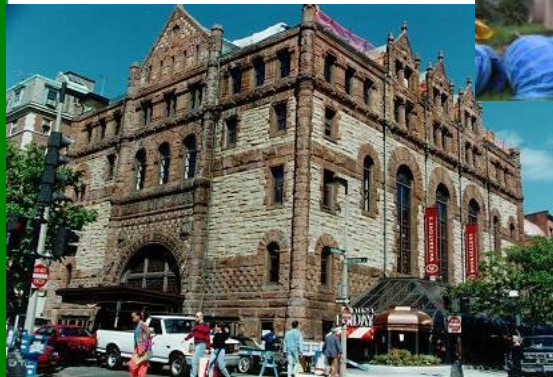


# Commercial Drying Specialist

A Clean Trust Certification Course



**Study Guide**

3<sup>rd</sup> Edition

*Mickey Lee Consulting*

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This Study Guide is excerpted from the full course manual used in the CDS Course. It was written using various technical and professional literature sources readily available to restorers.

This manual is intended to provide current and accurate information about the drying of commercial structures. However, users of this manual and the information contained are responsible to keep abreast of current development in the field and must follow any applicable local, state or federal regulations, and should not rely solely upon this material.

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Every commercial job is unique and may require deviations from the procedures, guidelines or standards provided in this manual. It is the sole responsibility of the restorer or contractor to act appropriately with regards to the conditions encountered.

By use of this manual and/or participation in this course, each participant hereby accepts these limitations and disclaimer.

# Commercial Drying Specialist Course

## Objectives

To teach damage inspection and evaluation, work flow management, process administration and technical methods of effective and timely drying of commercial, industrial, institutional and complex residential water-damaged structures, systems, and furniture, fixtures and equipment (FFE). Resources for this course include: the current ANSI/IICRC S500 Standard and Reference Guide for Professional Water Damage Restoration, reference media, scientific, technical and industry resources.

## Scope:

Commercial, industrial, institutional and complex residential water-damaged structures, systems, and furniture, fixtures and equipment based on ANSI/IICRC S500 Standard and Reference Guide for Professional Water Damage Restoration, reference media, scientific, technical and industry resources.



## Introduction

### PRINCIPLES OF DRYING

“A “principle” is defined as: “A basic comprehension, or fundamental doctrine or assumption that is accepted as true and that can be used as a basis for reasoning, process, or conduct.” There are five general principles used in the restoration of water damaged structures and materials.

1. Provide for the Health and Safety of Workers and Occupants
2. Inspect and Document the Project
3. Contain the Damage
4. Dry Affected Areas
5. Clean and Repair the Structure, Systems and Contents

### DIFFERENCES BETWEEN RESIDENTIAL AND COMMERCIAL STRUCTURES

#### ***Commercial Buildings are not Large Houses!***

Commercial buildings are not just large houses. Houses are for a single-purpose – for people to live in. Commercial buildings are MANY.

retail	heavy mfg plants
hospital	light assembly facility
convention centers	distribution centers
schools/universities	bowling alleys
government offices	apartments/hotels

### DEFINITIONS OF CATEGORIES OF COMMERCIAL BUILDINGS

Large commercial projects are categorized in the S500 Standard & Guide in one of four ways: commercial, industrial, institutional, and complex residential.

**Commercial** structures are “buildings or facilities where the use is primarily for retail, office, mixed-use and warehousing\*.”

**Industrial** structures are “buildings or facilities where the use is primarily for manufacturing, foundry, and distribution.”\*

**Institutional** structures are “buildings or facilities where the use is primarily for public facilities such as schools, hospitals, municipal buildings, sports complexes, airports, libraries or other governmental facilities.”\* These structures can have issues of power availability, public access, security, or various layers of authority and organizational hierarchy.

**Complex Residential** structures are “residential facilities such as a townhouse, condominium, apartment complex, hotel, multi-family dwellings, or large single family mansions or estates.”\*

In addition to the preceding categories there is another type of building that is sometime encountered in commercial projects that may be used for any of the above uses and may have construction characteristics not seen elsewhere. These buildings are **historical buildings** that exist all over the world and may be scattered in and around modern buildings. These buildings are often registered on national, state or local historical registries and they pose their own particular challenges.

*\*Definitions are excerpted from S500*

## Inspections

### INITIAL DAMAGE INSPECTION

Once you are sure you are in contact with the proper authority, you can begin to define the project boundaries. As the project manager, you may or may not be the estimator on the project but regardless, the project management plan and the estimate should be developed simultaneously. As damage restoration has become more technical and expensive the demand for detailed estimates has risen.

#### Inspecting the Damage on a Project

Inspecting the damage begins with good investigation of (1) the history of the facility, (2) the details of the damage that occurred and (3) the details of the site and contents.

It is important to ask questions and investigate the past usage of the facility as well as any renovations and re-construction that has occurred. Your goal is to understand the present construction of the building. The information you gather will be used to construct a scope of work, estimate, work plan and presentation to the customer.

#### Some Important Questions to Consider

- *What type of facility is affected?*
- *What is the source of the water?*
- *How wet is the structure?*
- *What materials are affected?*
- *Are hazardous materials present?*
- *Is there a health risk to the occupants?*
- *What is the value of the affected components or contents?*
- *Is there a need to respond quickly to a specific critical area?*

#### Damage Inspection Checklist

As one can see, the Damage Inspection phase is a critical step in the restoration process. Damage Inspection is the task of determining the degree of damage and the scope of services that will be necessary to return the facility to useable condition. It is recommended that the person performing the damage inspection use some form of a checklist to remind him/her to cover all potential issues. In addition to the checklist, comprehensive notes, measurements, floor plans and photographs are valuable to help in the writing of the scope of work and the estimate.

### PRELIMINARY DETERMINATION

In many commercial drying projects, preliminary determination will be made in conjunction with other materially interested parties on a project. Items that need to be determined during or soon after the initial inspection include, but are not limited to:

#### Initial Determination of Category of Water

- Initial determination of category of water should be made during the initial inspection as this will indicate the need for many of the processes and actions that follow.
- The Categories of Water as defined in ANSI/IICRC S500 Standard and Reference Guide for Professional Water Damage Restoration – 3<sup>rd</sup> Edition will be discussed.
- The restorer should determine the potential for cross-contamination during the initial inspection. This will indicate the need for critical barriers, containment and pressure approach within the drying chamber.

#### Class of Water Saturation & Evaporation

The approximation of the degree that hygroscopic materials have adsorbed moisture as well as how

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readily it will migrate through them and evaporate is an important factor in properly sizing amount of drying equipment initially needed. The S500 gives useful definitions to help determine this.

