MOLD CONTROL

A Comprehensive Report submitted
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Civil Engineering Consultant degree

By

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ABSTRACT

Molds are part of the natural environment, It called Mold (American English) or mould (British English) is a fungal growth that develops on materials, and can be found everywhere, indoors and outdoors. Outdoors, molds play a part in nature by decomposition of organic matter, nutrient recycling, Mold is not usually a problem unless it begins growing indoors. indoors, mold growth should be avoided.

Molds reproduce by means of tiny spores that usually cannot be seen without magnification which float in air, the spores are invisible and begin growing indoors when mold spores land on moist surfaces with correct temperature, and available nutrient conditions.

Mold growth poses significant threats to building structures and occupant health, particularly in regions with high air humidity, prevent mold growth by controlling moisture in buildings and homes before they become mold problems.

DEDICATION

First of all, I dedicate this report to all building engineers , students and construction companies of engineering path, and all agencies who working in cleaning buildings.

Shvan Faraidwn Mhamadsalh

ACKNOWLEDGMENT

In the beginning many thanks for Allah
I would like to express my special thanks of gratitude to all engineers I was worked with who lead me one day of my journey work life time .

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INTRODUCTION

1.1 Background

The first case of mold dates back to 1837, where it was sampled from wallpaper in a house in Prague, molds can growth indoors in all over the world as well as our city-Sulaymaniah, molds growth affect building structures and papulations health so the aim of this report is to inform readers how to prevent mold growth and mold remediation.

1.2 Molds

1.2.1 types of Molds

Mold can appear in various colors, including black, green, white, or yellow, and it often develops on organic materials such as food, wood, wall paper, or fabric as well as on most of building materials like brick, concrete surfaces, cement mortar, cement bord, gypsum bord and insulations. While some molds are harmless, Molds that commonly grow in buildings belong to various genera and species.

Here are some of the most common types of molds found indoors:

1. Aspergillus: Found in areas with dampness and poor ventilation, such as basements, crawl spaces, and areas affected by water damage. This type found on wet building materials like wood, drywall, and insulation. Aspergillus molds can vary in color and texture, appearing as green, yellow, or brownish colonies.

2. Stachybotrys: Commonly known as black mold ,Thrives in water-damaged materials with high cellulose content, such as drywall, ceiling tiles, and carpeting. Commonly found in areas with persistent moisture issues, such as leaky pipes or roofs. It can produces mycotoxins that can pose health risks when inhaled or ingested.

3. Cladosporium: is a genus of mold commonly found in indoor environments It appears as black or greenish colonies and can grow on a variety of surfaces Flourishes on porous materials like wood, fabrics, and carpets. This type found in areas with high humidity and water damage areas, like kitchens, bathrooms, and areas with poor ventilation.

4. Penicillium**:** Penicillium molds are characterized by their blue or greenish appearance ,found on materials with high cellulose content, including wallpaper, insulation, and fabrics. Often seen in areas affected by water leaks, condensation, or flood damage such as damp walls, ceilings, and carpets.

5. Alternaria**:** Thrives in damp environments, such as showers, bathrooms, and basements. And found in areas with persistent moisture problems and building materials like drywall and carpeting.

6. Chaetomium: Typically found in water-damaged areas with excessive moisture, such as basements, attics, and crawl spaces. Can also be seen on building materials like drywall, wooden framing, and sheathing. The appearance of this type like cottony white colonies that later turn black as they mature.

7. Fusarium**:** Fusarium molds are commonly found in soil and plant material but can also grow indoors under favorable conditions. They appear as white, pink, or reddish colonies and are often found on water-damaged materials, including wallpaper, carpets, and upholstery. Some Fusarium species produce mycotoxins that may pose health risks.
8. Trichoderma: Trichoderma molds are commonly found on damp surfaces such as wallpaper, carpet backing, and insulation. They appear as green or white colonies with a wooly texture.

1.2.2 Places which mold could develop in:

- In crawl spaces
- Around showers and bathtubs
- In ceilings, near exhaust fans or recessed lights
- In or near areas where water is dripping (drainpipes, gutters, etc.)
- In the wall near the clothes dryer vent
- Near HVAC vents
- Under carpeting

Occasionally, indoor mold growth may not be easily discovered. It is possible that mold may be growing on hidden surfaces, such as the back side of drywall, wallpaper, or paneling, the top of ceiling tiles, the underside of carpets and pads, etc. Probable locations of hidden mold may include pipe chases and utility tunnels (with leaking or condensing pipes), walls behind furniture (where condensation forms).

