2010-02-09 WHS ATC IAQ

INDOOR AIR QUALITY EVALUATION

WILTON HIGH SCHOOL
395 DANBURY ROAD
WILTON, CT 06897

ATC PROJECT NO. 61.38954.0002 TASK 2
FEBRUARY 9, 2010

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1.0 BACKGROUND INFORMATION

ATC Associates, Inc. (ATC) was retained by the Town of Wilton to perform an Indoor Air Quality (IAQ) Evaluation at Wilton High School, located at 395 Danbury Road in Wilton, CT. The purpose of this evaluation was to assess the interior environment of the school upon completion of major renovations occurring during the summer of 2009, as well as HVAC duct cleaning activities performed between December 22, 2009 and January 19, 2010. The evaluation strategy included use of direct-read instrumentation to monitor temperature, relative humidity, carbon dioxide, carbon monoxide, and total particulate (nuisance dust).

2.0 OBSERVATIONS

On February 1, 2010 ATC observed generally clean and dry conditions throughout the school. The building was minimally occupied as this was a holiday (no classes). ATC understands that HVAC systems were operating normally.

3.0 AIR MONITORING

Physical Conditions

ATC recorded measurements of temperature, relative humidity, carbon monoxide and carbon dioxide in representative locations utilizing a TSI Q-Track Model 7565 direct reading instrument. Measurements of total particulate were recorded using a TSI Dustrak Model 8520 direct reading instrument. All data readings were collected instantaneously for approximately one minute at each location. Instrument calibration documentation is included in Appendix A. An outdoor reading was also collected for comparative purposes.

Please note that carbon dioxide, temperature and relative humidity readings are compared with standards set forth by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). These standards are recommended guidelines aimed at providing reference values for comfort within an indoor environment. The standards are not regulations and may not be applicable to certain buildings based on structural, mechanical, usage and occupancy details. Carbon monoxide and total particulate readings are compared with permissible exposure limits (PELs) set forth by the Occupational Safety and Health Administration (OSHA), which is a regulatory standard.

Table 1 presents results of monitoring for specified indoor air quality physical parameters.

TABLE 1
ENVIRONMENTAL CONDITIONS
WILTON HIGH SCHOOL
2/1/10

LOCATION	TEMP (°F)	RH (%)	CO (ppm)	CO2 (ppm)	TOTAL DUST (mg/m^3)
Outdoors	18.8	37.6	0.0	344	0.019
Room 104	65.0	21.8	0.0	493	0.010
Room 103	64.8	22.5	0.0	453	0.012
Hall by Room 103	65.1	23.5	0.0	469	0.10
Room 102	66.1	23.2	0.0	471	0.009
Room 108	65.8	22.9	0.0	479	0.009
Room 110	66.4	23.5	0.0	483	0.011
Hall by Room 109	66.3	24.6	0.0	505	0.013
Room 109	67.3	24.2	0.0	470	0.006
Hall by Stair 3 - 1st Floor	66.8	23.1	0.0	471	0.012
Room 106	66.8	25.1	0.0	500	0.012
Culinary Room	65.7	24.8	0.0	474	0.010
Room 110B	66.5	25.7	0.0	489	0.010
Room 110C (B149)	65.9	24.5	0.0	477	0.013
Room 110C (B148)	66.1	26.7	0.0	470	0.010
Hall by Room 150	65.4	24.2	0.0	474	0.015
Hall of Offices 151	64.0	25.5	0.0	465	0.010
Hall by Stair 5 – 1st Floor	64.0	23.0	0.0	470	0.017
Choral Room	67.1	26.7	0.0	484	0.010
Room 119	65.9	28.6	0.0	455	0.011

