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STANDARD AND REFERENCE GUIDE FOR PROFESSIONAL WATER DAMAGE RESTORATION

Fourth Edition

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jurisdiction, at a minimum. Many jurisdictions follow the discovery rule, whereby the statute of limitations applicable to a restoration project only begins to run from the date of discovery of the problem, not the date the service was performed. Thus, in some circumstances, it may be appropriate to maintain restoration project documentation indefinitely. It is recommended that restorers obtain advice from qualified counsel regarding timeframes for documentation retention. The method of recordkeeping and record retention is beyond the scope of this document.

9.2.8 Emergencies

In many circumstances, water damage restoration projects begin on an emergency basis. Emergency situations might impede communications about the project or limit the opportunity to document the project as described in this section. However, once an emergency situation is resolved, to the extent possible, restorers should complete the appropriate documentation and correct communication deficiencies caused by the emergency.

9.3 Risk Management

It may be appropriate for restoration businesses to consider development of a formal Risk Management Program, including a review of insurance coverage both required by law and appropriate to the risk (e.g., general liability, contractor's pollution liability). Restorers shall determine and comply with any governmental insurance requirements related to their business operations. The conduct of business as a restoration firm requires consideration of several other types of insurance coverage, including:

- workers' compensation: restoration firms shall meet legal requirements to provide workers' compensation coverage for businesses having employees.
- automobile: it is recommended, and in many jurisdictions required by law, that restoration firms using vehicles in business obtain commercial automobile liability insurance.

Restorers shall determine and comply with any governmental insurance requirements related to their business operations. It is recommended that restorers stay abreast of insurance industry developments impacting their business. It is recommended that restorers develop and maintain a relationship with a qualified insurance professional to assist in this regard.

10 Inspections, Preliminary Determination, and Pre-Restoration Evaluations

10.1 Introduction

At the start of a restoration project, restorers are often compelled to make initial judgments between taking immediate action to begin quickly removing water and starting the drying process, versus the need to accurately identify and control hazards and contaminants. Restorers should conduct the following activities at the beginning of the project:

- information gathering;
- initial response;
- safety and health issue resolution;
- pre-restoration inspection;
- arriving at the preliminary determination;
- pre-restoration evaluations; and
- work planning

The ANSI/IICRC S500 *Standard and Reference Guide for Professional Water Damage Restoration* has been written to provide methods and procedures for restorers to safely restore property damaged from water intrusion. The processes in a project do not always follow a linear progression and may occur in varying orders; even simultaneously. The order of the processes presented in this section is by no means a mandatory order, although there are steps that should occur early in the initial response. Each project can present a unique set of circumstances that should be considered when establishing the order of the procedures discussed in this section.

10.2 Qualifications

Restorers are expected to be qualified by education, training, and experience to appropriately execute the skills and expertise required to safely perform restoration of structure and contents. Restorers shall only perform services they are licensed, certified, or registered to provide when required by local, state, provincial, or federal laws and regulations. If situations arise where there is a need to perform services beyond their expertise, restorers should hire specialized experts or other support services, or recommend to their customer that the appropriate specialized expert be retained in a timely manner. Restorers should also address occupant questions when the subject is within the scope of their authority and ability.

10.3 Documentation

Throughout the project, the restorer should establish, implement, and consistently follow methods and procedures for documenting all relevant information. This information can affect and provide support for project administration, planning, execution, and cost. In addition, pre-existing damage (e.g., evidence of wear, use, physical damage, previous water intrusions, staining, odors) should be documented and communicated to materially interested parties. Refer to Chapter 9, *Administrative Procedures, Project Documentation and Risk Management*.

10.4 Definitions

Before beginning the inspection, restorers should have an understanding of the category of water, classes of water, and other factors that influence the appropriate response.

10.4.1 Category of Water

The categories of water, as defined by this document, refer to the range of contamination in water, considering both its originating source and its quality after it contacts materials present on the job site. Time and temperature can affect or retard the amplification of contaminants, thereby affecting its category. Restorers should consider potential contamination, defined as the presence of undesired substances; the identity, location, and quantity of which are not reflective of a normal indoor environment; and can produce adverse health effects, cause damage to structure and contents, or adversely affect the operation or function of building systems.