Class 1 (least amount of water, absorption and evaporation) – Water damage restoration projects that affect only part of a room or area; or larger areas containing materials that have absorbed minimal moisture. Little or no wet carpet and/or cushion are present.

Class 2 (large amount of water, absorption and evaporation) – Water damage restoration projects that affect at least an entire room of carpet and cushion (pad). Water has wicked up walls less than 24 inches. There is moisture remaining in structural materials (e.g., plywood, particle board, structural wood, VCT, concrete and substructure soil).

Class 3 (greatest amount of water, absorption and evaporation) – Restoration projects in which water has wicked up walls greater than 24 inches, or it enters from overhead affecting the ceiling, walls, insulation, carpet, cushion and subfloor. The entire area is saturated.

Class 4 (specialty drying situations) – These consist of wet materials with very low permeance/porosity (e.g., hardwood, plaster, brick, concrete, light weight concrete and stone). Typically, these are deep pockets of saturation, which require very low relative and humidity ratio for drying.

Situations can arise during the course of the job that requires adjustments to the equipment being used during the drying process.

### **Establish Dry Standard & Drying Goals**

- Dry Standard – a dry standard is a reasonable approximation of the level of moisture of materials prior to the water intrusion. It may be established by taking a sampling of readings in similar materials in unaffected areas of the same facility.
- Drying Goal(s) – these are target moisture levels of materials that are determined by the restorer and are based on the measured dry standard. To what moisture content do you need to dry gypsum board to say it is “dry enough”?

### **Specialized Experts Needed**

Restorers should understand their strengths and limitations. Knowing when to call in other experts will help reduce risks, facilitate the completion of a job and demonstrate the restorer’s professionalism to customers. During the initial inspection, restorers should determine the need for specialized experts.

### **ON-GOING MONITORING**

- Once you have completed your initial inspection and the project has started now is the time when documenting your progress could be the difference in a great job, or one that will end up in court!
- Job documentation should be in real time and notes should be kept throughout the day to document changing situations, drying progress, key conversations, decisions and other items.
- Contemporary records should be kept on equipment and supplies that were used.

### **END-OF-JOB VERIFICATION**

- Upon completion of any project you need to have a means of evidencing acceptance by the customer.
- On large projects it may be necessary to have partial sign-offs for areas that are completed earlier than others.
- An end of job report (a job book) should document that the agreed upon scope of work was accomplished and that any criteria that was established prior to job startup have been met.

## Commercial Sizing Guidelines for Initial Dehumidification

### The Complexities of Commercial Buildings

Sizing dehumidification for commercial buildings is more involved than in most residences for several reasons. Though there are exceptions, most houses are wood-framed, have gypsum-board finished walls, exterior walls with fiberglass insulation and an HVAC system that uses passive ventilation. The variability of commercial buildings begins with the numerous uses (e.g. schools, retail, healthcare, hospitality, airports and theaters) with each having different configurations, sizes of rooms, construction practices and HVAC system requirements. Nearly all commercial buildings use an active ventilation system requiring carefully designed outside air make-up. This makes the control of a drying chamber by a drying contractor considerably more difficult.

It also makes the development of a practical, transferable and valid equipment sizing tool for drying commercial buildings extremely challenging.

### The Rationale for Sizing

The following sizing guideline uses a methodology that is well-established with most drying contractors doing extensive work in commercial buildings. It is based on calculating a targeted air change rate per hour (ACH) of processed air for the space being dried. The equipment needed to satisfy the ACH requirement is then sized by their delivered CFM of processed air.



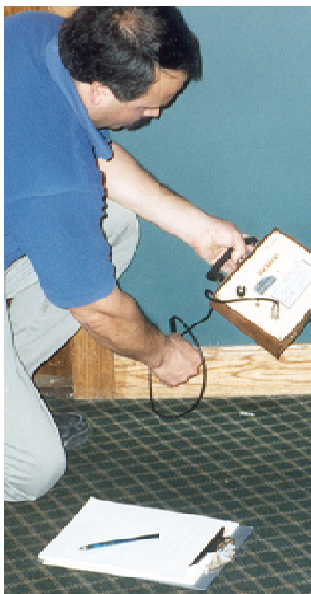
In principle, the targeted ACH is a function of the following criteria:

- The volume of the space needing to be dried
- The kinds and amount of building materials that are wet
- The degree of saturation or wetness of the building
- The condition of the existing installed HVAC to help or hinder the process
- The prevailing weather conditions outside and how readily they impact the interior conditions

For many years knowledgeable commercial drying contractors have assessed damages and estimated commercial projects by taking many, if not all, of these criteria in to consideration. In some cases they may not have been able to describe exactly how they calculated it, but they made it work and successfully dried the buildings. So, how can such an inconsistent, non-standard sizing method work? In many cases, it is because as important as calculating the amount of dry air one needs to dry a building may appear to some, just as important is the management of airflow against the materials, measuring the wet materials frequently and managing the ongoing ambient conditions during the drying process. A successful commercial drying project requires that all of the tools in the hands of the restorer be managed and used with skill. Many fine furniture craftsmen of the 19<sup>th</sup> century turned out pieces that are still functional today, but they did it with less than perfect and efficient tools. Today, we too often elevate the importance of the equipment above that of the project manager. A good project manager can take a less-than-adequate inventory of equipment and deliver a successful

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job, on-time and within budget if he manages other aspects of the job carefully. On the other hand, there are others who regularly invest in the latest technology and still deliver mediocre results.



Experienced restorers who understand their climate, general building practices and their equipment will be able to use the Commercial Drying – Sizing Guidelines more easily and effectively. New restorers are cautioned to make it a practice to have more experienced personnel within your organization review your choices and conclusions from the use of this guideline.

### **Cautions & Disclaimers**

It must be understood that no guideline is perfect nor can it take into account all of the other considerations that exist after a damage event, unrelated to the building's construction. These considerations may include (1) the client's needed schedule, (2) category of water, (3) the elapsed time since the event, (4) power availability or (5) other unique building characteristics. These factors must be considered in the professional judgment of the restorer.

### **The Calculation**

The calculations needed for this tool are fairly straightforward. The important evaluations are in choosing the multiplication factors to use. Here is the process:

1. The restorer begins by determining the total volume in cubic feet of the space needing controlled, then divides that number by 60 (i.e. 60 minutes in an hour) to determine the number of CFM needed to achieve one ACH.
2. Then the other factors are carefully considered and a multiplier is applied that may increase or decrease the indicated ACH.
3. Once the multipliers are applied to the one ACH, a targeted ACH is calculated.

