of occupant thermal comfort. Occupant thermal discomfort is often associated with increased dissatisfaction with indoor environmental quality and may exacerbate occupant symptoms. ASHRAE has developed widely accepted guidelines for managing temperature and humidity in buildings to help ensure the thermal comfort of occupants in general (see ANSI/ASHRAE Standard 55-2010 – Thermal Environmental

Conditions for Human Occupancy). While these guidelines attempt to define conditions that are widely acceptable for occupants, individual preferences may vary.

Measurements of temperature and relative humidity were collected in representative locations and were compared to outdoor control measurements collected at the exterior as well as relevant industry guidelines. Results of humidity and temperature readings collected during the evaluation were consistently generally out of ranges recommended in ASHRAE guidelines. Elevated relative humidity levels were consistently measured in several locations throughout the building. Elevated relative humidity can lead to excessive dampness in indoor environments, which can provide conditions that support the growth of bacteria and molds, if present, and potentially result in the increased perception of poor indoor air quality issues. Consistently low air temperatures were also measured in all areas, with the exception of some classrooms. Low indoor air temperatures can directly impact occupant comfort and can potentially lead to the increased perception of indoor air quality issues. However, it should be noted that measurements were collected in rooms where no occupants were present. Increased occupancy may cause temperature levels to increase due to radiant body heat.

Carbon Dioxide:

Without appropriate ventilation of a room with outside air, common contaminants (e.g., particles, odors, carbon dioxide) can accumulate and result in degraded indoor air quality. Occupants in poorly ventilated rooms will frequently describe the air as “stuffy” or “stale” and will more often report symptoms and discomfort related to indoor environmental quality. In occupied buildings, CO_2 concentrations are often higher then ambient outdoor concentrations and serve as a surrogate measure of ventilation to occupied spaces. Indoor CO_2 concentrations above 1,000 ppm have been associated with complaints about indoor air quality. OSHA recommends 1000 ppm CO_2 as an indication of inadequate outdoor air and ASHRAE previously recommended 1,000 ppm CO_2, or 700 ppm above outdoor CO_2 level as the upper limit for comfort and odor control indoors. Current ASHRAE guidelines focus on the measurement of actual ventilation rates (e.g., 15 cfm per person).

Carbon dioxide direct reading measurements were collected using a TSI QTrak 7545 IAQ meter in several locations throughout the subject building (see Appendix C for specifics), and were compared with outdoor control measurements collected at the exterior of the building as well as industry guidelines. Indoor concentrations of carbon dioxide during the direct reading were within acceptable levels outlined in the prior ASHRAE guidelines. Based upon these results and prior conversations with key players, it appears that the ventilation issue has been adequately addressed and corrected.

Noise:

Per school representatives and online surveys, occupants of the subject building reported that the noise levels caused by the exhaust air system in the building laboratories cause them distractions from work and result in the inability to concentrate on general work functions. During the June 22, 2012 pilot study, it was concluded that the replacement of hard duct with flex duct at the exhaust air system attenuated the greatest amount of noise. Noise levels at the registers decreased approximately 15 decibels and ambient levels decreased approximately 3-4 decibels. Following the assessment, FACS recommended that all laboratories identified as having an exhaust noise issue have the same flex duct replacement.

Equivalent sound level measurements were collected using a Quest (Type 2) Sound Level Meter. The equivalent is the single value sound level, which includes all of the time-varying sound energy within the monitoring period or the average sound level calculated by the sound level meter during the task under the specified instrument settings

In general, sound levels appeared to be similar to those collected during the pilot study, with the exception of Storage Room 435. Noise levels measured in Storage Room 435 were approximately 8 decibels greater than the pilot study location when measured at the register. However, it should be noted that this is not a classroom setting, and is not typically occupied for long periods of time.

Conclusions

School settings often have occupants with extremely variable sensitivities to IEQ variables. Communication with and between the occupants will be an important component in resolving these issues. It is anticipated that open communication with the occupants and the implementation of recommendations will result in the improvement in overall indoor environmental quality.

HVAC System

1. Findings of the investigation indicate that there continues to be a temperature and relative humidity issue in the subject building. The majority of temperature and relative humidity levels measured were not within current ASHRAE standard. Although it is not anticipated that the issues identified (temperature and relative humidity) appear to be hazardous, sensitive occupants may perceive them as degraded indoor environment quality, and continue to experience the symptoms reported.

Noise

1. Results of the noise monitoring in all locations monitored indicated acceptable equivalent noise levels when compared to current occupational exposure limits.

2. Findings of the investigation indicate that the nuisance noise issue appears to have been adequately addressed and corrected.

Recommendations

1. Evaluate the feasibility of adjusting the HVAC system to raise temperature and lower relative humidity in the subject building to above 73°F and below 60%, respectively.

2. Inform all interested building occupants of the results of this survey. Communication with and between the occupants will be an important component in resolving these issues. It is anticipated that open communication with the occupants and the implementation of recommendations will result in the improvement in overall indoor environmental quality.

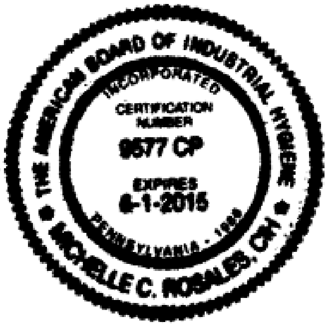
Limitations

This investigation is limited to the conditions and practices observed and information made available to FACS. The methods, conclusions, and recommendations provided are based on FACS' judgment, experience and the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor indicate that other hazards do not exist.

Please do not hesitate to contact our office at 310-668-5600 if you have any additional questions or concerns. Thank you for the opportunity to assist ASCIP in promoting a more healthful environment.