Category 1: Category 1 water originates from a sanitary water source and does not pose substantial risk from dermal, ingestion, or inhalation exposure. Examples of Category 1 water sources can include, but are not limited to: broken water supply lines; tub or sink overflows with no contaminants; appliance malfunctions involving water-supply lines; melting ice or snow; falling rainwater; broken toilet tanks; or toilet bowls that do not contain contaminants or additives.

Category 1 water can deteriorate to Category 2 or 3. Category 1 water that flows into an uncontaminated building does not constitute an immediate change in the category. However, Category 1 water that flows into a contaminated building can constitute an immediate change in the category. Once microorganisms become wet from the water intrusion, depending upon the length of time that they remain wet and the temperature, they can begin to grow in numbers and can change the category of the water. Odors can indicate that Category 1 water has deteriorated.

Category 2: Category 2 water contains significant contamination and has the potential to cause discomfort or sickness if contacted or consumed by humans. Category 2 water can contain potentially unsafe levels of microorganisms or nutrients for microorganisms, as well as other organic or inorganic matter (chemical or biological). Examples of Category 2 water can include, but are not limited to: discharge from dishwashers or washing machines; overflows from washing machines; overflows from toilet bowls on the room side of the trap with some urine but no feces; seepage due to hydrostatic pressure; broken aquariums; and punctured water beds.

Category 2 water can deteriorate to Category 3. Once microorganisms become wet from the water intrusion, depending upon the length of time that they remain wet and the temperature, they can begin to grow in numbers and can change the category of the water.

Category 3: Category 3 water is grossly contaminated and can contain pathogenic, toxigenic, or other harmful agents and can cause significant adverse reactions to humans if contacted or consumed. Examples of Category 3 water can include, but are not limited to: sewage; wasteline backflows that originate from beyond the trap regardless of visible content or color; all other forms of contaminated water resulting from flooding from seawater; rising water from rivers or streams; and other contaminated water entering or affecting the indoor environment, such as wind-driven rain from hurricanes, tropical storms, or other weather-related events if they carry trace levels of contaminants (e.g., pesticides or toxic organic substances).

10.4.2 Regulated, Hazardous Materials and Mold

If a regulated or hazardous material is part of a water damage restoration project, then a specialized expert may be necessary to assist in damage assessment. Restorers shall comply with applicable federal, state, provincial, and local laws and regulations. Regulated materials posing potential or recognized health risks can include, but are not limited to: arsenic, mercury, lead, asbestos, polychlorinated biphenyls (PCBs), pesticides, fuels, solvents, caustic chemicals and radiological residues. For situations involving visible or suspected mold, refer to the current version of ANSI/IICRC S520 *Standard and Reference Guide for Professional Mold Remediation*. The presence of any of these substances does not constitute a change in category; but qualified persons shall abate regulated materials, or should remediate mold prior to drying.

10.4.3 Class of Water Intrusion

Restorers should estimate the amount of humidity control needed to begin the drying process. A component of the humidity control requirement is the Class of water.

The term “Class of water intrusion” is a classification of the estimated evaporation load and is used when calculating the initial humidity control (e.g., dehumidification, ventilation). The classification is based on the approximate amount of wet surface area, and the permeance and porosity of affected materials remaining within the drying environment at the time drying is initiated. Information needed to determine Class should be gathered during the inspection process. The Classes are divided into four separate descriptions, Class 1, 2, 3, and 4.

Class 1 — (least amount of water absorption and evaporation load): Water intrusion where wet, porous materials (e.g., carpet, gypsum board, fiber-fill insulation, concrete masonry unit (CMU), textiles) represent less than ~5% of the combined floor, wall and ceiling surface area in the space; and where materials described as low evaporation materials (e.g., plaster, wood, concrete, masonry) or low evaporation assemblies (e.g., multilayer wallboard, multilayer subfloors, gym floors, or other complex, built-up assemblies) have absorbed minimal moisture.

Class 2 — (significant amount of water absorption and evaporation load): Water intrusion where wet, porous materials (e.g., carpet, gypsum board, fiber-fill insulation, concrete masonry unit (CMU), textiles) represent ~5% to ~40% of the combined floor, wall, and ceiling surface area in the space; and where materials described as low evaporation materials (e.g., plaster, wood, concrete, masonry) or low evaporation assemblies (e.g., multilayer wallboard, multilayer subfloors, gym floors, or other complex, built-up assemblies) have absorbed minimal moisture.