## Health & Safety

### OSHA GENERAL DUTY CLAUSE

To assure safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health; and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Occupational Safety and Health Act of 1970."*

Each employer –

- (1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;
- (2) shall comply with occupational safety and health standards promulgated under this Act.
  - (b) Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.

### HAZARD IDENTIFICATION AND RISK ASSESSMENT

#### Hazard Identification

A Hazard is anything that has the potential to cause injury or illness (to employees, contractors, visitors or the neighboring public). A hazard can be related to a physical state or a work practice or procedure. Hazard identification is the process of identifying all situations or events that could give rise to the potential for injury, illness or damage to a person.

#### Risk Assessment

From a project standpoint, risk means identifying the likelihood of an injury resulting from exposure to an identified hazard. Risk assessment is the process of determining the likely seriousness of an injury or damage happening.

We need to assess the risk of harm regarding health and safety that arises from any identified hazard. Risk assessment is therefore logically a process used to determine the level of risk or injury associated with each identified hazard, for the purpose of control.

#### The Hierarchy of Control & Administration

The Hierarchy of Control is (from most to least effective): As we will face safety risks on almost all job sites we attend we must also learn to control those risks so that they can be minimised. A hierarchy of control is set forward as follows and this appears to be common to almost all countries.

1. **Elimination** of the hazard may be able to be done. Is there another way of accomplishing the work?
2. **Substitution** of the activity or method one that presents fewer or lower risk. Using less dangerous chemicals, such as substituting a flammable solvent for a water based solvent or replacing toxic solvent with detergent.

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3. **Engineering control** involves some engineering change to the work environment, equipment, or work process to the project.
4. **Isolation** (e.g. distance or enclosure) refers to isolating the person from the risk or separating the risk from the person.
5. **Administrative controls** involve reducing or eliminating exposure to the risk by adherence to procedures or instruction. Providing instruction or training
6. **Personal protective equipment** – Note: Provision of protective equipment should always be the *last* control option considered unfortunately it is often the first as it appears to offer the cheapest and most expedient route to getting a job done.

### RE-ASSESSMENT DURING THE PROJECT:

The safety concerns on larger projects can change from day to day. It is the responsibility of the restoration contractor to ensure that safety concerns are addressed and re-addressed and necessary. These safety concerns extend beyond our own employees and into the tenants and their customers.

Some impacts on your initial safety inspection during the projects are:

1. Changes in contractors after the completion of a phase or specific task.
2. Changes in your own flexible work force
3. New hazards may be introduced day or weeks into the project, planned or unplanned.
4. A change in the scope of work may introduce a new hazard that was not part of the initial safety inspection.
5. Hazards may be introduced that are outside of your control – Natural disasters

### COMMERCIAL JOB SITE POTENTIAL HAZARDS:

Commercial job site by nature can expose a restoration contractor to many different hazards not normally present in residential type environments. The buildings can be very large in nature and may require the use of fall protection when working 6' or more above a lower level.

- The size and type of equipments used will vary greatly. Instead of an LGR type dehumidifiers a large desiccant dehumidifier or cooling based DX (direct expansion) unit may be used due to the size of the space being dried.
  - Many larger dehumidifiers use 208 or 460 volt 3 phase power and must be hooked up by trained and qualified technicians.
  - Portable power generators may be used to power temporary dehumidification. Important considerations are locate for re-fueling, spill-containment and proper grounding.
  - Electrical extension cords and temporary power cable must be sized appropriately
  - The primary fall arrest system PPE includes a body harness and tie off points
- Commercial projects come in many different shapes and sizes and in some cases may be classified a confined space or even a permit required confined space.
  - A confined space is a space (1) that has limited or restricted means of entry or exit; (2) is large enough for a person to enter and perform tasks and (3) is not designed for continuous occupancy
  - Some examples of a confined space on a commercial drying project are: HVAC duct plenums, elevator pits and electrical chases.
- When hazards have been identified, the restorer shall develop a written jobsite safety plan to mitigate them.

## Commercial Construction Practices

### Structural & Building Envelopes

The focus of most building regulations over the years has primarily been fire and structural safety. Only in the past two decades have they added energy-efficiency to this list of priorities. A focus on moisture control in commercial construction still lags behind.

The surest way of knowing the construction you have is to actually see it, but in many cases you may not have that opportunity during your initial inspection. Ask one of the building representatives if architectural drawings are available. If they are, the best ones to look at are the “as-built” drawings, rather than the construction drawings.

The building envelope is the separation between the interior and the exterior environments of a building. It serves as the outer shell to protect the indoor environment as well as to facilitate its climate control. Building envelope design is a specialized area of architectural and engineering practice that draws from all areas of building science and indoor climate control.

### Methods of Construction

#### Tilt-wall Construction

Tilt-up and tiltwall are two terms used to describe the same process. There are two methods of producing the concrete panels. The walls may be either pre-cast in a manufacturing facility and then trucked to the site or they may be cast on-site. Once cast, the panels are tilted up into position around the building's slab to form the walls. This type construction is most popular in office warehouses, distribution centers and theaters.

#### Masonry Construction

Masonry construction involves the use of concrete masonry units (CMU), also called concrete block, and brick veneer exterior walls. Interior walls may be CMU construction or light gauge steel interior walls. This type construction is often found in schools, assisted living centers and other campus-like developments.

#### Light gauge steel construction

Light gauge steel channels, light gauge steel stud and track framing with steel framed trusses and truss plates. Drywall is screwed directly to the steel framing members. This construction is used in many light commercial buildings.

#### Structural steel framed construction

Structural steel is usually used in heavy commercial buildings that are multi-storied low-rise and high-rise buildings. Since many of these buildings have multiple tenants, the finish-out may vary from space to space. It is critical for the restorer working on water damages in these buildings to understand the construction in the space involved. It may be quite different from floor to floor.

#### Structural steel & curtain wall construction

Structural steel buildings may have traditional building envelopes of brick, stone or concrete or may have exterior curtain wall construction. Prior to the middle of the nineteenth century, buildings were constructed with the exterior walls of the building (bearing walls, typically masonry) supporting the load of the entire structure. The development and widespread use of structural steel

and reinforced concrete allowed relatively small columns to support large loads and the exterior walls of buildings were no longer required for structural support. This gave way to increased use of glass as an exterior facade, and the modern day curtain wall came into common practice.

### **Potential Impact of Variations**

How does construction impact drying decisions? Following are a number of things to look for and tips on techniques.

#### Walls

- Drywall in most commercial buildings is 5/8" thick, but in residential and many complex residential buildings is 1/2".
- Multiple layers of drywall are often found in school hallways in order to achieve a required fire-rating.