Respectfully,
FORENSIC ANALYTICAL

Michelle Rosales, MPH, CIH



REVIEWED BY

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Appendix A:
Materials and Methods

Carbon Dioxide, Relative Humidity & Temperature in Air

Temperature, relative humidity, carbon dioxide (CO_2), and carbon monoxide (CO) measurements were made using a TSI Model 7545 Q-Trak IAQ Monitor. The monitor had been factory calibrated within the previous 12 months at the time of sampling. Measurements for carbon dioxide are expressed in concentration values of parts per million (ppm) with a detection limit of 1 ppm. Temperature was collected in degrees Fahrenheit and relative humidity in percentage.

Noise Sound Level Meter Monitoring

June 22, 2012 Monitoring Period

Area monitoring was conducted using an Extech (Type 2) Sound Level Meter (SLM) with 1/3 octave band analyzer. The SLM was calibrated prior to and following monitoring efforts using an Extech 40744 calibrator. All instruments including the SLM, octave band filter and calibrator, had been factory calibrated within the previous 12 months at the time of sampling. Broad spectrum average sound pressure level (L_a) as well as frequency-specific measurements were collected using a slow response A-weighted scale.

August 31, 2012 Monitoring Period

Area monitoring was conducted using Quest (Type 2) Sound Level Meter (SLM) SoundProDL2. The SLM was calibrated prior to and following monitoring efforts using a Quest QC-10 calibrator. In addition, the instruments had been factory calibrated within the previous 12 months at the time of sampling. Broad spectrum average sound pressure levels were collected using a slow response A-weighted scale.

Appendix B:
Noise Sound Pressure Level
Direct Reading Summary Table

Direct Reading Measurement Results – Collected on August 31, 2012				
Location	**Average Sound Pressure Levels in dBA**			
	At Register	**3' below Register**	**Desk Level**	**Center of Classroom**
Lab 207	49.1	49.0	49.0	44.1
Lab 205	48.0	44.8	45.0	44.0
Lab 204	50.0	45.3	43.1	42.6
Lab 232	58.6	52.8	48.9	45.6
Storage 231	58.7	51.8	50.6	45.7
Lab 307	56.2	49.6	47.2	49.6
Lab 305	46.4	43.1	42.4	42.1
Storage 337	55.1	51.2	50.6	42.6
Lab 304	50.3	45.3	43.6	42.9
Lab 303	52.6	46.4	43.9	43.0
Lab 339	55.9	53.3	51.2	52.6
Lab 343	53.5	50.2	48.4	49.8
Lab 404	54.5	50.2	49.0	47.2
Lab 403	50.3 at front desk			
Storage 435	66.7	60.5	53.5	49.1
Lab 407	64.2	57.9	50.9	46.2
Lab 408	59.5	53.3	48.7	45.6
Lab 409	61.9	54.5	50.0	47.2
Prior Study Lab 404 (after scenario 4)	**53.5-58.0**	**50.1-54.5**	**50.2-53.4**	**48.0-48.4**

Appendix C:
Indoor Air Quality Comfort Parameter
Direct Reading Summary Table

Direct Reading Measurement Results – Collected on August 31, 2012				
Location	**Time Collected**	**Carbon Dioxide Concentration[1] (ppm)**	**Relative Humidity[2] (%)**	**Temperature[3] (^oF)**
Lab 207	9:01	456	58.1	69.1
Lab 205	9:05	447	61.0	69.3
2nd floor hallway	9:10	448	59.9	68.9
Lab 204	9:12	460	62.0	68.4
Lab 232	9:14	451	63.6	67.1
Lab 231	9:16	444	63.6	67.5
2nd floor hallway	9:20	472	64.6	69.8
Office 222	9:22	460	61.7	69.9
Office 224	9:24	514	61.8	70.6
2nd floor hallway	9:26	505	62.6	70.8
Office 323	9:28	442	55.3	72.2
Office 329	9:30	540	57.0	71.2
3rd floor hallway	9:31	581	57.2	71.5
Lab 307	9:35	420	62.5	66.3
Lab 305	9:37	426	67.1	64.9
3rd floor hallway	9:39	421	65.8	68.3
Storage 307	9:40	422	63.0	69.1
Lab 304	9:42	453	58.1	72.5
Lab 303	9:45	427	58.8	69.8
Lab 339	9:47	413	61.5	69.1
Storage 341	9:50	444	62.1	69.9

Lab 343	9:55	420	62.0	77.0
Lab 404	10:00	435	56.3	72.9
Lab 405	10:03	487	58.0	72.4
Storage 434	10:05	412	58.4	70.4
4th floor hallway	10:07	426	60.3	70.6
Lab 407	10:10	441	60.7	71.3
ab 408	10:14	417	61.8	70.8
Lab 409	10:17	419	61.1	72.0
4th floor hallway	10:20	455	59.9	70.5
Office 423	10:21	472	61.0	70.4
Office 426	10:23	431	60.7	72.0
Office 422	10:25	480	60.4	71.0
Office 421	10:30	466	60.8	72.2
3rd floor hallway	10:33	415	59.9	72.9
Exterior – NE elevation	8:55	398	53.8	81.1
Exterior – NW elevation	9:58	386	74.0	77.0

(1) Industry guidelines[4] recommend CO_2 levels be no greater than 700 ppm above ambient outdoor levels.
(2) Industry guidelines[4] recommend indoor relative humidity levels less than 60 %.
(3) Industry guidelines[4] recommend indoor temperatures between 68° and 76 °F for winter months, 73° to 80° for summer months.
(4) "Industry Guidelines" refers to American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) standards 62.1-2010.

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