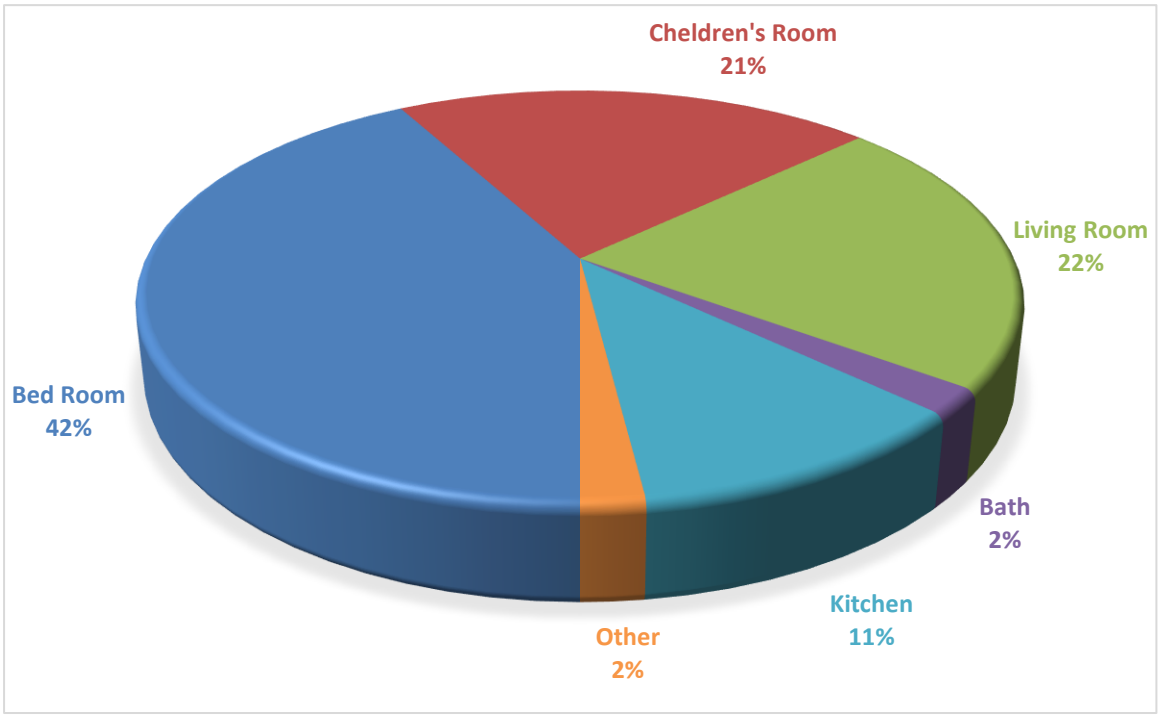


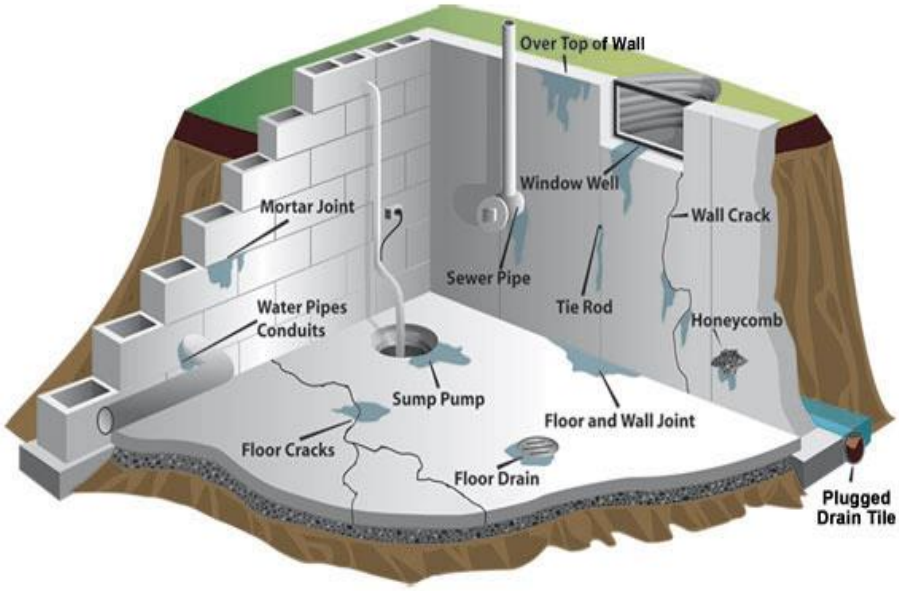
Chart 1.1: Areas of home are prone to mold growth

1.2.3 What does mold need to grow:

1. Moisture

- **Water:** Moisture happen when water moves from a source into some part of a building that should be dry like water in the form of rain, plumbing leaks or floods which easy to detect but water problems which are less obvious and difficult to detect like the adhesive that secures flooring to a concrete slab.

- **Condensation:** Both indoor air and outdoor air contains water vapor, Wherever air goes, water vapor goes. When humid air contacts a surface that is cold enough, the water vapor in the air will condense onto that cold surface, condensations also like water problems may be not obvious or difficult to detect or identify. For example, humid indoor air may condense on the cool backside of vinyl wallpaper that covers an exterior wall, providing ideal conditions for mold to grow.
  Condensation forms when air is rapidly cooled and loses its ability to hold moisture. Your basement is the coolest area of the house and is usually more humid. Cool, humid air with little to no ventilation can create the perfect environment for mold to grow.



Pic 1: water moves from a source into some part of a building

2. Warmth

Most molds prefer temperatures ranging from (25°C to 30°C) 77°F to 86°F, although some can grow in cooler temperatures as well.

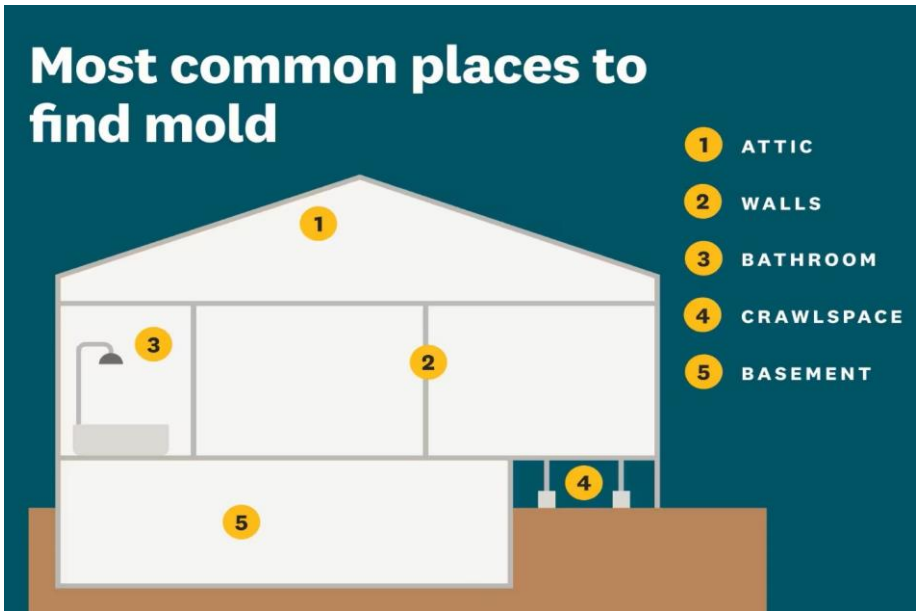
3. Low PH

In general mold can survive in low pH conditions, but it may not be able to thrive. Molds differ in their pH requirements, depending on the environment and other factors. But most of molds prefers neutral to slightly acidic conditions to grow approximately (pH = 4).

4. Nutrients (Organic matter)

Mold prospers on organic materials like wood, paper, and fabric which provide nutrients for molds spores to grow and reproduce.

Nutrient requirements for molds may vary from mold to mold. Some molds may thrive well on substrates with high sugar or salt content. with some preferring simple sugars, while others can break down and utilize complex sugars.



Pic 2: Most common places to find mold

CHAPTER TWO

MOLD AND CONSTRUCTION PROJECTS

2.1 How To Prevent Mold On Construction Projects

Building projects consist of three main stages, the planning and design phase, the construction phase, and the post-construction phase. Preventing mold growth is crucial to safeguard occupants from negative health effects and to protect the building, its mechanical systems, and its contents from physical or chemical damage. Despite this, mold issues are so prevalent in buildings that many people view them as unavoidable.

2.1.1 Design Phase

Good design is a prerequisite for a building that resists mold growth problems, many common moisture problems and mold growth can be traced to poor decisions in design. Here are things designer should consider during designing.

