

# Preventing Moisture and Mold Claims in Construction

- I) Why Buildings Fail  
*... in the Moisture and Mold Mode*
- II) Design and Construction Solutions
- III) Due Diligence for Acquisitions

# Introduction

Who is Halliwell Engineering Associates?

*A team of Consulting Engineering Experts*

Areas of Expertise?

*Mechanical, Electrical and Environmental Engineering*

Focus of Practice?

- ✓ *Building Systems Failure Analysis, Retrofit*
- ✓ *Failure Prevention Programs*
- ✓ *Claims Support*

Years of Practice?

*Fifty*

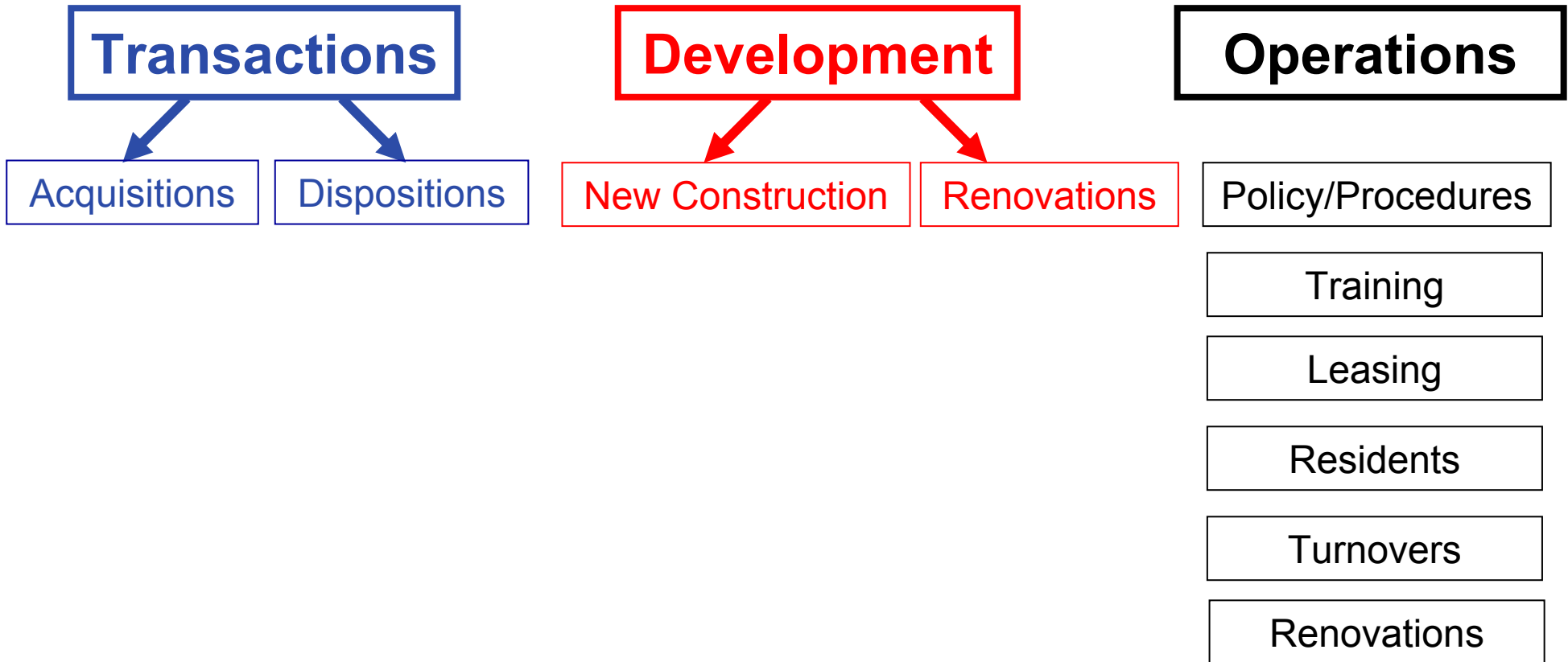
How to Reach Us?