Class 3 — (greatest amount of water absorption and evaporation load): Water intrusion where wet, porous materials (e.g., carpet, gypsum board, fiber-fill insulation, concrete masonry unit (CMU), textiles) represent more than ~40% of the combined floor, wall, and ceiling surface area in the space; and where materials described as low evaporation materials (e.g., plaster, wood, concrete, masonry) or low evaporation assemblies (e.g., multilayer wallboard, multilayer subfloors, gym floors, or other complex, built-up assemblies) have absorbed minimal moisture.

Class 4 — (deeply held or bound water): Water intrusion that involves a significant amount of water absorption into low evaporation materials (e.g., plaster, wood, concrete, masonry) or low evaporation assemblies (e.g., multilayer wallboard, multilayer subfloors, gym floors, or other complex, built-up assemblies). Drying may require special methods, longer drying times, or substantial water vapor pressure differentials.

10.4.4 Other Factors Necessary to Estimate Drying Capacity

Other factors can impact the drying environment. Restorers should understand and consider these factors when estimating the drying capacity needed to prevent additional damages and begin the drying process. These factors include:

- influence of heating, ventilating, and air conditioning (HVAC) systems;
- build-out density of the affected area;
- building construction complexity; and
- influence of outdoor weather.

10.5 Initial Contact and Information Gathering

The information gathering process begins with the initial contact between the restorer and the property owner or authorized agent. In addition to administrative information found in Chapter 9 *Administrative Procedures, Project Documentation, and Risk Management*, the restorer should gather information to allow for an effective mobilization and response. Inaccurate or incomplete information can impact the ability of the restorer to take appropriate measures during the initial response. This information can include, but is not limited to:

- structure type and use;
- source, date, and time of water intrusion;
- status of water source control;
- general size of affected areas (e.g., number of rooms, floors);
- suspect or known contaminants;
- history of building usage;
- history of previous water damage;
- types of materials affected (e.g., flooring, walls, framing);
- age of structure;
- changes in structure design; and
- number of occupants.

The restorer can make assumptions using the information above to mobilize a proper response. Once the restorer arrives at the worksite and performs an initial inspection, these assumptions can change. The information gathered helps to establish a moisture inspection strategy and evaluate the existence of moisture problems that have caused or can lead to structural, system, or content damage or contamination. Contaminants (e.g., fungal or bacterial) can be visible or hidden. Where mold growth is discovered or is suspected refer to the current version of ANSI/IICRC S520 *Standard and Reference Guide for Professional Mold Remediation.*

10.6 Initial Response, Inspection and Preliminary Determination

During the initial response, the information gathering process should continue with a site walkthrough and customer and occupant interviews. At a minimum, the restorer should conduct the following activities during the initial response:

- conduct a site specific safety survey;
- identify customer priorities and concerns;
- verify the source of water intrusion;
- identify the extent of the water migration;
- arrive at a preliminary determination;
- identify pre-existing damage;
- identify immediate secondary damage concerns; and
- establish dry standards and drying goals.

10.6.1 Safety and Health Hazards

Safety and health hazards shall be documented. As hazards are identified, appropriate actions shall be implemented to resolve the hazard, or minimize the potential for injury or other safety risks. Actions may include the involvement of a specialized expert. Refer to Chapter 8, *Safety and Health.*

10.6.2 Identify Priorities and Concerns

During the initial inspection, restorers should consider the priorities and concerns of the materially interested parties. The type of structure, contents affected, building use, occupancy, and the impact associated with the loss-of-use can significantly influence priorities and concerns. Refer to Chapter 11, *Limitations, Complexities, Complications and Conflicts*.

10.6.3 Extent of Water Migration

Restorers should evaluate and document the extent of water migration in structure, systems, and contents, using the appropriate moisture detection equipment which can include, but is not limited to:

- moisture sensors;
- thermo-hygrometers;
- invasive and non-invasive moisture meters;
- infrared thermometer; and
- thermal imaging cameras.