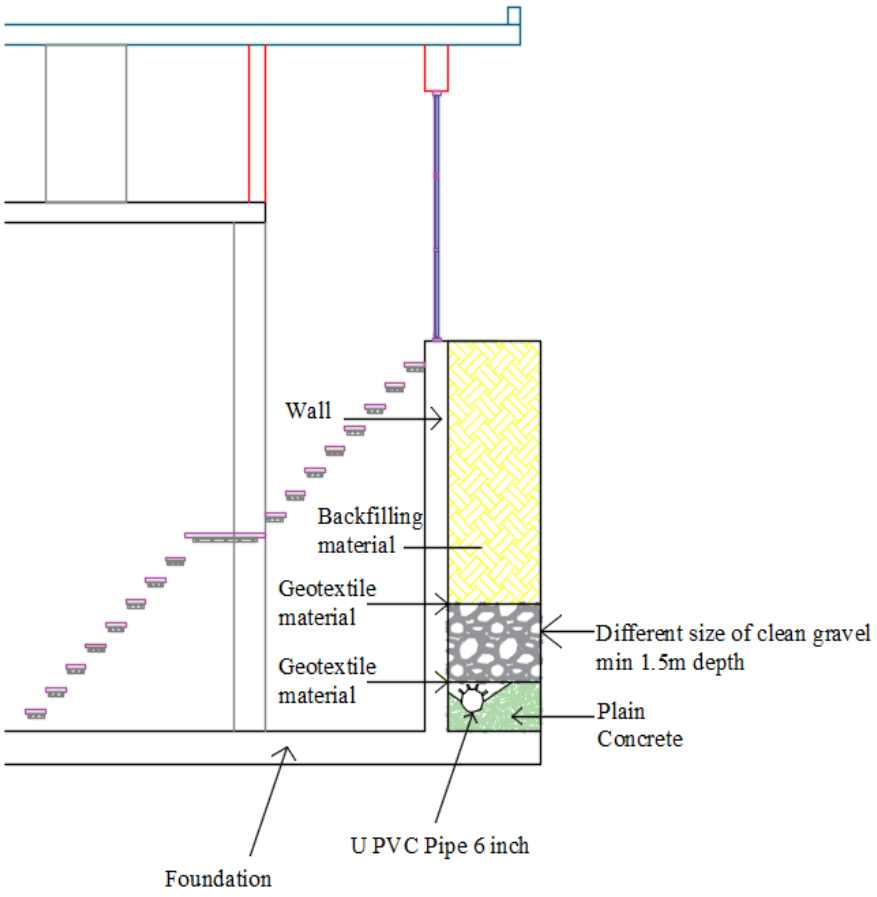
The design team must understand the problems that water causes in the project and the dynamics of moisture sources and moisture control, This knowledge must be reflected in the design documents, building drawings and specifications to design the site so that water from landscape irrigation , rain and snowmelt are prevented from entering the building.

Suitable design for moisture control may contain:

1. Site Drainage:
    - The site drainage design creates a controlled condition to help move water away from the building.
    - Use grading to slow down runoff and achieve a more balanced infiltration rate, and Plan the surrounding slope to divert water away from the building.
    - Making sure the finished floor is elevated enough so that water will not back up into the building if the drainage systems are blocked.
2. Foundations, walls and roof isolations:
    - Keep rain water away from outer perimeter.
    - Using capillary break may be needed between foundation and wall to prevent water wicking also providing plastic or elastomeric membrane to be used in place of a concrete slab can create a capillary break and stop evaporation from the soil.

- Specify a curtain of free-draining material like sand and gravel, coarse aggregate with no fines for backfilling (around the outside of the foundation between the unexcavated earth and the basement wall).

3. Good Plumbing Systems.
4. Design proper ventilation system, good maintained heating, ventilation, and air conditioning (HVAC) systems. Inadequate airflow can lead to moisture buildup, promoting mold growth.
5. Using suitable and dry materials, according to the type of structure and climate condition of the city, building materials such as wood, drywall, and insulation contain organic matter that mold can feed on.



Pic 3: Keep rain water away from outer perimeter

2.1.2 Construction Phase:

In construction projects can effectively prevent mold growth and maintain an indoor air quality, structural integrity and future healthy indoor environment for occupants by understanding the moisture control design features in detail and ensuring their constructability and ensuring the moisture control features are effectively installed.There is now more focus on moisture control during construction than ever before due to the heightened concern about mold growth in buildings.

To protect a building from moisture problems during construction and to ensure the design's moisture control elements are properly implemented, the project manager needs to subsume moisture control into the planning.

Create a storm water management plan specifically for the construction phase. This plan should cover at least the following aspects:

- Techniques to reduce the risk of storm water runoff during construction.
- Strategies for directing storm water away from the construction site and the building structure.
- Procedures to keep construction materials dry.
- Methods to ensure the building or its sections remain dry throughout construction.
- Policies and procedures for drying out materials and the building if they do become wet.

To prevent mold during construction , Here are some key strategies:

1- Construction Techniques: Employ construction techniques that minimize moisture infiltration and promote drying. This includes proper flashing and sealing of windows and doors, installation of waterproof membranes in wet areas like pools, bathrooms and kitchens. and ensuring proper slope and drainage on roofs and exterior surfaces.

2-Moisture Control: Moisture is the primary factor contributing to mold growth. Implement effective moisture control measures throughout the construction process. This includes proper site drainage, installation of vapor barriers, and sealing of potential water entry points such as roof penetrations, windows, and doors.

The order of activities is crucial in preventing moisture issues during construction:

- Coordination between construction companies who are obligated to control moisture in buildings as specified in the construction documents.
- Moisture-sensitive and moisture-absorbing material and equipment should be scheduled for delivery when dry, protected storage is available.
- Moisture-sensitive materials need to be protected from the weather as they arrive on site, It is preferable to enclose the building so it is weather-tight before the moisture-sensitive materials arrive.
- Wet, porous materials should be dry before moisture-sensitive materials are installed or moisture-sensitive coatings are applied.
- For smaller projects the building can be weather-tight before the moisture-sensitive materials arrive, but for larger ones it may not be possible may provide temporary shelter for materials and equipment stored on site.

3-Materials Selection: Choose construction materials that are resistant to moisture and mold growth. Use mold-resistant drywall, insulation, and flooring materials where applicable. Avoid using organic materials such as wood or cellulose-based products in areas prone to moisture exposure.

4-Drying Out: In the event of water intrusion or flooding during construction, take immediate steps to dry out affected areas thoroughly. Use fans, dehumidifiers, and other drying equipment to remove excess moisture and promote drying. Remove and replace any water-damaged materials as necessary to prevent mold growth.

5-Proper Ventilation: Ensure adequate ventilation in areas prone to moisture build up, such as bathrooms, kitchens, and basements. Proper ventilation helps to reduce humidity levels and prevent condensation, which can promote mold growth. Use exhaust fans, dehumidifiers, and HVAC systems to maintain proper airflow and moisture levels.

Proper ventilation for the storage of building materials is crucial to reduce humidity and prevent issues like mold, mildew, and deterioration by natural ventilation like window or by mechanical ventilation like exhaust fans or dehumidifiers.

Improper installation of HVAC systems can create condensation and moisture-problems. Examples include:

- Inadequate dehumidification and pressurization performance of the HVAC system, which can lead to occupant discomfort and mold growth.
- Condensation on HVAC equipment components, which can damage components, increase maintenance costs, decrease component and system lifespan and lead to mold growth.
- Inadequate drainage of collected condensate or other water, which can result in moisture damage to the building and its contents and to mold growth.
- Inadequate ventilation of indoor humidity sources (e.g., showers, bathrooms, spas and kitchens), which can lead to mold growth and deterioration.
- controlling the improved insulation and increased airtightness in modern housing have led to a decline in the proportion of damp residences, consequently reducing the prevalence of respiratory diseases.

6-Regular Inspections: Conduct regular inspections during construction to identify and address any sources of moisture intrusion or water damage promptly. This includes inspecting for leaks, plumbing issues, and areas of standing water. Address any issues immediately to prevent mold growth from occurring.