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LOCATION	TEMP (°F)	RH (%)	CO (ppm)	CO2 (ppm)	TOTAL DUST (mg/m^3)
Room 119B	66.7	27.6	0.0	458	0.012
Room 119D Ceramics	66.2	27.1	0.0	468	0.011
Hall by 119C	66.2	26.1	0.0	469	0.039
Art Workroom	66.5	26.6	0.0	457	0.010
Room 120	66.4	24.0	0.0	460	0.045
Room 121	66.0	28.4	0.0	451	0.021
Room B178	64.3	26.0	0.0	432	0.018
Hall by Auxiliary Gym	64.8	25.3	0.0	463	0.015
Boys Locker Room	64.7	22.1	0.0	425	0.014
Bridge by Field House – 2^{nd} Floor	64.0	23.7	0.0	475	0.008
Field House – 2^{nd} Floor	65.7	25.6	0.0	525	0.004
Room 241 / Fitness Room	65.5	24.7	0.0	477	0.010
Hall by Fitness Room	65.8	24.3	0.0	463	0.011
B261 Computer Room	67.0	23.9	0.0	493	0.016
Room 215A	66.7	26.4	0.0	484	0.008
Hall by Room 211	67.8	25.7	0.0	472	0.053
Room 211	67.3	25.1	0.0	475	0.008
Room 210	67.9	24.7	0.0	460	0.007
Room 204A	67.9	24.9	0.0	473	0.005
Room 208A	67.9	23.4	0.0	461	0.006
Room 205	67.9	25.5	0.0	471	0.008

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LOCATION	TEMP (°F)	RH (%)	CO (ppm)	CO2 (ppm)	TOTAL DUST (mg/m^3)
Room 206A	68.9	26.4	0.0	461	0.006
Hall by Stair 3 – 2nd Floor	68.7	22.9	0.0	473	0.005
Nurses Office	68.6	25.9	0.0	478	0.005
Conference Room by Stair 3 – 2nd Floor	69.0	26.4	0.0	479	0.006
Offices Corridor	68.6	25.6	0.0	480	0.007
Main Office	68.9	26.5	0.0	497	0.016
Associate Principal Room	68.9	27.7	0.0	491	0.008
2nd Floor Lounge/Lobby by Bridge	69.0	24.8	0.0	565	0.007
Room 217	69.2	23.7	0.0	491	0.008
Hall by Room 217	69.1	24.8	0.0	521	0.008
Room 216	68.5	24.8	0.0	486	0.025
Hall by Room 240	68.0	26.6	0.0	533	0.014
Hall by Room 319C – 3rd Floor	67.3	22.9	0.0	513	0.012
Room 317D	67.9	28.4	0.0	641	0.013
Room 317B	68.2	28.1	0.0	540	0.012
Hall by Stair 5 – 3rd Floor	68.4	26.5	0.0	489	0.029
Room 315	68.3	25.5	0.0	482	0.008
English Workroom 3rd Floor	68.9	26.8	0.0	529	0.007
Room 312	69.2	25.7	0.0	505	0.014
Hall by Room 312	68.8	24.5	0.0	494	0.009
World Language Workroom – 3rd Floor	68.8	26.6	0.0	518	0.011

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LOCATION	TEMP (°F)	RH (%)	CO (ppm)	CO2 (ppm)	TOTAL DUST (mg/m^3)
Hall by 301B	69.7	23.3	0.0	483	0.012
Room 301D	68.7	25.6	0.0	498	0.011
Room 302C	67.9	25.8	0.0	486	0.010
Room 302D	68.3	25.9	0.0	499	0.020
Room 303 Workroom	67.7	26.1	0.0	500	0.051
Room 303C	67.6	26.2	0.0	521	0.071
Hall by Room 302C	67.3	27.9	0.0	488	0.013
Room 329	68.3	25.9	0.0	519	0.010
Hall by Room 329	68.3	24.0	0.0	510	0.077
Room 327	67.7	24.4	0.0	482	0.014
Hall by Stair 7 – 3rd Floor	68.0	22.2	0.0	532	0.025
Storage Room by Stair 7 – 3rd Floor	68.5	26.4	0.0	528	0.014
2nd Floor Lobby	67.9	24.0	0.0	508	0.015
2nd Floor Bridge to Library	68.3	26.3	0.0	514	0.008
Office by Library – 2nd Floor	69.4	27.4	0.0	541	0.005
Hall by District Technology – 2nd Floor	69.6	26.8	0.0	507	0.007
Library	70.4	29.1	0.0	520	0.006
Library Computer Area	70.9	28.4	0.0	532	0.006
Library M Level (Computer Area)	71.3	28.2	0.0	536	0.008
Library R Level (Center)	70.9	28.3	0.0	521	0.013
Library R Level (Far Corner)	69.4	28.2	0.0	522	0.010