Since water can flow under walls, and come from above, restorers should inspect adjoining rooms even when no water is visible on the surface of floor coverings. The amount of surface area to inspect within a building can make it inefficient to detect moisture using moisture meters alone. Thermal imaging cameras can be used to show possible water flow patterns in a building in hard to reach places, increasing the efficiency of documenting affected areas and water migration. Thermal imaging cameras can be useful as they show apparent surface temperature variations commonly associated with moisture, but should always be verified by a moisture meter.

10.6.4 Pre-existing Damage

Throughout the inspection process, restorers should inspect for pre-existing damage issues. Pre-existing damage is the wetting or impairment of the appearance or function of the material from direct or indirect exposure to water or other conditions not related to the current water intrusion. Examples of pre-existing damage can include, but are not limited to: dry rot, chronic water leaks, urine contamination, and visible mold growth. Indications of pre-existing damage can include, but are not limited to:

- malodors;

- visible evidence of staining and deterioration; and
- evidence of damage unrelated to water (e.g., wear, use, lack of maintenance).

10.6.5 Secondary Damage

Throughout the drying process, restorers should inspect for water-related secondary damage issues. Secondary damage is defined as the wetting or impairment of the appearance or function of a material from prolonged indirect exposure to water or indirect exposure to contamination carried by or resulting from the current water intrusion, which is reversible or permanent. Restorers should inspect for excessive humidity and elevated moisture content in areas adjacent to the affected area.

10.6.6. Dry Standards and Drying Goals

Dry standards are a reasonable approximation of the moisture content or level of materials prior to a water intrusion. An acceptable method to establish a dry standard is to evaluate the moisture content or level of similar materials in unaffected areas. When unaffected materials are not present, the restorer may use a reference from similar structures, experience from similar drying projects, and knowledge of the geographical area. The dry standards are then used by the restorer to establish acceptable drying goals.

Drying goals are a target moisture content or level of materials established by the restorer that are based on the dry standards. Individuals establishing drying goals should have a working knowledge of the instrumentation used and local influences on normal moisture content or level in building materials.

Drying goals may be at, or above the dry standard and should be documented as they relate to specific materials. The restorer should establish drying goals that would be expected to:

- inhibit microbial growth; and
- return materials to an acceptable moisture content or level.

Returning materials to an acceptable moisture content or level can be accomplished by setting a drying goal that returns materials to a close approximation of their dry standard. Returning materials to an acceptable moisture content or level can be accomplished by setting a drying goal that returns materials to a close approximation of their dry standard. In the case of solid hardwood products, the drying goal should be within 4 percentage points of its normal moisture content or dry standard, but in all cases below the point that would support microbial growth. For all materials, it is recommended the drying goal be within 10% of the dry standard, and not support microbial amplification. To illustrate this, if the measured dry standard is 20 points, then the drying goal would be a maximum of 22 points.

10.6.7 Preliminary Determination

The “preliminary determination” is the determination of the Category of water. If the preliminary determination is that the water is Category 1, then the restorer can proceed without contamination controls (e.g., erecting containment barriers, initial cleaning, establishing pressure differentials). With regard to Category 2 or 3 water intrusions, remediation should occur prior to restorative drying and restorers shall use contamination controls and appropriate worker protection. Where necessary, an indoor environmental professional (IEP) should be used to assess the levels of contamination. For humidity control in Category 2 or 3 contaminated structures, refer to Section 13.3.5.

In many cases an assessment by an IEP on a water damage restoration project is not necessary. However, if the inspection shows that one or more of the following elevated risk situations are present, then an IEP should be retained by one of the materially interested parties (refer to Chapter 12, *Specialized Experts*). Considerations can include, but are not limited to:

- occupants are high risk individuals; (refer to Chapter 3, *Health Effects from Exposure to Microbial Contamination in Water-Damaged Buildings*);

- a public health issue exists (e.g., elderly care or child care facility, public buildings, hospitals);
- a likelihood of adverse health effects on workers or occupants;
- occupants express a need to identify a suspected contaminant;
- contaminants are believed to have been aerosolized; or
- there is a need to determine that the water actually contains contamination.

The preliminary determination prepares the restorer to perform a pre-restoration evaluation.