Regular inspections should be scheduled to identify and address potential moisture issues promptly. Additionally, the project manager should enforce protocols for proper material handling and storage, such as using pallets and maintaining adequate spacing for air circulation.

2.1.3 Maintenance Phase:

During the maintenance phase of buildings, we should know that molds can grow on wood, paper, carpet, foods, and insulations, and preventing mold growth requires proactive measures to control moisture and maintain a healthy indoor environment.

Moisture problems may include roof leaks, landscaping or gutters that direct water into or under the building, and unvented combustion appliances which may cause in increasing relative humidity to a level of mold growth. Moisture issues in schools and large buildings are often linked to delayed or inadequate maintenance. Portable classrooms and other temporary structures frequently encounter mold problems due to moisture issues.

Maintenance plan for mold and moisture control :

- Inspect plumbing fixtures, roofs, windows, doors, and HVAC systems for any leaks or damage.
- Repair any water leaks, plumbing issues, or roof damage promptly to prevent moisture intrusion.
- Address any ventilation problems, such as clogged dryer vents or bathroom exhaust fans, to reduce humidity levels.
- Improve ventilation in areas prone to high humidity, such as kitchens, bathrooms, and laundry rooms, to reduce moisture buildup.
- Replace damaged or deteriorated building materials, such as water-damaged drywall or insulation, to prevent mold growth.
- Conduct regular inspections of all units and common areas to identify any signs of moisture intrusion, water leaks, or mold growth.
- Utilize moisture meters and thermal imaging tools to detect hidden moisture and mold issues behind walls or in ceilings.
- Implement measures to control moisture intrusion, such as repairing leaky roofs, windows, plumbing fixtures, and HVAC systems promptly.
- Ensure proper drainage around buildings and install gutters and downspouts to direct water away from the foundation.
- Improve ventilation in kitchens, bathrooms, and laundry areas to reduce humidity levels.
- Install vapor barriers in crawl spaces and basements to prevent moisture from seeping into the building envelope.

- Regularly clean and disinfect surfaces in kitchens, bathrooms, and other areas prone to moisture and mold growth.
- Clean and maintain air vents, fans, and ductwork to prevent the accumulation of dust and debris that can harbour mold spores.
- Use mold-resistant cleaning products and techniques to remove mold and prevent its return.

Pic 4: Mold growth inside duct.

Maintenance Schedule for a building:

- Develop a preventive maintenance schedule for HVAC systems, including cleaning and replacing filters, inspecting ductwork, and ensuring proper drainage of condensate lines.
- Schedule routine inspections of plumbing systems, including checking for leaks, repairing faulty fixtures, and insulating pipes to prevent condensation.
- Regularly clean and inspect common areas, such as laundry rooms and community spaces, to identify and address any sources of moisture or mold growth.

CHAPTER THREE
MOLD GROWTH INDEX

3.1 Relationship between Surface Water Ratio and Mold Growth Index:

Moisture is one of the environmental parameters that determine the possibility of mold growth on building materials, and there is a corresponding relationship between surface water ratio and moisture content of building materials. Materials with larger pores have higher surface water ratios and different materials have different distribution of pore size and pore volume. Fig no.1_1 show the pore volume distribution of four different building materials.

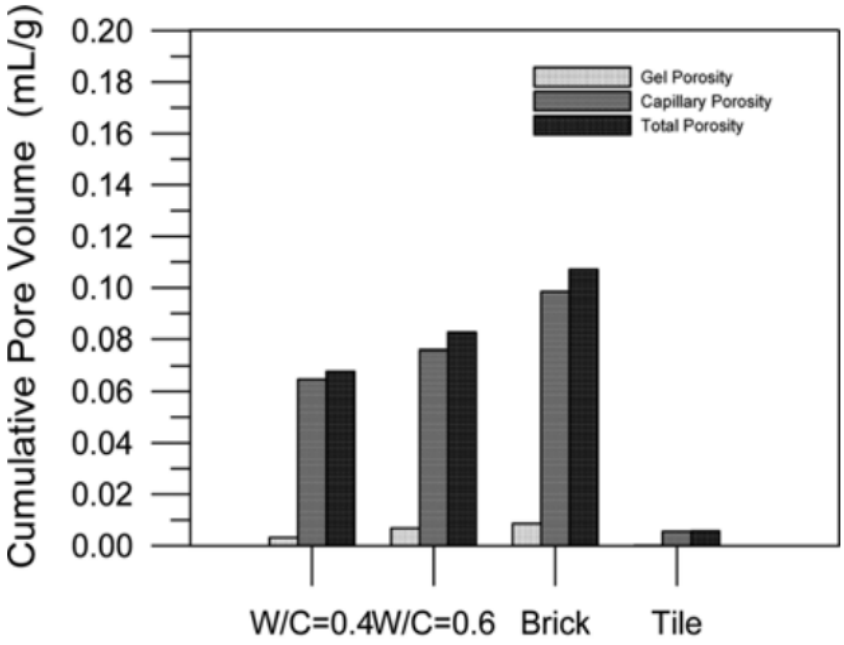


Fig 2 Pore Volume Distribution Of Four Different Building Materials.

The total porosity ranked in ascending order : tile > cement mortar w/c = 0.4 > cement mortar w/c = 0.6 > brick .

in an environment of high humidity, the surface water ratio of the materials increased with time and as we know materials with larger pores had higher surface water ratios so materials with higher porosity showed a greater change in surface water ratio.with regard to pore distribution, the pore size of brick > cement mortar (w/c = 0.6)> cement mortar (w/c = 0.4)> tile. Pore distribution affected the surface water ratio and moisture content of sample materials. Higher porosity resulted in higher surface water ratio and greater moisture content.

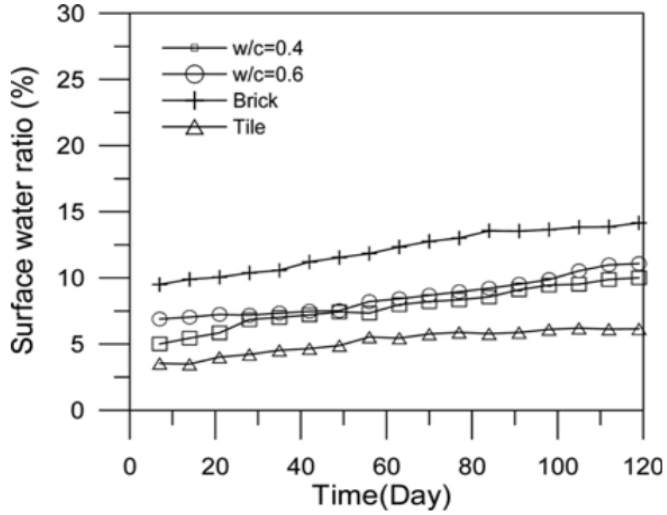


Fig 3-1 The Surface Water Ratio of Different Building Materials in Climate Chamber.