#### Heating, Ventilating & Air Conditioning (HVAC) Systems

- Types of HVAC systems
  - Zoning with constant volume packaged equipment
  - Chilled-water room fan coil
  - Packaged terminal air conditioners (PTACs)
- It is important to identify HVAC zones, especially as they relate to mold issues, cross-contamination and achieving a negative pressure on a space.

#### Insulation

- Unfaced fiberglass batt insulation can often be dried in place
- Faced fiberglass batt insulation usually cannot be dried in place.

#### Fire Codes:

- Fire-rated drywall, Type X, is manufactured with gypsum that has special additives to achieve the rating and any penetrations are required to be patched properly in order to maintain their fire-rating
- Fire-rated and multiple layers of drywall are often found around elevator shafts, stairwells and mechanical rooms.

#### Plaster

- Has the plaster been applied over expanded metal mesh or wood lath? If it has been applied over wood, it is important to carefully monitor the drying process of the wood. It is possible to over-dry and shrink the lath causing plaster to release, resulting in the plaster falling off the walls or ceilings.

## Drying Complex Structures

### ADVANCED PSYCHROMETRY & MOISTURE MECHANICS IN MATERIALS

As structural drying professionals, we are most concerned with moisture in materials and applying effective methods for returning them to their pre-loss moisture content. Since we are by and large unable to directly manipulate the materials, we instead manipulate the surrounding air to achieve the goal. Therefore, a good understanding of (1) the properties of air, (2) their impact on the materials and (3) how materials' moisture moves through them is crucial to developing the best drying approach.

#### Introduction to Air/Water Mixtures

Psychrometrics is the sub-science of physics relating to the thermodynamic properties of air/water mixtures. Air is a simple mixture of various gases, all occupying the same space; the region surrounding the earth known as our atmosphere. This mixture includes a number of dry gases (e.g. nitrogen, oxygen, argon, helium, carbon dioxide) as well as a “wet gas” (i.e. water vapor).

#### Laws of Thermodynamics

The laws of thermodynamics impact every aspect of our lives, though we rarely think about them. The first law is commonly called the “conservation of energy” principle and most people understand it as describing the fact that energy is not created or destroyed in a closed system but is only changed from one form to another.

The second law of thermodynamics describes the direction of energy flow. Energy always flows from being concentrated in one place to becoming diffused or dispersed. In other words heat disperses toward cooler areas, high pressure disperses toward lower pressure areas and a higher moisture concentration disperses toward lower areas of concentrations. Movement of energy in the opposite direction never happens!

The Second Law of Thermodynamics helps the restorer understand why (1) moisture in an enclosed environment disperses to other areas of the environment, (2) moisture moves through material from areas of high to low vapor pressure and (3) heating a space causes heat to be introduced into building materials.

#### Psychrometric Properties

There are several psychrometric properties that need to be defined and the restorer should be proficient at determining the needed properties as a result of taking measures with instrument on a jobsite.

Dry bulb temperature is the temperature of the air as measured by a thermometer with a dry sensing bulb, expressed in degrees F or C. It is the temperature that we “sense” or “feel”. This is the single property of air that has nothing to do with moisture in the air.

Humidity Ratio (HR) is the ratio of the mass of water vapor to the mass of dry air in a volume or sample of dry air, and is expressed in grains per pound of dry air (aka gr/lb or gpp). It is easily measured by many instruments in use in the restoration industry today.

Specific Humidity (SH) is the ratio of the mass of water vapor to the total mass of a moist air sample. It is often confused with the humidity ratio, because the calculation is very similar, and it yields numbers that are nearly identical. But the specific humidity is different. The value is seldom used in air conditioning or heating, and does not appear on most psychrometric charts.

Dew point temperature is the temperature at which humidity in air reaches saturation (100% RH), below which water vapor will condense from that air to form condensation on surfaces. It is useful to the restorer when evaluating the likelihood of condensation forming within wall systems or on surfaces within a structure.

Vapor Pressure is the pressure exerted by the molecules of a vapor on surrounding surfaces, expressed in inches of mercury ("Hg). Water vapor pressure differences constitute the driving force in the diffusion of water vapor molecules between ambient air and hygroscopic materials or between a surface of water and ambient air.

Relative Humidity is the amount of moisture contained in a sample of air as compared to the maximum amount the sample could contain at that temperature. This definition is accurate in concept; but strictly speaking, relative humidity is the ratio of the partial pressure of water vapor in a sample of air to the saturation pressure at a given temperature and barometric pressure.

Enthalpy is a measure of the total energy in the air. It is expressed in British Thermal Units per pound of dry air (kilojoules per kilogram of dry air). A British Thermal Unit (BTU) is the amount of heat needed to raise a pound of water by one (1) degree. There are two components of energy in the air: sensible energy and latent energy. The greater the energy in a sample of air, the more moisture can be evaporated and suspended as a gas in the sample of air.

### **Heat Theory**

Heat is the energy that causes molecules to be in motion and to raise the temperature of a substance. Heat is energy in transit from one mass to another because of a temperature difference between the two. This transfer of energy over a course of time is work.

### **DRYING TECHNOLOGY**

Drying technology is a field of science that deals with moisture in materials and its effects on, movement within and evaporation from their surfaces. Drying principles are applied in various industries and the production of many materials, including food (e.g. meat, cereal, and pasta), paper, building materials (e.g. gypsum board, kiln-dried wood, bricks), pharmaceuticals and cosmetics.

### **Moisture in Materials**

Many of the materials that are used in building construction are hygroscopic, meaning they draw moisture into them from the surrounding environment. All hygroscopic materials in the built environment will contain moisture and will generally be at dynamic equilibrium in the absence of a vapor barrier or retarder. Water (either as a liquid or vapor) can be held in hygroscopic materials as bound or free water:

1. **Bound water** – this is moisture held within the cellular or crystalline structure of the material. This moisture may be sorbed into the cells or can become physically or chemically bound to the surfaces of cells.

2. **Free water** – this is liquid moisture on the surface and held in the pores of the material. All of this is excess moisture which has been drawn into the materials through capillary action.

### Moisture Movement through Materials

When building materials become saturated following a water intrusion, the drying effort needs to reverse the mechanisms by which the moisture entered. The free water is drawn out through capillary action, followed by the excess bound water via diffusion – both mechanisms can be driven by vapor pressure differentials. **Capillary action** is the movement of a liquid through the slender tubes or pores of a material. Since capillary action is a movement of liquid, it is a quicker means of moisture movement than diffusion. **Vapor diffusion** is the movement of water vapor molecules from cell wall to cell wall – literally evaporating from one surface and condensing on the next as it moves through the mass of the material. It is caused by a difference in vapor pressure from inside the material to one or both outer surfaces of the material.