10.6.8 Performing the Initial Moisture Inspection

An initial moisture inspection should be conducted to identify the full extent of water intrusion, including the identification of affected assemblies, building materials, and the edge of water migration. Normally, this process begins at the source of water intrusion. Water migration can then be traced across and beneath carpeted surfaces with a moisture sensor. Hard surfaces such as wood flooring, gypsum wallboard, resilient flooring and plaster should be inspected. This can initially be accomplished using a non-invasive (non-penetrating) moisture meter. Thermal imaging cameras can be used to help identify areas of potential migration followed by appropriate moisture detection instruments, especially on projects with complex or multiple areas of water intrusion.

The initial inspection should continue in all directions from the source of water intrusion until the restorer identifies and documents the extent of migration. As affected assemblies are discovered, the restorer should identify and document the building materials that comprise the assembly and the impact of the water on each material. In some cases limitations and complexities (refer to Chapter 11 *Limitations, Complications, Complexities and Conflicts*) can hinder the identification of materials and assemblies. Identification of building materials within an assembly can be accomplished through several methods (e.g., building drawings, existing access openings, inspection holes, partial disassembly, invasive moisture meters). The extent of moisture migration should be documented using one or more appropriate methods including at a minimum a moisture map (i.e., a diagram of the structure indicating the areas affected by migrating water).

The initial inspection process should include establishing a dry standard for affected materials. An acceptable method to establish a dry standard is to evaluate the moisture content or level of similar materials in unaffected areas. The dry standard should be documented and used to establish a drying goal for salvageable affected materials. Results of the initial moisture inspection should be used to establish a monitoring method (i.e., the same meter and setting) to be followed for subsequent follow up visits to the project (i.e., daily). The results of the inspection should be documented (e.g., meter, setting, types of material).

Infrared thermometers measure the average temperature on a spot at the surface of the material. The size of the sample area is determined by the distance-to-spot ratio. An infrared thermometer can be used to determine temperature differentials. The surface temperature difference can indicate evaporative cooling of wet materials. Cooler surfaces do not always indicate evaporative cooling.

Restorers should use the appropriate meter or instrument during inspections and follow the manufacturer instructions. An understanding of meter operation and limitations is critical to accurate measurements. Restorers using thermal imaging cameras in surveying buildings for moisture damage should be competent in its use. Areas identified with the camera as suspect for being wet should be verified by further testing with a moisture meter.

10.7 Pre-Restoration Evaluation

Following the preliminary determination, the restorer should conduct a pre-restoration evaluation. Pre-restoration evaluations establish recommended corrective actions based on information and evidence collected during the inspection process and conclusions derived from the preliminary determination. The information gathered from the pre-restoration evaluation is then used to develop the work plan, drying plan, safety and health plan, and to identify the need for specialized experts that may be required to clean and dry the structure, building systems, and contents to an acceptable drying goal. Information gathered shall include safety and health hazards and the approximate age of the building. Factors considered in the pre-restoration evaluation process can include but are not limited to:

- emergency response actions;
- building materials and assemblies;
- contents and fixtures;
- HVAC, plumbing and electrical systems; and
- below-grade, substructure and unfinished spaces.

10.7.1 Evaluating Emergency Response Actions

Restorers shall identify and manage potential safety and health hazards. During the inspection process, restorers shall make a reasonable effort to identify potentially hazardous materials that could impact building occupants or might be disturbed. Whenever occupants or other workers are present during the initial inspection, restorers should communicate known potential hazards (refer to Chapter 8, *Safety and Health*). Restorers shall comply with federal, state, provincial, and local laws and regulations regarding the inspection or handling of hazardous or regulated materials, such as asbestos or lead-based paints.

10.7.2 Evaluating Building Materials and Assemblies

Determining the composition of affected materials and assemblies helps establish and implement an appropriate restoration strategy. The construction, permeability, placement of vapor retarders, number of layers, degree of saturation, presence of contamination, degree of physical damage, and the presence of interstitial spaces should be considered when evaluating materials and assemblies.

If materials are restorable, the restorer should use appropriate measuring devices to obtain and document moisture readings, and compare them to the drying goals. All building materials that are likely to be affected, including multiple layers in a single assembly, should be considered.

If a material or an assembly is generally unrestorable and a restorer attempts to dry that portion of the structure through agreement with the MIP(s), it is recommended there be an understanding in regards to the responsibility for the services rendered if the attempt is not successful.