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LOCATION	TEMP (°F)	RH (%)	CO (ppm)	CO2 (ppm)	TOTAL DUST (mg/m^3)
Library R Level (Far Corner)	68.2	28.5	0.0	509	0.007
District Technology – 1st Floor	68.2	27.2	0.0	512	0.009
Copy Center – 1st Floor	68.6	27.3	0.0	510	0.012
Hall by Lunch Room – 1st Floor	68.4	26.8	0.0	491	0.010
Audio Visual – 1st Floor	67.8	25.0	0.0	502	0.007
Central Office – 1st Floor	68.4	26.0	0.0	567	0.008
1st Floor E Building Stairwell Lobby	67.6	25.2	0.0	506	0.008
Outside	28.8	39.6	0.0	361	0.015

°F – degree fahrenheit
ppm – parts per million
mg/m^3 – milligrams per cubic meter

4.0 CONCLUSIONS

Temperature and Relative Humidity

Temperature perceptions (too hot, too cold, drafts, etc.) are a common source of building occupant air quality complaints. ASHRAE Standard 55-2004 (Thermal Environmental Conditions for Human Occupancy) generally defines methods for determining acceptable indoor temperature ranges based on the level of human activity (i.e., metabolic rate), clothing insulation, humidity, and other factors. The intent of the standard is to provide acceptable thermal comfort for a desired percentage of the occupants. For typical office space as defined by the Standard, Table 2 presents acceptable temperatures ranges intended to provide acceptable thermal comfort for 80% of the occupants.

TABLE 2 Acceptable Temperature Ranges at Indicated Relative Humidity Typical Office Space Activity ASHRAE 55-2004		
Relative Humidity	Temperature: Light Clothing	Temperature: Heavy Clothing
10%	77-83°F	71-78°F
20%	76-82°F	70-78°F
30%	76-82°F	69-77°F
40%	76-81°F	69-77°F
50%	75-80°F	68-76°F
60%	75-78°F	68-75°F
70%	- -	67-73°F

Standard 55-2004 does not provide recommendations for maintaining indoor relative humidity within a specific range but does establish an upper boundary for dew point at 62.2 degrees Fahrenheit, which occurs at approximately 65% relative humidity at 72 degree Fahrenheit.

Temperature and relative humidity measurements as generally conducted for indoor air quality investigations are not intended to demonstrate compliance with all requirements of ASHRAE Standard 55-2004. The standard includes other requirements such as temperature variation and air speed within a space and defines specific protocols and procedures for evaluating compliance with the standard.

Indoor temperatures recorded during this evaluation ranged from 64.0°F to 71.3°F. These temperatures can be considered acceptable for February as low ambient temperature and humidity are common. Indoor relative humidity levels recorded during this evaluation ranged from 21.8% to 29.1%. While ASHRAE Standard 55-2004 does not specify an optimal range for humidity, these levels can be considered somewhat below the commonly accepted optimal range of 30% to 50% indoor relative humidity, which is not unusual during winter months with low ambient humidity. The calculated average indoor dew-point temperature on this day was found to be approximately 29°F.

Carbon Dioxide

Carbon dioxide monitoring is a useful screening technique (non-quantitative) for determining if outside air supply is sufficient for maintaining acceptable indoor air quality. Carbon dioxide is a naturally occurring constituent of the atmosphere and is also a product of human respiration. During periods of occupancy, carbon dioxide levels in a building will rise above the normal background level. The level of increase of carbon dioxide concentrations is related to the number of persons in an area and the amount of outside air being introduced into that area.

Procedures for determining recommended outside air supply rates for occupied buildings are prescribed in the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Standard 62.1-2006, *Ventilation for Acceptable Indoor Air Quality*. The purpose of this standard is to specify minimum ventilation rates and indoor air quality that will be acceptable to human occupants and are intended to minimize the potential for adverse health effects.

The following table presents default design outside air supply rates for some of the common space types listed by the standard. Theoretical equilibrium carbon dioxide concentrations above background levels, assuming steady state conditions and sedentary persons, are also presented.