**800-394-9680**  
**[www.heainc.com](http://www.heainc.com)**

# MOLD PREVENTION STRATEGIES

in

## Commercial Real Estate






# I) Why Buildings Fail

*... in the Moisture and Mold Mode*

## 3 Underlying Causes

- A) Design Errors and Omissions
- B) Construction Defects
- C) Operating Deficiencies

## 3 Responsible Parties

-  Architect/Engineer
-  Contractors/C.M.
-  Building Engineer

# Why Buildings Fail...

## Systemic Problems in the Design and Construction Process

### 1) Gaps in Technical Knowledge

Designers .....▶ Contractors .....▶ Operators

### 2) Disconnects in Responsibilities

Design .....▶ Build .....▶ Operate

### 3) Conflicting Information in Guidelines and Standards

Energy Conservation vs. Moisture Control

### 4) “Standard” Design Practices

Do Not Work in Every Building, System or Climate

# *Why Buildings Fail...*

## **Four Primary Sources of Building Moisture**

- ★ 1) Bulk Water Intrusion: Rain, Snow, Groundwater
- ★ 2) Infiltration of Warm Moist Air
- 3) Vapor Diffusion
- 4) Internally Generated Moisture

# Why Buildings Fail...

Two Main Building Systems Control Moisture

## Building System

## Performance Requirements

1) The Building Envelope



- A) Prevents/Retards Moisture or Air Movement into the Building
- B) Allows any Accumulated Moisture to Drain to the Exterior ... or Evaporate

# Why Buildings Fail...

Two Main Building Systems Control Moisture

## Building System

2) The HVAC System



## Performance Requirements

- A) Control Temperature
- B) Control Humidity
- C) Ventilate Occupied Areas
- D) Pressurize the Building
- E) Filter (Clean) the Air

# Building System and Moisture Sources

## Building System

1) Building Envelope

2) HVAC Systems

## Cause of Failure

Wall Systems Design  
Design Details  
Construction Details

No Design Intent  
No Performance Criteria  
Systems Selection, Size  
No Acceptance Criteria  
Inadequate Operating Information

## Mold Growth

Water Source Mold

Humidity-Driven Mold

3)

Envelope

“Infiltration”

Uncontrolled Airflows



Condensation

HVAC

Depressurized Spaces  
Cooled Surfaces

# Why Buildings Fail...

## Causes of Envelope System Failures

- 1) Improper air barrier location(s) and/or air resistance rating
- 2) Improper vapor retarder location and/or moisture permeability
- 3) Multiple vapor retarders within a wall system
- 4) Infiltration paths to cooled surfaces
- 5) Building materials that promote fungal growth
- 6) Open joints around windows
- 7) Windows without flashing
- 8) Inadequate sealing of protruding fixtures
- 9) Inadequate flashing techniques
- 10) Lack of a proper drainage plane
- 11) No protection behind the cladding
- 12) No integration of fenestration to the external membrane
- 13) Roof flashing not integrated with the wall drainage plane
- 14) Wall cavities behind brick veneer without ventilation
- 15) Incompatibility of sealants and flashings
- 16) Over-reliance on surface sealants

### 2 Performance Requirements:

1. Moisture & Air Shield
2. Moisture Relief

# Why Buildings Fail...

## Causes of HVAC System Failures

- 1) Inadequate building pressurization
- 2) Inadequate building ventilation
- 3) Inadequate building temperature control
- 4) Lack of humidity control
- 5) Inadequate filtration
- 6) Over-sizing HVAC equipment
- 7) Inadequate re-heat
- 8) Use of pressurized supply plenums
- 9) Lack of HVAC shut-offs with open sliders
- 10) Use of door sweeps in pressurized corridors
- 11) Inadequate draining condensate system
- 12) Imperfect vapor barriers on chilled water risers
- 13) Inaccessible HVAC equipment
- 14) Use of fiberglass ductboard in southern climates
- 15) Paper faced gypsum enclosures around fan coil units
- 16) Improper start-up, performance testing
- 17) Lack of measurable acceptance criteria

