**WATER DAMAGE ASSESSMENT**

**Brookfield Town Hall**

**6 Central Street**

**Brookfield, Massachusetts**



Prepared by:

Massachusetts Department of Public Health

Bureau of Environmental Health

Indoor Air Quality Program

June 2019

**BACKGROUND**

|  |  |
| --- | --- |
| **Building:** | Brookfield Town Hall (BTH) |
| **Address:** | 6 Central Street Brookfield, MA |
| **Assessment coordinated via:** | Brookfield Board of Health |
| **Reason for Request:** | Water damage and general indoor air quality (IAQ) |
| **Date of Assessment:** | May 10, 2019 |
| **Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) Staff Conducting Assessment:** | Michael Feeney, Director, IAQ Program |
| **Date of Building Construction:** | 1904, with addition of wall-to-wall carpeting over maple tongue-in-groove floors and installation of vinyl wall paper in sections of the building |
| **Building/Site Description:** | The BTH is a three-story brick building with basement located near downtown Brookfield. |

|  |  |
| --- | --- |
| **Building Population:** | The building is staffed with about 5 employees and serves the public daily. |

|  |  |
| --- | --- |
| **Windows:** | Openable |

# METHODS

Please refer to the IAQ Manual for methods, sampling procedures, and interpretation of results (MDPH, 2015).

# RESULTS and DISCUSSION

## Ventilation

No mechanical ventilation systems exist in the building. Each room has radiators. The main hallway has a floor vent to provide heat (Picture 1). The sole source of fresh air is through openable windows. With the lack of supply and general exhaust ventilation, pollutants that exist in the interior space can build up and lead to indoor air quality and comfort complaints.

The building was configured in a manner to use cross-ventilation to provide comfort for building occupants. The BTH is equipped with windows on opposing exterior walls. This design allows for airflow to enter an open window, pass through a room, through the open hallway door into the hallway, pass through the opposing room’s hallway door, into the opposing room and exit the building on the leeward side (opposite the windward side) ([Figure 1](https://www.mass.gov/doc/open-transoms-figure-0/)). With all windows and hallway doors open, airflow can be maintained in a building regardless of the direction of the wind. The system fails if the windows or hallway doors are closed ([Figure 2](https://www.mass.gov/doc/closed-transoms-figure-0/)).

## Microbial/Moisture Concerns

During the course of the assessment, building occupants expressed concerns about possible mold in the Board of Health office. Areas of the first floor were covered with wall-to-wall carpet. A musty odor was detected upon entering a large room used for public meetings which had wall-to-wall carpeting (Picture 2). Carpeting in a hallway was rippled in a manner which indicates that moisture was passing through seams in the tongue-in-groove floor (Picture 3). This is shown by the straight lines of ripples in the carpet. A musty odor was detected in this area as well. Each of these conditions indicates that a significant water source has impacted carpeting/flooring, likely from the basement below.

Upon entering the basement, a distinct musty odor was detected. An examination of the basement found moistened floors and walls from water infiltration through the foundation. An examination of the exterior of the BTH found a number of means for water to penetrate through the building envelope to accumulate in the basement.

* Large spaces exist between the steps of the main entrance (Picture 4).
* The junction between the sidewalk and base of the exterior wall has missing/damage sealant (Picture 5).
* The BTH does not have a gutter/downspout on its roof edge. Rainwater falls from the roof into a cement trough (Picture 6), which is directed to a small drain (Picture 7). The cement trough has numerous cracks and spaces that require sealing.
* The seam between the trough and foundation is missing sealant as evidenced by moss (Picture 8).
* Areas of cement were either paved over or replaced with asphalt, which creates unsealed seams between stone, cement, and tarmac. Asphalt is a porous material that has different porosity than stone and cement, which can allow for water to pass through asphalt, which in turn holds moisture against the foundation.

All of these conditions would allow moisture penetration into the basement (Pictures 9 and 10). In addition to water leaks, it is important to note that the New England area experienced an unprecedented period of extended hot, humid weather. According to the Washington Post, “[d]ata…show[s]…cities in the Northeast have witnessed such humidity levels for record-challenging duration...[i]ncluding Albany, Boston, Burlington Portland and Providence” during the summer of 2018 (WP, 2018). “Boston and nearby locations… [saw]…historic numbers of those warm nights with low temperatures at or above 70 degrees…Providence and Blue Hill Observatory have already broken their annual records” (WP, 2018). If a building does not have adequate exhaust ventilation and air chilling capacity to remove/reduce relative humidity from outside air, then hot, moist air can be introduced into a building and linger to increase occupant discomfort as well as possibly moisten materials that may lead to mold growth, particularly in areas that are in direct contact with soil (e.g., basement floor and walls).

Buildings constructed in the early 1900’s did not have waterproofing or insulation installed on the exterior side of foundation walls or beneath the basement floor. Basement areas were intended for building utilities, such as furnace for heating, fuel storage (e.g., coal), water service and electrical equipment, and for storage, not for occupancy. Based on observations made during the assessment, the basement appears to be significantly impacted by moisture, and has become a source of moisture to the maple floor and to wall-to-wall carpeting on the first floor.

Areas of the first floor have walls covered with what appears to be vinyl wallpaper. Vinyl wallpaper is a water impermeable material which can trap moisture. The second floor auditorium has peeling wall paint. Paint can peel from walls due to water exposure to the paint surface, significant temperature differences and/or a combination of these factors. Plaster is porous and can allow water vapor to traverse from its exterior wall surface to its interior surface. If the interior surfaces of plaster are covered with vinyl instead of paint, water vapor can wet wallpaper paste, which may consist of a material that readily supports mold colonization (e.g., wheat paste).