### Materials Drying

During the drying of any solid material, two processes occur simultaneously:

**Process 1: Surface evaporation** takes place as energy is transferred from the surrounding environment to the water molecules at the surface of the material. The rate at which this occurs depends on the surrounding conditions of temperature, humidity, air flow and exposure of the wet surfaces to the environment.

**Process 2: Internal moisture** is moved toward the surface to be evaporated. The rate of moisture movement is a function of the physical properties (i.e. porosity, permeability) of the material, its temperature and its moisture content gradient.

In a drying operation disrupting either of these processes will impede the rate of drying as both are required for drying to occur. It is important for the restorer to understand how to optimize the factors that influence both surface evaporation and internal moisture movement.

### The Impact of Energy on the Movement of Moisture in Materials

For water to change phase from liquid to gas, energy (heat) is required. When energy is applied to a material with bound moisture, the bond between moisture molecules and the material is broken, resulting in vaporization. The greater the vapor pressure differential and the more effectively energy is transferred into the core of the material, the faster the moisture will move through and evaporate from the material.

### Evaporation from Material Surfaces

Evaporation is the process by which water changes from its liquid phase to its gaseous phase while staying below the boiling point. The rate of evaporation is influenced by several factors:

- Concentration of the moisture in the surrounding air; impacts the capacity of the air to hold more moisture
- Vapor pressure differential between the surface of the wet material and the surrounding environment; impacts the direction and speed of moisture movement
- Temperature of the wet material; impacts the energy available for the phase change of the water;
- Air movement across the surface of the wet material; impacts the disruption of the boundary layer; and
- Exposure of wet materials; impacts the surface area available to the drying air.

## Project Management

### OVERVIEW OF PROJECT MANAGEMENT

Project managers always work within several boundaries. These boundaries can be likened to a box within which a project needs to stay. The three dimensions of any box are height, width and depth. The three dimensions of the “Project Box” are scope of work, schedule or time and budget.



So, think of the successfully managed project as being one in which you completed the scope of work, within an agreed time-frame and within an agreed budget. If you are able to deliver this, you will be successful in this business and should never lack for a place to work. Commercial drying projects follow the classic project management plan involving four activities:

#### 1. PROJECT INITIATION

Project initiation begins with the project manager knowing clearly what the scope of work, time-frame and estimated budget is on the project. It is impossible to plan the project if the end goal is unclear.

#### **Execute Clear Contract, Scope, Schedule & Budget**

It cannot be emphasized enough the importance of having a clear, duly executed contract prior to starting work. Once a project is started much of the leverage to execute a proper one is no longer present.

#### **Involve Needed Specialized Experts**

Restorers who work on commercial projects should be aware of their capabilities, qualifications and limitations, as large projects tend to multiply the problems and allow less room for error. Know your limitations! Specialized experts on commercial projects may include engineers, trades-people, hazmat contractors, indoor environmental professional or document specialist.

#### 2. PROJECT PLANNING

##### **Project Sequencing**

Once a project has been contracted the operations team is activated and the project manager should prepare a project plan, to include sequencing of events. This allows the project manager to: (1) place tasks in order over the course of the project, (2) budget time and resources for the tasks and (3) provide the customer a good way of seeing or measuring progress.

Following are some general notes and sequence of events on typical commercial:

- Implementation of your site safety plan is always done as the first task on a drying project in order to make the site safe for workers as well as occupants.
- Generally speaking, the order of activities for drying most buildings would be:
  - Extraction to mitigate further migration of water
  - Humidity control to reduce secondary damage
  - Controlled demolition and debris removal
  - Rough cleaning to prepare for the drying process
  - Restorative drying to return materials to proper moisture levels

- It is important for restorers to understand the construction of all wall, flooring or other building components that are being dried, prior to determining and setting up the drying approach.
- When it is deemed necessary to remove drywall as typically would be done in the event of a loss of structural integrity, damage or contamination, it is recommended that it be removed prior to performing further drying services.

### Site Considerations

During your initial inspection, you should have taken many notes and measurements detailing everything you need in order to plan for equipment, personnel, subcontractor and supplies that will be needed on the drying project. During the inspection you will take various measurements and readings as well as answer many questions, including but not limited to the following.

- Is there sufficient power for equipment?
- Where will large equipment be placed?
- Will I have access to elevators when needed?
- Do I need a forklift for placement of equipment?
- Does the project need 24 hour security?
- What is the process to gain access to the building?
- Is an energy management system (EMS) installed?

### Determine Resources Needed

#### Equipment

Determining which equipment and how much are usually done during the estimating phase of a project, but estimating the monetary aspects of a job is not within the scope of this course. We will discuss the determination of equipment type, size and quantity from a standpoint of what is the best indicated configuration for accomplishing the drying of the facility.

#### Personnel

The personnel on a job completely depend on the size of the job and complexity of the scope of services you are providing the client. In addition to drying the structure, how extensive is the extraction work, debris removal and manipulating of contents?

#### Ancillary Equipment & Supplies

You may need various other pieces of equipment and supplies on commercial drying projects that may include but not be limited to the following:

### 3. Project Execution

**Mobilize Resources** - the first step in the execution process is to mobilize the staff.

**Implement Safety Plan** - review the plan with your team and document those present.

**Implement Mitigation Plan** - begins as soon as safely practical following the initial moisture intrusion.

Elements of effective mitigation include:

1. Effective extraction
2. Prevention of cross-contamination
3. Humidity control to reduce secondary damage
4. Controlled demolition and removal of debris
5. Rough cleaning

### **Implement Restorative Drying Plan**

**Stage & Setup Drying Equipment** - You will usually have only one chance at placing larger equipment where you want it so ensure that you confirm all of the things you considered during the project planning phase of the job. Your initial goal on the first day is to gain control of the humidity conditions of the affected area.

**Manage Production** - Many large, commercial projects are contracted on a time & materials basis which means you will need to track all equipment, company-owned as well as re-rented units; as these are charged by the day or run-time of actual operation on-site.

**Manage Personnel** - A lesson that every restorer working on large commercial projects should learn is that the equipment used on a project is not as important as the people monitoring and managing the job.

**Monitor the Process** - Your drying goals should be established during the initial inspection process and become a part of your job file documentation. But the questions are, “what is dry?” “How do I know when the building is dry enough to pull off?”

#### **Instruments**

We often say that, “the building will tell you when it is dry!” The means of “communication” between the building and the technician is the instruments being used. These instruments should be appropriate for the materials they are being used on.