10.7.3 Evaluating Contents

Determining the material composition of affected contents helps establish a moisture inspection strategy and implement an appropriate restoration strategy. The construction, permeability, degree of saturation and the presence of contamination should be considered when evaluating contents. Affected contents should be evaluated. Refer to Chapter 15, *Contents Evaluation and Restoration*.

If contents are generally unrestorable and a restorer, based upon an agreement with the MIPs, attempts to dry those items, there should be an agreement between the parties about the responsibility for the services rendered in the event that the attempt is not successful.

10.7.4 Evaluating HVAC Systems

Determining the material composition of affected HVAC systems helps establish a moisture inspection strategy and implement an appropriate restoration strategy. The construction, presence of moisture and contamination should be considered when evaluating HVAC systems. Affected HVAC systems should be evaluated by a qualified individual. Refer to Chapter 14, *Heating, Ventilating and Air Conditioning (HVAC) Restoration*.

10.7.5 Evaluating Below-Grade, Substructure and Unfinished Spaces

Depending on the type of construction, water can collect in below-grade, substructure or unfinished spaces (e.g., basements, crawlspaces, mechanical chases, and attics). These areas should be evaluated. Below-grade, substructure and unfinished spaces can present unique challenges and may involve special evaluation procedures. The inspection and evaluation process shall be conducted according to federal, state, local, or provincial laws and regulations. Restorers should consult with a specialized expert when appropriate.

Below-grade, substructure and unfinished spaces can contain safety and health hazards. Safety issues for entrants to consider include, but are not limited to: electrical shock hazards, puncture wounds and bites from rodents, insects or small animals, oxygen deprived atmospheres, and airborne contaminants. If a hazardous condition is known or suspected, it should be contained or removed by a qualified individual as necessary. Entrants should wear appropriate personal protective equipment. Refer to Chapter 8, *Safety and Health.*

A water intrusion can be a single, short duration event; however, the amount of flow into the space can be significant. The restorer should evaluate the Category of Water, Class of Water Intrusion specific to the space, size of the affected area, and the composition and moisture content of structural materials (e.g., joists, subflooring).

Many below-grade, substructure and unfinished spaces are considered a confined space. Before entering, accessibility issues for a confined space shall be addressed. Some confined spaces are classified as “permit-required” spaces. Refer to Chapter 8, *Safety and Health.*

Once safety and health issues have been addressed, the below-grade, substructure and unfinished space inspection can begin and evaluations can be made. Items that can be useful when inspecting these areas include a flashlight, safety harness and rope, drop lights with GFCI cords, GFCI extension cords, a mechanics creeper, thermo-hygrometers, moisture meters, plastic sheeting and drop cloths.

10.8 Project Work Plans

The information gathered from the pre-restoration evaluation is used to develop work plans. Refer to Chapter 9, *Administrative Procedures, Project Documentation and Risk Management.* The structural restoration procedures that follow the development of work plans are discussed in Chapter 13, *Structural Restoration*, and in Chapter 15, *Contents Evaluation and Restoration.*

10.9 Ongoing Inspections and Monitoring

Once the project has been controlled and the correction of the damage has begun, the restorer should continue gathering information through ongoing inspections and monitoring. The monitoring process can include, but is not limited to: recording temperature and relative humidity readings and other calculated psychrometric values, checking the moisture levels of materials, and updating progress reports.

Because differences in calibration occur from one instrument to another, restorers should use the same meter throughout a project or establish an in-house method to verify that the meters used are within a reasonable tolerance of each other. Refer to Chapter 6, *Equipment, Instruments, and Tools*.

Restorers should record and monitor relevant moisture measurements daily, preferably at the same time of day, until drying goals have been achieved and documented. The first of these inspections to monitor and make adjustments should be performed no later than the day following the initiation of restorative drying. The frequency of subsequent monitoring should be daily until drying goals have been met, but may be adjusted by the agreed scope of work, potential for secondary damage, job site accessibility, or by agreement between the materially interested parties. Such adjustments should be documented.

The information gathered during ongoing inspections and monitoring can lead the restorer to adjust the placement of drying equipment and modify drying capacity. Where progress is not acceptable, the restorers should take corrective action. The ongoing inspection process can lead to the discovery of a complication. As complications arise, restorers should document the nature of the complication, the impact on the restoration process and scope, and communicate with materially interested parties. Refer to Chapter 11, *Limitations, Complications, Complexities and Conflicts.* Restorers should continue the drying process until drying goals have been achieved and documented. Refer to Chapter 13, *Structural Restoration*.