These conditions, in combination with high ambient temperature during the summer, increased relative humidity, and moisture from the basement, may contribute to moistening of porous materials. The American Conference of Governmental Industrial Hygienists (ACGIH) and the US Environmental Protection Agency (US EPA) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (ACGIH, 1989; US EPA, 2008). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a mildewcide to porous materials is not recommended.

In order to explain how mold and associated odors/particulates in the basement can migrate into occupied areas, the following concepts must be understood:

* Heated air in occupied areas will create upward air movement (called the stack effect).
* Cold air moves to hot air, which creates drafts.
* As the heated air rises, negative pressure is created, which draws cold air to the heat source.
* Airflow created by the stack effect, drafts or wind-driven air can draw airborne particulates into the air stream (i.e., from the basement).
* The opening of the door to the basement at the base of the town selectmen’s office can provide a pathway for air to travel from the basement to the upper floors.

Each of these concepts has an influence on the movement of basement odors and/or other particulates up the stairwell. In order to control possible mold growth, water penetration into the basement area must be minimized. Water penetration through the foundation can be limited by tightening up the building envelope and reestablishing proper drainage around the building foundation.

## Other Concerns

Most areas had carpeting that appeared to be several decades old. In many areas, this carpeting was visibly very worn, frayed, wrinkled and stained. The service life of carpeting in schools is approximately 10-11 years (IICRC, 2002), and will be similar in an environment such as a town hall. Aging carpet can produce fibers that can be irritating to the respiratory system. In addition, tears or lifting carpet can create tripping hazards. Carpeting should be cleaned annually or semi-annually in soiled high traffic areas as per the recommendations of the Institute of Inspection, Cleaning and Restoration Certification (IICRC, 2012).

# Conclusions/Recommendations

In order to address the conditions listed, the recommendations made to improve indoor air quality in the building are divided into short-term and long-term corrective measures. The **short-term** recommendations can be implemented as soon as practicable. **Long-term** measures are more complex and will require planning and resources to adequately address the overall indoor air quality concerns.

## Short-term measures

1. Remove carpet and padding in first floor areas.
2. Clean residue from floor beneath carpet and allow to air dry. Once dry, refinish the floor during temperate weather or cover the floor with a non-permeable surface.
3. Remove any rotten timber and other accumulated debris from the basement.
4. Install weather-stripping and a door sweep to basement doors to limit air movement into occupied areas.
5. To prevent moisture penetration into the basement, the following actions should be considered:
   1. Reseal the stairs.
   2. Seal all cracks in cement and asphalt around the front of the building.
   3. Consider installing a gutter/downspout on roof edges to drain rainfall away from the building.
   4. Seal all cracks in the foundation and the foundation/cement/tarmac junctions with an appropriate sealing compound.
   5. Remove foliage to no less than five feet from the foundation.
   6. Improve the grading of the ground away from the foundation at a rate of 6 inches per every 10 feet (Lstiburek, J. & Brennan, T.; 2001).
   7. Install a water impermeable layer on ground surface (clay cap) to prevent water saturation of ground near foundation (Lstiburek, J. & Brennan, T.; 2001).
6. Remove vinyl wallpaper and replace with an appropriate surface to prevent water accumulation.
7. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
8. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. These materials are located on the MDPH’s website at <https://www.mass.gov/lists/indoor-air-quality-manual-and-appendices>.
9. Consult “Mold Remediation in Schools and Commercial Buildings” published by the US EPA (2008) for further information on mold. Copies of this document can be downloaded from the US EPA website at: <https://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide>.

## Long Term Recommendations

1. Consideration should be given to installing a low-speed exhaust fan in one of the basement windows. The fan should be operated during hot, humid weather to exhaust water vapor and draw dry air from the upper occupied levels during summer months.
2. Consult a building engineer on the appropriate method to insulate the basement floor to prevent moisture accumulation.
3. Consult with a building engineer on further methods to permanently render the basement as water tight as feasible.

# REFERENCES

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

IICRC. 2002. Institute of Inspection, Cleaning and Restoration Certification. A Life-Cycle Cost Analysis for Floor Coverings in School Facilities.

IICRC. 2012. Institute of Inspection, Cleaning and Restoration Certification. Carpet Cleaning: FAQ.

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. 2015. Massachusetts Department of Public Health. Indoor Air Quality Manual: Chapters I-III. Available at: <http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/iaq-manual/>.

US EPA. 2008. Mold Remediation in Schools and Commercial Buildings. US Environmental Protection Agency, Office of Air and Radiation, Indoor Environments Division, Washington, D.C. EPA 402-K-01-001. <https://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide>.

WP. 2018. ‘It’s been relentless’: Smothering summer humidity in the Northeast has crushed records. Washington Post, Washington, DC. <https://www.washingtonpost.com/news/capital-weather-gang/wp/2018/08/30/its-been-relentless-smothering-summer-humidity-in-the-northeast-has-crushed-records/>

**Picture 1**

****

**Floor vent in main hallway**

**Picture 2**

****

**Carpeting in meeting room**

**Picture 3**

****

**Rippled carpet in hallway**

**Picture 4**

****

**Spaces between steps (Note plant and asphalt seam)**

**Picture 5**

****

**Junction between sidewalk and base of the exterior wall has missing/damaged sealant**

**Picture 6**

****

**Cement trough at front of building**

**Picture 7**

****

**Trough drain**

**Picture 8**

****

**Moss in wall/trough junctions**

**Picture 9**

**.**

**Wet spot on basement floor**

**Picture 10**

****

**Moistened basement floor**