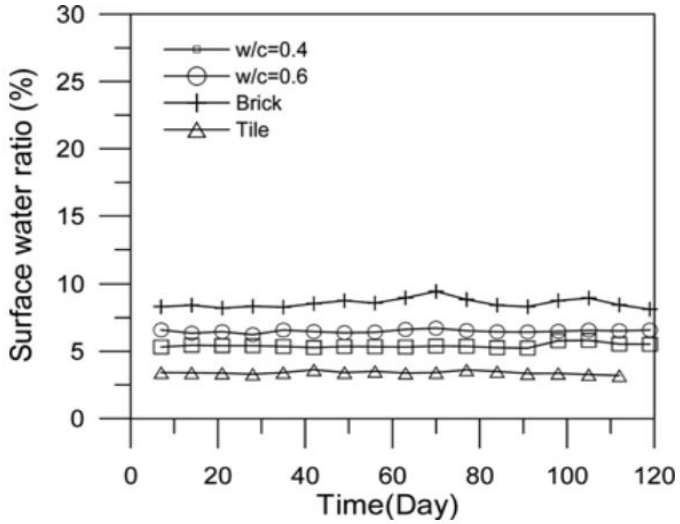


Fig 3-2 The Surface Water Ratio of Different Building Materials in Indoor Environment.

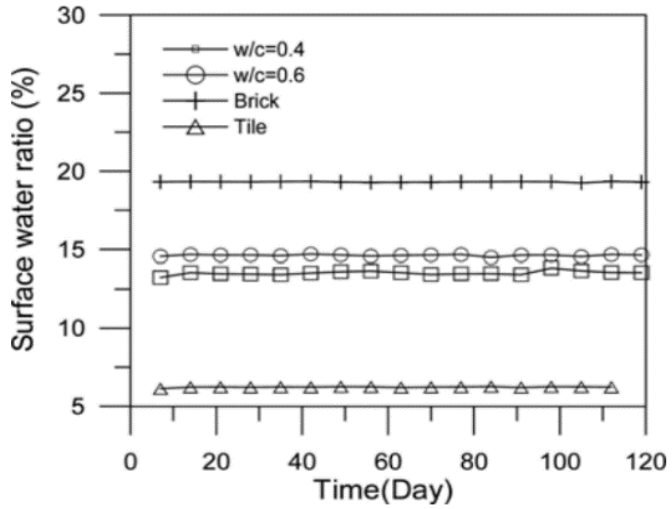


Fig 3-3 The Surface Water Ratio of Different Building Materials in Water Damage Environment.

In this figs we see the relation of surface water ratio and mold growth index of four different materials in Climate Chamber.

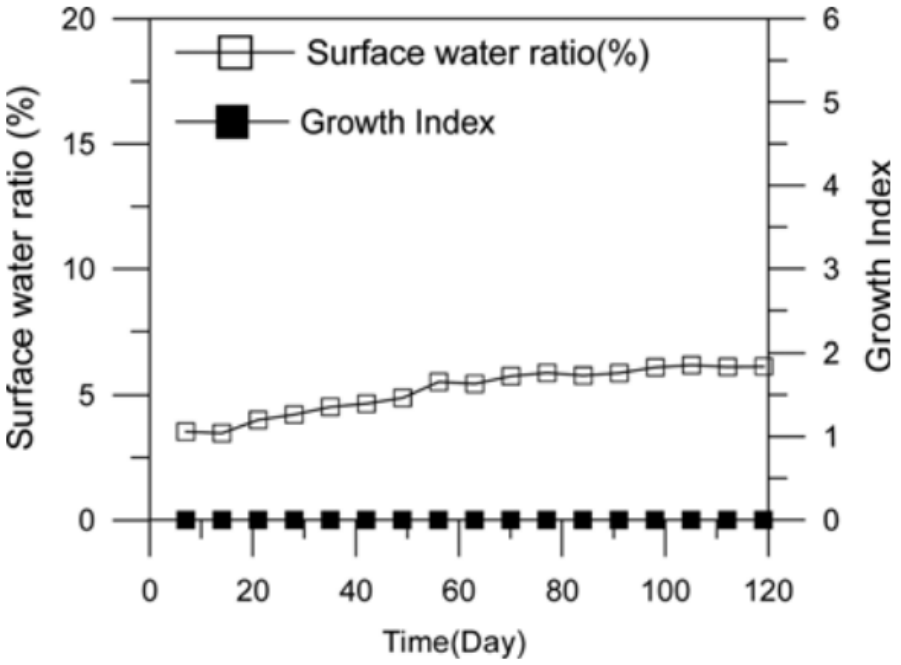


Fig 4-1 The Relationship between Surface Water Ratio and Mold Growth Index in Climate Chamber (Tile).

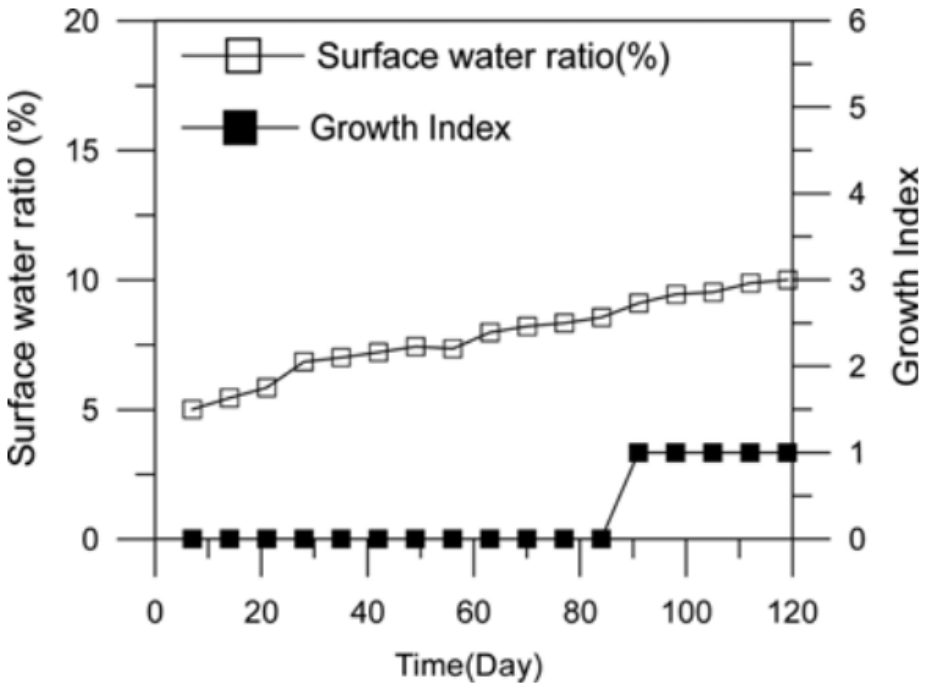


Fig 4-2 The Relationship between Surface Water Ratio and Mold Growth Index in Climate Chamber (Mortar, w/c = 0.4).