##### Thermohygrometers

A thermohygrometer is usually the instrument-of-choice to measure air temperature and relative humidity inside or outside a building. These instruments will reduce the time spent to determine these values from a psychrometric chart or calculator.

Since moisture in materials move and evaporate primarily due to vapor pressure differences, a quick method of evaluating the system is by comparing the difference between the dewpoint of the air and the surface temperature of the materials.

##### Moisture Meters

Several instruments may be used for measuring the level of moisture within building materials. They usually fall into one of two classes: penetrating and non-penetrating. Penetrating means that the instrument’s probe(s) must enter the material, requiring a puncture or other type of entry. In many cases a penetrating probe is the best way or only way to properly test a material.

#### **Manage Equipment**

As the area is monitored, the restorer should reposition equipment, including air movers, AFDs, dehumidifiers and other drying equipment used in order to maintain a good drying environment for all affected materials. The greatest amount of evaporation occurs in the early stage of drying hence the need for the greatest amount of moisture removal in the air. As the free water from surfaces and pores are evaporated the need for air movement decreases but the need for low vapor pressure remains. At this point temperature will usually rise naturally as a result of energy (heat) being introduced through drying equipment.

#### **Manage Changes**

It is not often that a large, commercial project will be completed without some changes occurring. This will challenge the project manager to control the issue so it does not negatively impact the scope of work, budget or time schedule. If it does, than a change order will need to be executed.

### **Record Issues**

Good communication is critical to making changes in the scope of a project after it has begun. Prompt communication will help ensure acceptance.

### **Communicate Issues**

It is often said, “Bad news doesn’t get better with age.” This is never more important on a project then when some aspect of the process is not going well. Resolution to problems, conflict or changes is implemented quicker when good communication and a formalized sign-off takes place.

### **Execute Change Orders**

Restorers should have a formalized process of producing change orders. This is another contract with the client that changes the original contract in some manner. While verbal agreements are legally valid, they are very difficult to enforce when questions arise later.

### **Control Costs**

The project manager is responsible to manage and control costs on his project and should record them on a daily basis. Invoices, delivery tickets, supply receipts, time sheets and other documents representing costs should be maintained in the job record.

### **Control Quality**

In today’s business climate the thing often sets great companies apart from good ones, is the degree they deliver services that meet and exceed their customer’s expectations. Some restorers have implemented a process to have another experienced technician or manager to visit their jobs and have a QC check performed.

## **4. Project Close-Out**

### **Verify Drying Goals**

When the restorer has finished all aspects of the scope of work and the drying goals have been verified and documented, the job enters the close-out phase. The project manager should be confident of the completion of the work prior the final inspection with the client.

### **Conduct Final Inspection**

At this time it is important to demonstrate completion of the entire scope of work to the client through a final inspection of the building. The restorer should walk through the building allowing the client to see that all aspects of the scope have been completed.

### **Demobilize Resources**

The restorer is now ready to demobilize the resources by breaking down and removing drying equipment, cleaning equipment and supplies. Restorers should clean any contaminated equipment used during the drying process, on the jobsite prior to transport.

### **Complete Documentation**

All documentation should be updated and completed prior to the ending of the job or as quickly as possible after completion. Poor documentation, billing inaccuracies and customer complaints can often be traced back to a delay in completing inventories, readings, receipts and job notes during the job.

## Project Administration

Upon receiving a call on a loss, our first instinct is to run right out to the job site, and get a work authorization signed. For many restorers, this may be as far as the thought process goes with respect to contractual obligations. However, the first order of business in any project is data gathering.

### DATA GATHERING

The initial inspection should be devoted to gathering information about the building history and uses, the damage, various tenants, insurance companies involved, stakeholder agendas and what you are being asked to do initially. More than one person may need to authorize your work before it commences, as there is often more than one party that has a vested interest in a given piece of commercial property. Commercial insurance policies, unlike standard-form homeowner policies, vary depending upon the coverage options that have been selected.

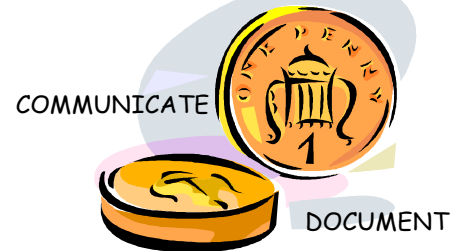
### Materially Interested Parties (MIP)

It is important that all personnel involved with any aspect of a project understand the many parties that may be involved on the particular project. It is not just the property owner and the adjuster who has some material interest in the process, agenda or outcome of the restoration of the facility. All of these parties have a specific interest in the scope of the project, the scheduling of the project and the financial aspects of the project.

### COMMUNICATIONS

Communications between various parties is important on all damage restoration projects but takes on even greater significance on larger projects, as they typically continue longer, involve more people or contractors, entail greater risks and involve higher financial amounts. It is recommended that all interested parties to a job establish and agree on the purpose, frequency and means of communication, prior to the beginning of the job.

Two sides of the same coin



### Pre-Job Communications:

Most of these items will be done during discussions between sales personnel and the customer. The obvious things you must discuss are related to gathering building history, insurance information and damage assessment.

### Communications to have includes:

- The customer's need to resume business activities should be discussed. You need to understand their desired schedule to return to the facility.
- Critical areas should be detailed along with their priority. These may include certain equipment (e.g. computers), critical files (e.g. customer lists, jobs-in-progress files) or specific areas of the facility (e.g. data center, call center).

### Communications During the Job

- A communication structure or "tree" should be established at the beginning of the job and followed throughout the project.
- Generally on a daily basis you will let the client know (1) what was accomplished yesterday, (2) what progress and activities are scheduled today and (3) what is scheduled for tomorrow and beyond, to prevent surprises.

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- Additionally, there are communications which you need to obtain from the client. This includes (1) any event or scheduled activity of others that may impact your work and (2) any concerns they may have about the progress of the job.

### **Communications at the End of the Job**

- Communicate with the on-site contact at the conclusion of the project and do a walk through prior to completion.
- Get agreement and satisfactory completion records signed before you remove supplies and equipment.
- Once an invoice is sent out, call to ensure it was received by the proper party and if there are any questions

### **Estimates & Contracts**

As far as the Project Manager is concerned there are typically only two main types of contract. These have their own pricing approach, detail required for the scope, documentation and reporting requirements. It is important to note that there are several variations to these types, but in essence there are Time and Materials and Fixed Price contracts.

### **Budgeting & Cost Control**

Though this is a technical course designed to train technicians to perform commercial drying projects. It is to everyone's benefit, owner, manager, supervisor and technicians to generally understand the costs on a job, how purchases and production affect the profitability of a job and how to ensure the customer receives good value for the amount they pay.