### 5 Performance Requirements:

1. Temperature
2. Humidity
3. Ventilation
4. Pressurization
5. Filtration

## II) Design and Construction Solutions

### A) Any Solution Must Consider all 3 Causes of Building Failures:

- ✓ Design
- ✓ Construction
- ✓ Operations

### B) Checklists Alone Can't Fix the Problem

Too many variables:

- ✓ Building Type
- ✓ Design
- ✓ Construction
- ✓ Team/Talent
- ✓ Climate

## II) Design and Construction Solutions

### C) Inspections Alone Can't Fix the Problem

- ✓ Need Measurable Criteria Before Design and Construction Begins
- ✓ Need Measurable Criteria to Verify Performance


### D) Any Prevention Model Must:

- ✓ Articulate the Owner's Expectations
- ✓ Provide Guidance to Designers, Contractors
- ✓ Provide Measurable Acceptance Criteria
- ✓ Verify, Validate Performance

# Design and Construction Solutions

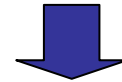
## A New Model For Best Practices

### *What's Important!*

- 1) Setting Expectations  Verifying Results
- 2) Defining Measurable Outcomes
- 3) Keeping Responsibilities with A/E, Contractors, Operators

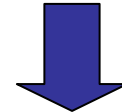
Step 1

Planning Phase



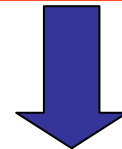
Step 2

Design Phase



Step 3

Construction Phase



Step 4

Ownership Transfer

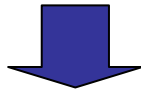
# Design and Construction Solutions

## A New Model For Best Practices

Step 1

Planning Phase

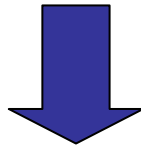
- 1) Setting Expectations
- 2) Explaining purpose, process



Step 2

Design Phase

- 1) Specifying Expectations
  - ✓ Design Criteria
  - ✓ Construction Requirements
  - ✓ Operational Requirements
- 2) Peer Review of Design



Step 3

Construction Phase

- 1) Contract Documents Specify
  - ✓ Protection of Materials
  - ✓ Sequencing Requirements
  - ✓ Moisture Event Response
  - ✓ O & M Documentation
  - ✓ Start-Up Procedures
  - ✓ Acceptance Criteria



Step 4

Ownership Transfer

- ✓ Performance Verification
- ✓ Operations Validation
- ✓ Maintenance Validation
- ✓ Training Validation

## III) Moisture and Mold Due Diligence

### 4 Things You Must Know:

- A) The Existence, Extent, Locations of Mold Growth
- B) The Scope, Cost of Remediation
- C) The Underlying cause(s) of Moisture Intrusion
  - ✓ Envelope
  - ✓ HVAC
- D) The Scope, Cost of Retrofit

**Be *cautious* of Inspection Standards that recommend sampling!**

# Moisture and Mold Due Diligence

## Cost Effective Due Diligence for Acquisitions

- 1) Utilize your Due Diligence Team to Screen for Mold Issues
- 2) Utilize Mold/Moisture Experts for Scope and Cost Solutions
  - Mold Remediation – Industrial Hygiene
  - Moisture Retrofits – Mechanical Engineering
  - Envelope Engineering
- 3) Develop Remediation/Retrofits
  - Plans/Scope
  - Budgets \$\$

# Summary

1) Mold/Moisture Problems are Created During:

Design → Construction → Operations

2) Systemic Problems Exist in this Process

3) Checklists Alone Cannot Solve this Problem

4) Building Codes, Standards, Guidelines are Responding

5) The Solution Requires A New Approach:

A. Setting Objective Expectations

B. Providing Clear Technical Guidance

C. Providing Measurable Acceptance Criteria

D. Verification of Performance