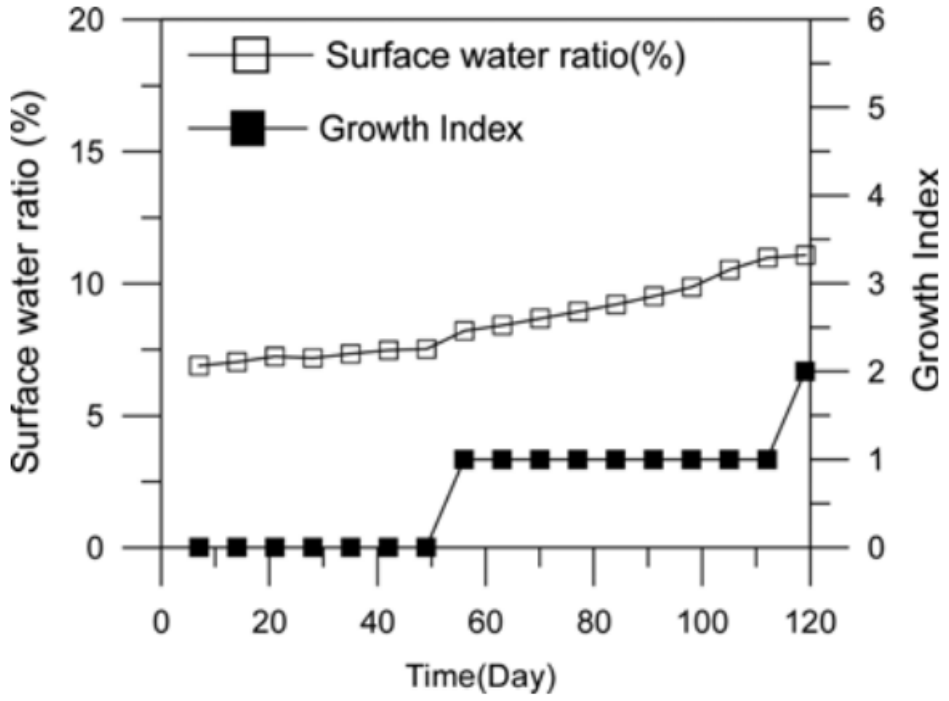


Fig 4-3 The Relationship between Surface Water Ratio and Mold Growth Index in Climate Chamber (Mortar, w/c = 0.6).

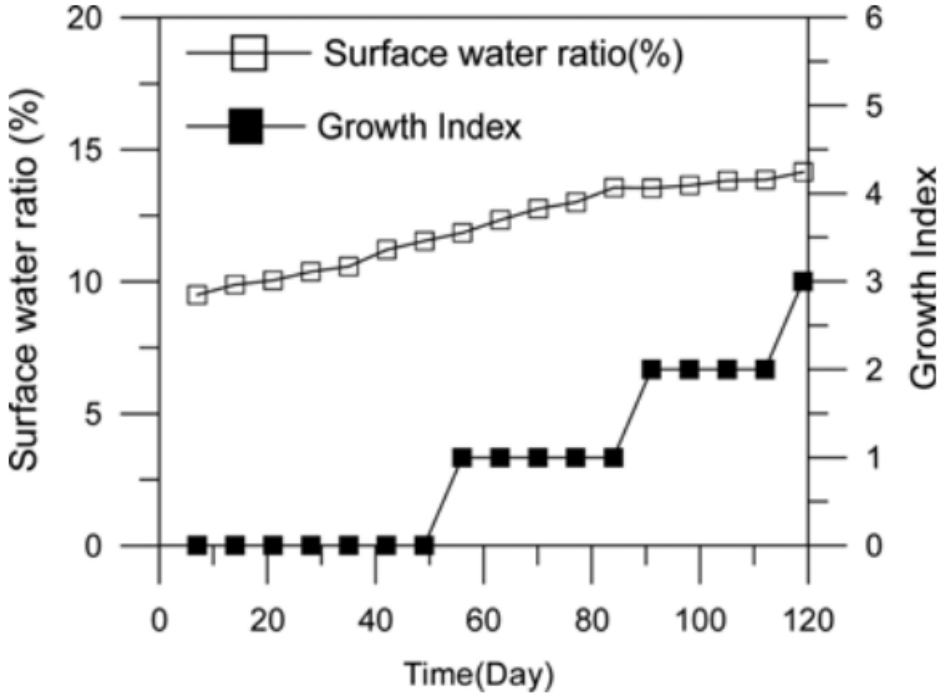


Fig 4-4 The Relationship between Surface Water Ratio and Mold Growth Index in Climate Chamber (Brick).

CHAPTER FOUR

MOLD REMEDIATION AND CLEAN Up

4.1 Mold Remediation Preparations:

Preparing for mold remediation involves several critical steps to ensure a thorough and safe process. First, assess the situation by identifying the affected areas and, if possible, the type of mold present. Develop a detailed remediation plan that includes a containment strategy to prevent mold spores from spreading. Prepare the area by clearing it of furniture and personal items, sealing off the contaminated space, and ensuring proper ventilation. Plan for the disposal of contaminated materials according to local regulations and disinfect all tools and equipment used.

Consideration to protect your health and indoor air quality (IAQ) when cleaning up after a flood :

1. Stay safe as you clean up.
2. Sort materials and throw away anything you cannot clean and dry.
3. Clean the house and everything in it that was wet or moldy.
4. Dry the house and everything in it completely.

Safety Tips for Investigating and Evaluating Mold and Moisture Issues:

1. Avoid touching mold or moldy objects with your bare hands.
2. Prevent mold or mold spores from coming into contact with your eyes.
3. Avoid breathe in mold or mold spores.
4. When disturbing mold, consider wearing personal protective equipment (PPE). At a minimum, use an N-95 respirator, gloves, and eye protection.

Pic 5: Removing contaminated material.

Questions to Consider Before Remediating:

1. Are there existing moisture problems in the building?
2. Have building materials been wet more than 48 hours?
3. Are there hidden sources of water or is the humidity too high (high enough to cause condensation)?
4. Are building occupants reporting musty or moldy odors?
5. Are building occupants reporting health problems?
6. Are building materials or furnishings visibly damaged?
7. Has maintenance been delayed or the maintenance plan been altered?
8. Has the building been recently remodeled or has building use changed?
9. Is consultation with medical or health professionals indicated?

Mold removal and remediation will always involve cleaning up existing mold while avoiding exposure to oneself as well as occupants, and preventing new growth by addressing the moisture source.

The first step to stopping mold is to remove the source of moisture and dry all wet surfaces and materials, then scrub mold off hard surfaces with detergent and water, dry completely and spray a vinegar by a spray bottle and finally you can paint the surface by a paint which does not let any substance.

For mold cleaning you can use white vinegar, a bleach solution, or a 50/50 solution of ammonia and water to kill mold. But mixing ammonia with bleach or all-purpose other cleaners will create toxic fumes so all remediation workers should be properly certified and adequate personal protective equipment (PPE) must be worn when engaging in mold remediation activities.

4.2 The clean up process steps:

Step one: Repair the water problem.

Fix the source of the water problem to prevent new mold growth. Inspect the building to identify mold-affected areas, which may require visual inspections.

Step two: Isolate the contaminated area.

Isolate the affected areas to prevent mold spores from spreading to unaffected areas. This typically involves sealing the non-affected area with plastic sheeting.

Step three: Remove wet and mold-damaged porous materials.

Safely dispose of materials that cannot be effectively cleaned or salvaged, such as heavily contaminated drywall, carpeting, and insulation. This may also include cleaning and disinfecting rescue materials.