### **File Management and Job Reports**

There are several reasons that good documentation is critical at every stage of the project and from all personnel who impact the job (i.e. sales, operations and back-office support).

1. It aids in the entire planning process of a project. It is recommended that restorers consider the need for dedicated administrative help on large projects during estimation as well as when it comes time for billing.
2. It provides the customer or other interested parties the documents to show satisfactory completion of the scope of work.

### **Types of Required Documentation**

Though the documentation on many projects will vary for the type or size of the job, there are some items that are absolutely critical on every job.

1. Documents that evidence a clear contract and authorization with the owner
2. Site safety documents or other documents required by laws or regulatory agencies.
3. Job documentation that describes the details of the activities and conditions on the job
4. Job completion documents showing that you completed the scope of work for the client

### **Limitations, Complexities, Complications and Conflicts (LCCC)**

Restorers should have an understanding of the various issues on commercial projects and how to resolve them.

**Limitations** are restrictions placed upon the restorer by another party that results in a limit on the scope of work or on the restoration activities. Only the owner or owner's agent, not the restorer or others, can impose limitations on the performance of a project.

**Complexities** are conditions that causes the job to be more difficult or detailed, but which does not prevent the ability to perform the work adequately. Before beginning non-emergency work, a clear

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understanding of the known or anticipated complexities and their consequences should be discussed and approved in writing by the restorer and the client.

**Complications** are conditions that arise after the start of work that necessitates a change in the scope of activities, because the work becomes more complex, intricate, or perplexing.

**Conflicts** are any limitations, complexities, or complications that result in a disagreement between the parties involved about how the restoration project is to be performed. Conflict resolution should be documented in writing and the releases and disclaimers should be reviewed by a qualified attorney.

### **POST JOB REVIEW**

Finally, a post-review of the job should be done formally or informally, depending on the scope and size of the project. It is always beneficial to review what went well and what did not go well. It is important for us to learn from our mistakes and seek to continually improve our processes and technical skills.

## IN-CLASS PROJECTS SCENARIOS

As an integral part of the CDS class, we will use several scenarios, based on actual jobs, to give the class near hands-on experience with commercial, institutional and complex residential structures. Following is one which we will be working on during the first day of class. We encourage you to read it ahead of time to become familiar with it.

### PROJECT 1 – HEAVY COMMERCIAL OFFICE BUILDING

A strong storm moved through the area overnight. Wind damaged a 6-story multi-tenant office building, breaking in several windows on one side of the building as well as removing a part of the membrane roofing material. The Property Manager called you and asks if you can come as soon as possible. The building is five-years old.

#### RESULTS OF YOUR ON-SITE INSPECTION:

Upon arrival, the property manager takes you around and explains that the building has 10,000 SF per floor and that the top four floors are affected. They need you to bring in additional crews to help with the water extraction.

Construction is structural steel skeleton, with light-gauge steel framing for all walls; brick-veneer exterior.

During your inspection, you determine that the top four floors are affected as follows:

**6<sup>th</sup> Floor:** 5000sf affected, walls are wet to 18”, gypsum board over light-gauge steel framing. Your readings with a penetrating meter in unaffected areas of the gypsum board average 11.0%. You estimate the finish walls are vinyl wall-covering (30%) and latex-painted (70%). There are 15 offices with some open clerical areas. Most areas are glue-down carpet. Two offices have higher-grade carpet over pad. One of the 12 offices is the company President’s where you find glue-down hardwood parquet floor. Also, an inspection of the surrounding walls shows it to be insulated with un-faced fiberglass batts (giving a low-level of sound attenuation). Using a small metal tool, you tap around on the floor and find that most areas sound solid but a couple of squares sound slightly hollow. Your non-penetrating moisture meter ‘pegs the needle.’ Looking up, you note many missing ceiling panels that have fallen from water coming through the damaged roof.

This tenant has temporarily sent his people home and will not be in the building for the next 6 days. But they want to reopen on Monday, six days from now.

**5<sup>th</sup> Floor:** 3000sf affected, walls are wet to 12”, latex-painted gypsum board over light-gauge steel framing, no insulation. All areas open modular cubicles, plus two corner offices. All areas and offices have glue-down carpets. You count about 12 ceiling panels have fallen in this area. This tenant is moving most people to the other side of the building temporarily and will pretty much be out of your way.

**4<sup>th</sup> Floor:** 2000sf affected, walls are wet to 12”, gypsum board over light-gauge steel framing (vinyl-wallcovering (10%) and latex-painted (90%)). . . 24 offices with very little open areas. You see a couple of missing tiles in the ceiling. This is an Executive Office Suite, primarily used by manufacturer’s representatives. All carpets are glue-down. The tenant of this space can not forbid his individual tenants

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from being in their space. He wants as little interruption to them as possible. About half of these tenants have decided to stay away while work is going on.

**3<sup>rd</sup> Floor:** 400sf affected, 20 LF of exterior wall wet to 4", latex-painted gypsum board over metal framing. This area is open-cubicle offices, glue-down carpet and you observe no missing ceiling tiles.

Typical 2'x4' grid ceiling throughout building at 9' height. . .12' story height.