11 Limitations, Complexities, Complications and Conflicts

11.1 Introduction

Restorers can be faced with project conditions that present challenges. These challenges can produce limitations, complexities, complications or conflicts. Restorers should have an understanding of these issues and communicate them to appropriate parties. The following is a definition of each of these challenges.

Before beginning non-emergency work, known or anticipated limitations and complexities, and their consequences, should be understood, discussed, and approved in writing by the restorer and the owner or owner's agent. The following is a discussion of each of these challenges.

11.2 Limitations

Limitations are restrictions placed upon the restorer by another party that results in a limit on the scope of work, the work plan or the outcomes that are expected, and can include but are not limited to one or more of the following:

- the source of the water intrusion has not been corrected;
- funds are limited;
- the appropriate use of containment is not allowed on contaminated water losses;
- the restorer is told to extract Category 3 water but not remove and discard contaminated porous material (e.g., carpet, gypsum board, fiber-fill insulation, CMU, textiles); and
- the restorer is told to return contaminated contents without returning them to a sanitary condition.

Only the owner or owner's agent, not the restorer or others, can impose limitations on the performance of a project. If an attempt to impose a limitation is initiated by any other materially interested party, the owner or owner's agent should be advised and provide approval before the limitation takes effect. Limitations that allow for services to be rendered in compliance with this standard should be clearly defined in writing. Limitations placed on any project that are inconsistent with this standard can result in a conflict.

11.3 Complexities

Complexities are conditions causing a project to become more difficult or detailed, but do not prevent work from being performed adequately, and can include but are not limited to one or more of the following:

- inconvenient or limited space or path for entry and exit serving the work area or building;
- the restoration occurs after business hours or within a specified time period;
- work needs to proceed during adverse weather;
- the restoration includes a permit required confined space;
- the business will be in operation or the space requiring work will be occupied during restoration;
- access to the restoration area is desired by occupants;
- a lack of available storage space for equipment, supplies, and debris;
- a project site location is complicated due to building-specific uses (e.g., a clean room, intensive care unit or immunocompromised patient ward in a hospital); and

The relationship of a specialized expert to the various parties can become quite complex depending on the reason they were hired and why the specialized expert accepted the assignment. While it is preferred that specialized experts be independent and unbiased resources, there can be contractual, adversarial, and unforeseen conflicts of interest that can limit or even prevent that from happening. However, an independent, unbiased opinion is essential when a specialized expert is hired to provide a second opinion. Other relationship issues can include:

- Confidentiality: A company owes a duty to its client, which can include confidentiality. When someone other than the restorer retains a specialized expert, there might be a limit to the information that the specialized expert can provide to the restorer. Ideally, a specialized expert will be authorized by the client to share information with materially interested parties. The EPA's *Mold Remediation in Schools and Commercial Buildings*, for example, encourages communication with occupants to help alleviate concerns and suspicions. However, in cases involving litigation, it can be difficult to share or obtain information.
- Reliance: In some cases restorers rely on a specialized expert to determine the scope of work and other essential tasks. However, relying on the training, experience, reputation, or credentials of a specialized expert might not absolve the restorer of legal risk or other responsibilities.
- Overlap: There can be circumstances when the normal activities of a restorer overlap or conflict with those of a specialized expert. In those circumstances, the restorer can reach the point where a decision should be made about whether to continue the inspection and not perform the restoration, or to transfer responsibility for further inspection and assessment to a specialized expert.

The safety and health of occupants and workers is a paramount principle of restoration, and since contaminated water and associated health impacts remain uncertain, restorers should engage the services of a specialized expert when necessary, including an IEP when appropriate, to protect the safety and health of occupants and workers, or when necessary to effectively complete a restoration project. Federal, provincial, state, and local laws requiring the use of a specialized expert shall be followed.

Additional factors that influence the decision of whether and when to involve specialized experts are addressed in Chapter 10, *Inspections, Preliminary Determination and Pre-Restoration Evaluations*.