Step four: Clean non-porous materials,

scrub all moldy surfaces using a damp cloth and detergent solution until all mold has been removed and rinsed cleaned surfaces with clean water. And Clean the affected areas with a

damp cloth and mop with detergent solution for smaller area than (3 m^2). But for affected area bigger than (3 to 9)m^2 requires you to vacuum all surfaces with a HEPA vacuum, and then clean all surfaces with a damp cloth.

Step five: Dry all cleaned materials to allow any remaining moisture to evaporate. And Accelerate the drying process by using fans, dehumidifiers or raise the indoor air temperature. Ensure all areas should be visibly free of contamination, as no dust and dirt means no mold.

How to Know if Remediation or Cleanup is Complete:

1. You must have completely fixed the water or moisture problem.
2. You should complete mold removal. Ensure if the cleanup is sufficient. Visible mold, mold-damaged materials, and moldy odors should not be present.
3. You should revisit the site shortly after remediation, and it should show no signs of water damage or mold growth.
4. People should be able to occupy space without health complaints or physical symptoms.
5. You can no longer see or smell mold.

4.3 Mold growth on different Building materials:

It's important to recognize that mold impacts various building materials differently. Certain materials are more prone to mold growth than others, and the most effective mold removal techniques may vary based on the material type.

1.Mold on Wood:

Wood is a prevalent building material in many countries, often used for structural elements, furniture, and other features. However, it is less common in our country due to its susceptibility to mold growth. Wood serves as both a food and moisture source for mold because of its high porosity, making it prone to mold colonization. Given sufficient time, mold can cause significant damage to wood surfaces. Fortunately, contaminated wood can often be salvaged by applying a mold-killing solution and ensuring thorough drying.

Pic 6: Mold growth on wood.

2.Mold on Concrete:

Keeping the concrete dry is the biggest key to preventing mold so make sure to routinely check concrete surfaces in high moisture areas such as the basement and crawlspace, because concrete absorbs moisture, so slowly it can have water damage for a period of time. However, concrete walls and surfaces can trap dust and dirt which do provide a food source for mold.

Pic 7: Mold growth on concrete surface.

3.Mold on Insulation:

All types of insulation, which means they can absorb water and trap dirt and dust that can provide a food source for mold. To prevent insulations becomes moldy, you must make sure that the area surrounding the insulation is completely dry before installing .

Pic 8: Mold growth on Insulation.

4.Mold on Carpet:

One of the most common spots for hidden mold is under permanent carpeting because moisture and liquids from spills and flooding get absorbed into the carpet but it is not common building material in our country. But as a furniture the best way to prevent mold in carpeting is to keep it dry and react quickly to any spills before they get too deeply absorbed.

Pic 9: Mold growth on carpet.

5.Mold on Paint:

Mold can develop on painted surfaces such as gypsum board and trim. Prolonged exposure to high humidity levels provides the moisture necessary for mold growth.
Similarly, mold may appear on painted concrete masonry surfaces. For instance, in a classroom adjacent to an ice rink, the cool masonry wall can cause moisture from the humid classroom air to condense on the painted surface, facilitating mold growth on the paint film.

Pic 10: Mold growth on painted surface.

6.Mold on Tile:

While tile is not a food source for mold, it can provide a damp and humid environment that allows mold spores to grow. In other words, any moisture or dampness on the tile can lead to mold growth. Long-term high humidity provided moisture that was absorbed into the cool vinyl tile and supported mold growth.

It's important to keep tile dry and well-ventilated to prevent mold growth from occurring.

Pic 11: Mold growth on tile.

7.Mold behind vinyl wallpaper:

Condensation occur behind vinyl wallpaper in a warm, humid climate. Condensation and mold growth occurs behind the vinyl wallpaper on both exterior and interior walls.

Pic 12: Mold growth under wall paper.

4.4 Forecasting Condensation :

Understanding condensation involves more than just knowing the relative humidity (RH) of the air. While RH provides insight into the moisture content of the air relative to its saturation point, it alone is not sufficient for predicting condensation. However, the dew point offers a more absolute measurement of the air's moisture content and plays a crucial role in condensation prediction.

4.4 .1 Relation of relative humidity and temperature:

Relative Humidity RH is the amount of water vapor in the air compared to the maximum amount of water vapor the air can hold at its current temperature, the relative humidity changes if air temperature Changes. The relationship between relative humidity and temperature is significant. As temperature increases, air can hold more moisture, so the relative humidity decreases, even if the actual amount of water vapor in the air remains constant. Conversely, as temperature decreases, the air's capacity to hold moisture decreases, so the relative humidity increases.

4.4 .2 Relation of dew point and temperature:

The dew point is the temperature at which air becomes saturated with moisture and dew forms. It is the temperature at which the air would need to be cooled at constant pressure and constant water vapor content in order for saturation to occur.
It means knowing only the RH of the air is not much help in predicting condensation, But the dew point does not change with air temperature. In that sense it is an absolute measurement of the amount of water vapor in the air. When you know the dew point of the air and the temperature of a surface, you can predict condensation. If the dew point is above the temperature of the surface, water vapor will condense onto that cold surface, because if the air temperature reaches the dew point, the air is unable to hold any more moisture, and excess water vapor condenses into liquid water, forming dew, fog, clouds, or even precipitation, But the dew point is below the surface temperature, moisture will not condense.

Pic 13: Condensation on glass.

Finding dew point from Psychrometric Chart:

When the instrument you are using does not display air dew point you will need a psychrometric chart to find the dew point based on the temperature and RH of the air. see Figure 1 a simplified psychrometric chart relates air temperature, RH and Dew Point.
With this chart and the readings from a monitor to measure air temperature and RH, one can determine the more useful value of air dew point in a few seconds. For example, assume an instrument shows the outdoor air is 85°F and its RH is 60 percent. Plot that point on the chart. Then, beginning at that point move horizontally to the left until your line intersects the saturation curve. From that intersection, read straight down to the bottom of the chart to determine the dew point. As shown in Figure 1-18, the dew point of air at 85°F and 60 percent RH is 70°F.