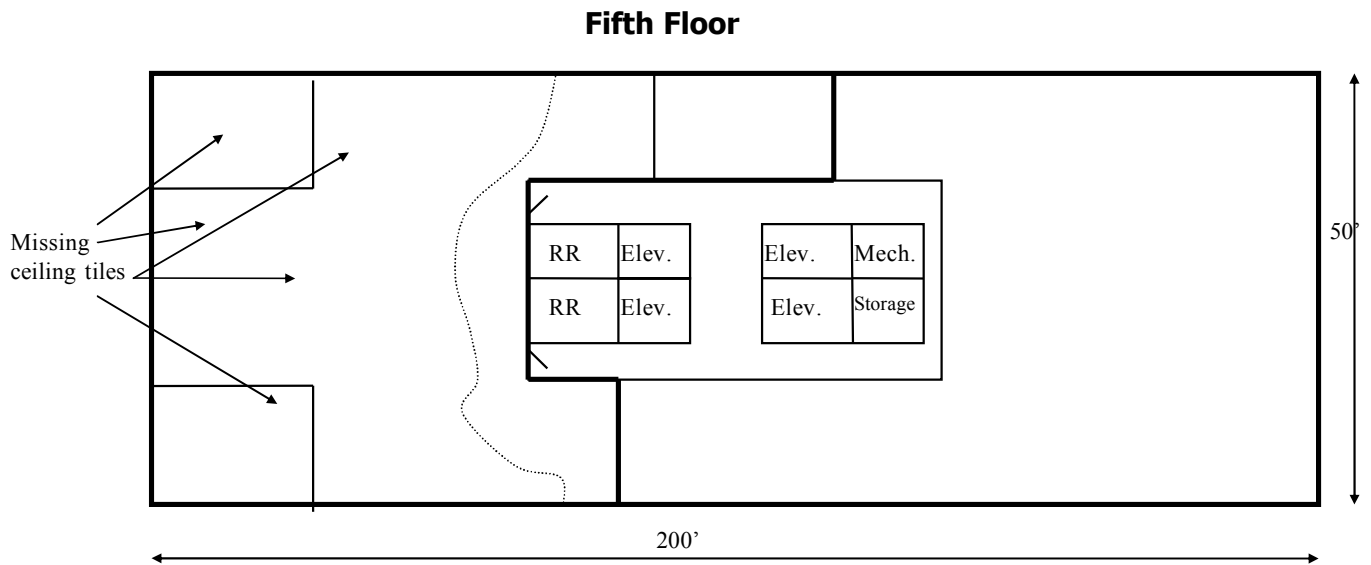
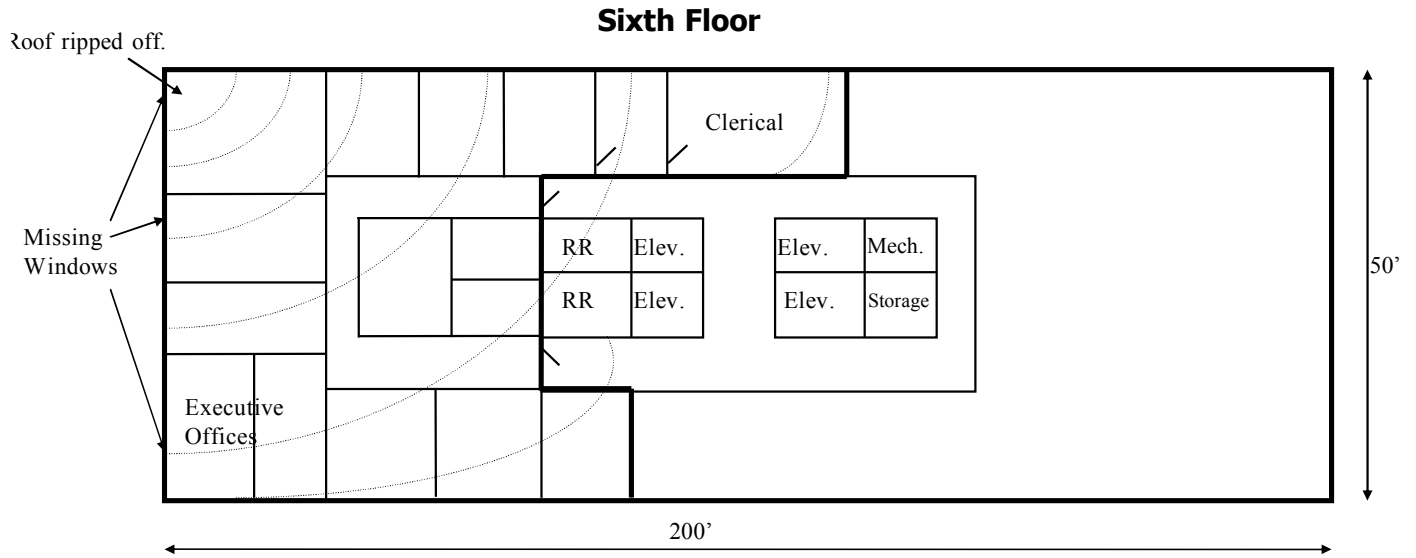
Power and HVAC is on and operating well, with the exception of the 6<sup>th</sup> floor. They estimate it will not be turned back on for a day or two. The power in the building is quite adequate. Pete Lowry, the Building Engineer tells you he can probably get you whatever power you need within 50-70' of any machine you may want to install. He says that there should also be adequate 115volt circuits throughout the office areas.

The freight elevator has good access to the loading dock, 4' wide door and is 8'6" deep.

### **LOCATION & AREA CONDITIONS:**

Weather: Lows = mid-50's, Highs = upper 70's, Dewpoints = 55 - 60

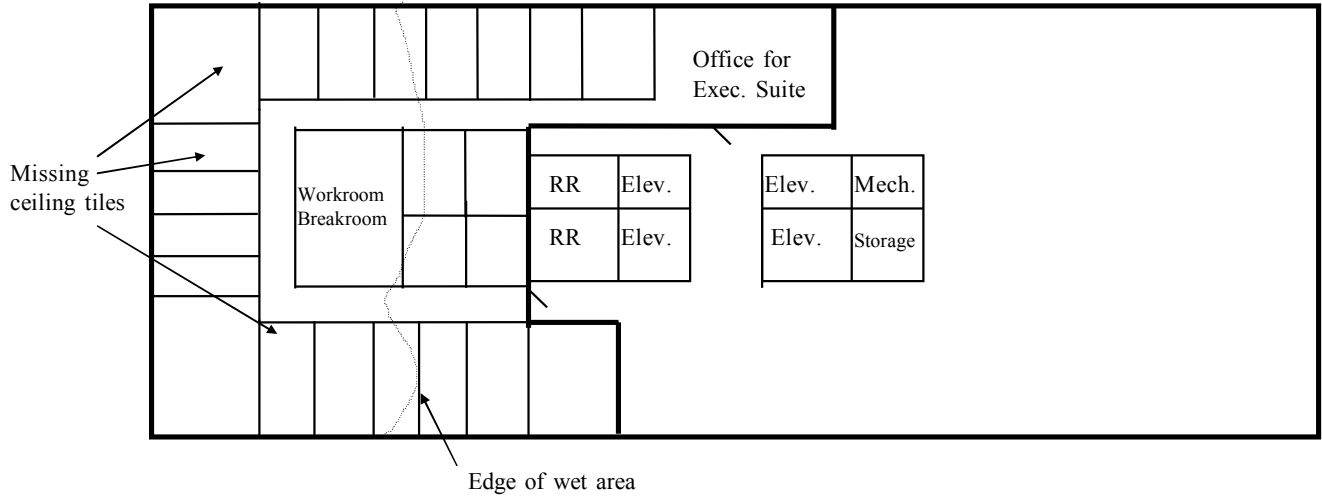
PROJECT 1: HEAVY COMMERCIAL BUILDING (cont)



PROJECT 1: HEAVY COMMERCIAL BUILDING (cont)

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**Fourth Floor**



**Third Floor**

