INDOOR AIR QUALITY ASSESSMENT

Supplemental Relative Humidity/Water Penetration Evaluation

Virginia Blanchard Elementary School
65 East Hartford Street
Uxbridge, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

At the request of Robert McGuire, Business Manager of Uxbridge Public Schools, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality at the Virginia Blanchard Elementary School, 65 East Hartford Street, Uxbridge, Massachusetts. BEHA staff had conducted an indoor air quality assessment of this school building in October, 2001, and a report was issued describing the conditions in the building at that time (MDPH, 2001). Mr. McGuire requested that BEHA staff return to the building to examine the basement for moisture penetration related to groundwater and/or other water sources that could serve to degrade indoor air quality. On January 9, 2002, a visit was made to this school by Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, to examine the basement.

The school is a two-story structure with a wood-clapboard exterior. The original school building was constructed in 1870 (see Picture 1). An addition was constructed in 1900 to the rear of the building (see Picture 2). The building has had several renovations to the interior of the building since 1900, with the latest occurring in 1985 that subdivided the school administrative offices with an interior wall. Windows are openable throughout the building and appear to be original wooden sash windows. Classrooms exist in the second, first and basement levels of the building. The front of the building has a finished attic that is currently used for storage. An unfinished attic space exists over the rear of the building and the 1900 addition. The basement of the building contains a classroom, kitchen, cafeteria (which is also used for classes), several storerooms, restrooms and the boiler room.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor Model 8551. Water content of the interior wall paneling and wooden 2x4's was measured with a Delmhorst, BD-2000 Model, Moisture Detector with a Delmhorst Standard Probe.

Results

Typical school operations were not in process at the time of this assessment. Students assigned to this building have been transferred to another building. The building does, however, continue to be occupied by administrative staff. Tests were taken during normal operations at the school and test results appear in Table 1.

Discussion

Ventilation

Prior to this assessment, the exhaust vent system servicing the basement had been restored. This system was operating during the assessment. Temperature readings measured in the basement ranged from 69^{o} F to 76 ^{o} F (outdoor temperature 36 ^{o} F). The relative humidity ranged from 25 to 28 percent (outdoor relative humidity 67 percent). The reduction of relative humidity indoors is consistent with expected conditions in a heated building in midwinter in New England.

The basement was found free of moisture accumulation in floor and wall materials. Moisture readings of wood paneling and 2x4's in rooms 001 and 003 were

non-detectable. Water damage was noted in foundation wall brickwork in a number of areas of the basement (see Picture 3). Corners of foundation walls have signs of brick deterioration and efflorescence (i.e., mineral deposits), which indicates water penetration. Efflorescence is a characteristic sign of water intrusion. As moisture penetrates and works its way through mortar around brick it leaves behind these characteristic mineral deposits. With moisture entering the basement, porous materials can become wet and serve as growth media for mold. Each of the areas of brick and mortar damage corresponds to the termini of gutter downspouts on the exterior of the building (see Picture 4).

As noted in the previous BEHA assessment, a possible pathway exists for water to penetrate through foundation walls from inadequately drained rainwater. In several areas, downspouts from roof gutters empty at the base of the building into dirt or cracks in pavement. The freezing and thawing action of water during winter months can create cracks and fissures in the foundation. Over time, this process can undermine the integrity of the building and provide a means of water entry into the building through capillary action through foundation concrete and masonry (Lstiburek, J. & Brennan, T; 2001).

Signs of possible water penetration exist at the top of wood stairs in the back of the building (see Picture 5). These stairs face southwest, which would subject this corner of the building to wind-driven rain during summer months. Wind driven rain can penetrate the wood stair seam and penetrate into the foundation wall.

Conclusions/Recommendations

No source of groundwater penetrating through the floor or foundation walls was found during this assessment, however signs of historical water penetration beneath downspouts and the back stairwell were noted. Based on these observations, the following recommendations are made:

1. Seal holes in tarmac around the exterior walls
2. Install means to direct rainwater from the base of the building.
3. Repair water damaged mortar and brickwork in the basement.

References

Lstiburek, J. & Brennan, T. 2001. Read This before You Design, Build or Renovate. Building Science Corporation, Westford, MA. U.S. Department of Housing and Urban Development, Region I, Boston, MA.

MDPH. 2001. Indoor Air Quality Assessment Virginia Blanchard Elementary School, 65 East Hartford Street, Uxbridge, Massachusetts. Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA. November 2001.

Picture 1

The Original School Building, Constructed In 1870

Picture 2

1900 Addition

Picture 3

Damaged Brickwork in Storeroom at Southeastern Corner of Building

Picture 4

Downspout on the Southeastern Corner of Building, Note Cracks in Concrete and Tarmac

Picture 5

Water Damaged Wood Threshold

TABLE 1

Indoor Air Test Results –Virginia Blanchard Elementary School, Uxbridge, MA-January 9, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	316	36	67					
Main Office	502	69	28	3		No	No	
	447	69	26	0		Yes	No	
	515	71	26	0		No	Yes	
003	698	76	25	0		No	No	
Storeroom (Off Boys' Restroom)	589	64	27	0		No	No	

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%