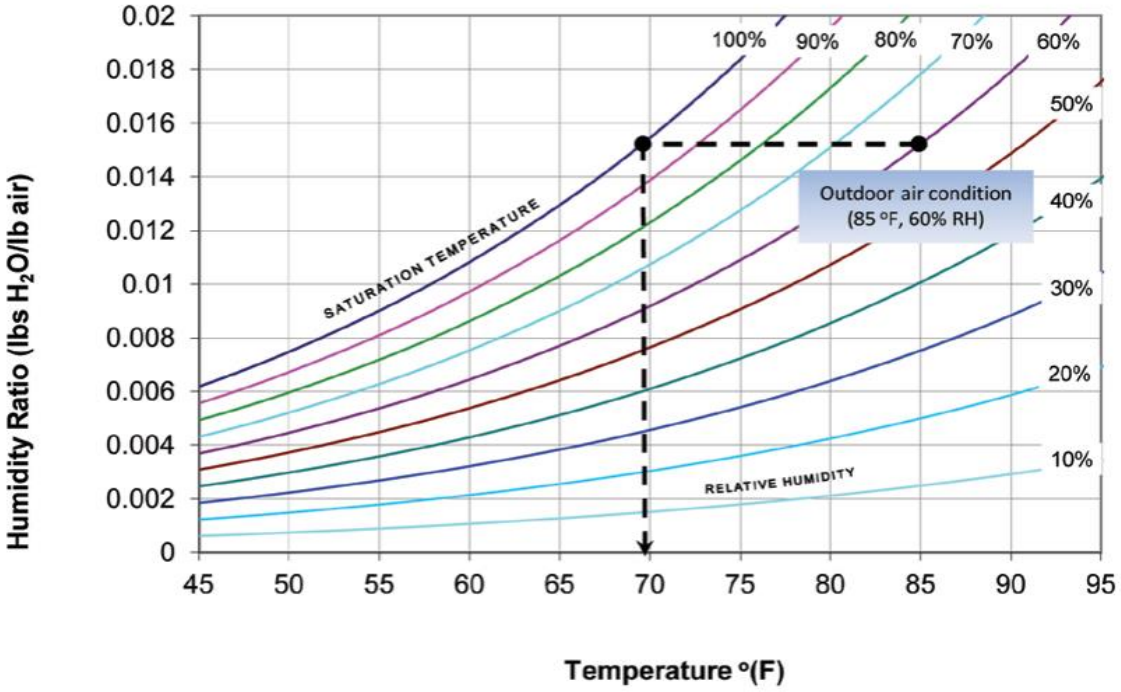


Fig 1: a simplified psychrometric chart relates air temperature

4.5 how to distinguish between mold and efflorescence :

Often, homeowners notice a white, powdery substance on their basement walls or floors and assume it's mold. It's actually something called efflorescence, a fancy term for salt crystals forming on the surface of masonry and other building materials, Efflorescence occurs when moisture that contains salts is drawn out from within the material and crystallizes on its surface.

Table: The difference between mold and efflorescence:

	Mold	**Efflorescence**
1	Mold is a type of fungus	Efflorescence is a crystalline deposit of salts
2	Mold can pose health risks	Efflorescence poses no health risks
3	Mold will turn into a powder when touched	Efflorescence will turn into a powder when touched
4	mold can be any color	Efflorescence is almost always white, yellow or brown. depending on the salt composition.
5	smells musty or earthy	smell vaguely like sea water- salty

A simple method to distinguish between mold and efflorescence is by spraying the affected area with water. If the discoloration disappears upon wetting, it is likely efflorescence. This occurs because efflorescence is caused by water-soluble salts, which dissolve when exposed to moisture. In contrast, if the discoloration persists after wetting, it is more likely to be mold. Mold is not water-soluble and will not disappear when sprayed with water.

Pic 14: Efflorescence on brick.

CHAPTER FIVE

RESULT AND DISCUSSION

TO prevent mold growth, it's essential to control moisture levels indoors through proper ventilation, prompt repair of leaks, effective moisture barriers, and maintaining indoor humidity levels below 60%. Addressing moisture issues promptly and implementing mold prevention strategies can help mitigate the risk of mold growth and its associated consequences.

Effective mold management involves addressing both visible and hidden mold growth. Regular inspections of potential hotspots, such as crawl spaces, bathrooms, and HVAC areas, are essential. Additionally, understanding the less obvious growth sites, such as behind drywall or under carpets, helps in comprehensive mold prevention strategies.

By recognizing the types of molds and their growth conditions, building managers and homeowners can implement targeted prevention measures. These include improving ventilation, controlling humidity, and using mold-resistant materials. The aim of this report is to equip readers with the knowledge needed to mitigate mold risks, thus protecting building structures and promoting healthier indoor environments.

A construction management service may participate in the management of the project at varying levels from inception, design and construction to turnover and occupancy. However, when a construction manager is integrated into the design team, this role can expand, it is crucial that the manager take on responsibility for implementing the team’s moisture control objectives.

By considering both the dew point and surface temperature, it becomes possible to anticipate condensation events accurately. This understanding is essential for managing moisture-related issues, such as mold growth, indoor air quality, and building maintenance.

Different building materials react to mold in various ways, and the chapter provides specific guidance for each material type. Wood, concrete, insulation, carpet, paint, tile, and vinyl wallpaper all have unique vulnerabilities and require tailored remediation approaches. For instance, wood's high porosity makes it a prime target for mold, necessitating thorough drying and treatment with mold-killing solutions. In contrast, concrete's ability to trap moisture and dust requires regular inspections and moisture control to prevent mold growth.

Mold control is a multifaceted issue requiring a combination of preventative and reactive strategies. By prioritizing moisture control, regular maintenance, and using appropriate treatments, we can effectively manage mold growth. Addressing the challenges in mold control through innovation and public education is essential for promoting healthier indoor environments and ensuring the durability of our buildings.

In summary, the effects of mold in buildings can be far-reaching, impacting structural integrity, occupant health, financial well-being, and reputation. Proactive measures to prevent mold growth, such as moisture control, ventilation, and regular inspections, are essential for maintaining safe, healthy, and sustainable built environments.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

Many types of molds exist. All molds have the potential to impact health. They can produce allergens that may cause allergic reactions or asthma attacks in individuals who are sensitive to mold. Others are known to produce potent toxins and irritants. Potential health concerns are an important reason to prevent mold growth and to remediate any existing indoor mold growth.

Mold Prevention Tips

- Fix leaky plumbing and leaks in the building envelope as soon as possible.
- Watch for condensation and wet spots within 48 hours. Fix source of moisture problems as soon as possible.
- Prevent moisture due to condensation by increasing surface temperature or reducing the moisture level in air.
- To raise surface temperature, consider insulating or enhancing air circulation. To lower moisture levels in the air, repair any leaks, increase ventilation if the outside air is cold and dry, or use dehumidifiers if the outdoor air is warm and humid.
- Keep heating, ventilation, and air conditioning (HVAC) drip pans clean, flowing properly, and unobstructed. And Perform regular building/HVAC inspections and maintenance as scheduled.
- Maintain low indoor humidity, below 60% relative humidity (RH), ideally 30 – 50%, if possible.
- Avoid allowing foundations to remain wet. Ensure proper drainage and slope the ground away from the foundation.

In summary, preventing mold in construction requires proactive measures such as proper design, moisture control, material selection, and regular inspections. Prompt remediation of mold issues is crucial to protect the health and safety of construction workers and building occupants.

Recommendation:

1-It's important to note that mold identification should be performed by professionals with expertise in microbiology and mold remediation. Proper identification helps determine the appropriate remediation strategies and potential health risks associated with mold exposure. Additionally, addressing underlying moisture issues is crucial for preventing mold growth and maintaining a healthy indoor environment.

2-Provide guidance on identifying and addressing potential mold hazards during construction.

3-A report about how to remove efflorescence .

REFRENCES:

1. Sustainable Cities and Society site.
2. Moisture Control Guidance for Building Design, Construction and Maintenance book.
3. Effects of Mold Growth on Building Materials by Different Environments book.
4. Improved Model to Predict Mold Growth in Building Materials book.
5. An official website of the United States government.