TABLE 3
ASHRAE Standard 62.1-2004 Default Outside Air Supply Rates (1) and Theoretical Carbon Dioxide Concentrations at Steady State Conditions (2)

Space Type	Default Occupant Density (Occupants per 1,000 SF)	Default Combined Outdoor Air Rate (cfm/person)	Approximate Equilibrium Carbon Dioxide Concentration Above Background
General Office	5	17	600 ppm
Telephone/Data Entry	60	6	1,700 ppm
Classroom (ages 5-8)	25	15	700 ppm
Classroom (ages 9 plus)	35	13	800 ppm
Lecture Classroom	65	8	1,300 ppm
Lecture Hall (fixed seats)	150	8	1,300 ppm
Auditorium Seating Area	150	5	2,060 ppm

(1) – Partial list. Refer to standard for complete list.
(2) – Assumes steady state conditions with sedentary persons.

The ventilation rates presented above include both an area-related component and an occupant-density-related component, which are added together to determine the required ventilation for the space. If actual occupant densities are known and vary from those indicated above, then expected equilibrium carbon dioxide concentrations would be adjusted accordingly.

Indoor carbon dioxide concentrations recorded during this evaluation ranged from 425 ppm to 641 ppm. These concentrations are, at a maximum, 297 ppm above the lowest recorded outdoor (background) concentration of 344 ppm, which is below the recommended differential for classroom space listed in the table above.

Carbon Monoxide

Carbon monoxide usually originates from outside the building from such sources as automotive traffic and loading docks. Internal sources include cigarette smoke, boilers and furnaces. Assuming internal sources are limited, monitoring for carbon monoxide is a useful surrogate for determining if outside air intakes are being impacted by automotive traffic. The EPA National Ambient Air Quality Standard (NAAQS) for carbon monoxide is generally accepted as an indoor air quality criterion. The NAAQS for carbon monoxide is 9 ppm for an 8-hour average or 35 ppm for a 1-hour average. In addition, significant short-term increases should not be noted indoors at any time, whether or not the NAAQS for carbon monoxide exceeded.

Indoor carbon monoxide concentrations recorded during this evaluation were found to be zero ppm (below detection limit of the instrument).

Total Particulate

Particulates not otherwise regulated are categorized as Total Particulate, or nuisance dust. The OSHA PEL for total particulate is 15 mg/m^3, as an eight-hour time weighted average.

Total Particulate concentrations recorded indoors during this evaluation were found to be well below the OSHA PEL, ranging from zero mg/m^3 to 0.10 mg/m^3.

Based on results of visual observations and air monitoring, ATC concludes that the IAQ parameters recorded on this day are acceptable with respect to published recommended guidelines and regulatory standards.

5.0 LIMITATIONS

ATC provided these services consistent with the level and skill ordinarily exercised by members of the profession currently providing similar services under similar circumstances at the time the services were provided. This statement is in lieu of other statements either expressed or implied. This report is intended for the sole use of the Town of Wilton. The scope of services performed in execution of this evaluation may not be appropriate to satisfy the needs of other users, and use or re-use of this document, the findings, conclusions, or recommendations is at the risk of said user.

As with all such assessments, the results of the sampling represent conditions found on the date of the survey and may not represent conditions found at other times. Additionally, this assessment was limited with respect to the specific parameters indicated above and should not be construed to be a comprehensive evaluation or a definitive representation of conditions within the facility. The information presented in this report is intended to be used as a guide to evaluate the need for further investigation or the need for modifications to the processes or procedures surveyed.

The Client recognizes and agrees that all testing and remediation methods have reliability limitations, no method nor number of sampling locations can guarantee that a condition will be discovered within the performance of the services as authorized by the Client. Additionally, the passage of time may result in a change in the environmental characteristics at this site. This report does not warrant against future operations or conditions that could affect the recommendations made. The results, findings, conclusions, and recommendations expressed in this report are based only on conditions that were observed during ATC's inspection of the site.

Thank you for this opportunity to be of service to the Town of Wilton. If you have any questions, please feel free to contact us at 860-282-9924.

Sincerely,
ATC ASSOCIATES INC.

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Steven E. Gothers, CMI
Senior Project Manager

APPENDIX A

CALIBRATION CERTIFICATES