13 Structural Restoration

13.1 Introduction

The purpose of this section is to provide procedural guidance and assist restorers in applying principles of water damage restoration. The five principles are: provide for the safety and health of workers and occupants, document and inspect the project, mitigate further damage, clean and dry affected areas, and complete the restoration and repairs. This section is divided into three sections:

- Initial Restoration Procedures;
- Remediation Procedures for Category 2 or 3; and
- Drying and Completion Procedures for Category 1

If the preliminary determination is that the water is Category 1, then the restorer can proceed without contamination controls (e.g., erecting containment barriers, initial cleaning, establishing pressure differentials) and worker protection. With regard to Category 2 or 3 water intrusions, remediation should occur prior to restorative drying. For humidity control in Category 2 or 3 contaminated structures, refer to Section 13.3.5.

13.2 Initial Restoration Procedures

13.2.1 Rapid Response

Mitigation procedures should begin as soon as safely possible following the initial moisture intrusion. If building materials and structural assemblies are exposed to water and water vapor for extended periods, moisture penetrates into them more deeply. The more water they absorb, the more time, effort and expense is required to dry them.

13.2.2 Administration and Job Coordination

It is recommended that job coordination takes place at or near the start of the water restoration project, though due to the time-critical nature of many emergency services, some aspects are often delayed until mitigation services are performed and the drying system is operational. Coordination steps may include but are not limited to reaching agreement on:

- procedures to be performed;
- drying goals; and
- completion requirements.

Restorers should execute a valid contract before beginning mitigation procedures and obtain informed consent for antimicrobial (biocide) application, if used.

13.2.3 Inspection

Restorers should be qualified by education, training and experience to appropriately execute the skills and expertise required to safely perform the restoration of structure and contents. The restorer or another qualified individual should gather information, conduct an inspection, make a preliminary determination, communicate to materially interested parties, provide initial restoration procedures, and know when to involve others who can assist in decision-making and the performance of tasks. When appropriate, the response can include implementing emergency response actions.

13.2.4 Health and Safety Considerations

Potential safety and health hazards shall be identified and, to the extent possible, eliminated or managed before implementing restoration procedures. Before entering a structure, the building's structural integrity, and the potential for electrical shock hazards and gas leaks shall be evaluated. Such evaluation or assessment may require a specialized expert (e.g., electrician, structural engineer). Customers should be warned of imminent hazards that are discovered. When hazards or potential hazards are discovered, appropriate steps, such as posting warning signs, shall be taken to inform workers and occupants.

13.2.5 Examining Water Source

Before restoration begins, the source or sources of moisture intrusion should be located and eliminated, repaired or contained to the extent practical. In some cases it may be appropriate to mitigate the spread of damage by starting procedures, such as extraction, to prevent further water migration, even before the source is found and contained or repaired.

3.2.6 Determining the Category of water

The categories of water, as defined by this document, refer to the range of contamination in water, considering both its originating source and its quality after it contacts materials present on the job site. Time and temperature can affect or retard the amplification of contaminants, thereby affecting its category. Restorers should consider potential contamination, defined as the presence of undesired substances; the identity, location and quantity of which are not reflective of a normal indoor environment; and can produce adverse health effects, cause damage to structure and contents, or adversely affect the operation or function of building systems.

13.2.7 Determining the Class of Water Intrusion

Restorers should estimate the amount of humidity control needed to begin the drying process. The term "Class of water" as defined in Section 10.4.3 is a classification of the estimated evaporation load and is used when calculating the initial humidity control (e.g., dehumidification, ventilation). It is based on the approximate amount of wet surface area, and the permeance and porosity of the affected materials left within the drying environment at the time drying is initiated. Initial information to determine Class should be gathered during the inspection process. The Classes are divided into four separate descriptions: Class 1, 2, 3, and 4. The determination of class may be dependent upon the restorability of wet materials and access to wet substrates. Depending upon the project, this determination may occur at a different point of the initial restoration procedures.

13.2.8 Evaluating for Restorability

Information obtained from the preliminary determination and during the inspection should be used to evaluate the restorability of materials on the project. Based on this evaluation, a work plan can be developed to address the affected materials and protect the unaffected materials. For more information on the evaluation of specific materials and assemblies, refer to Chapter 17, *Materials and Assemblies*.

13.2.9 Contents

Steps should be taken as quickly as practical to minimize damage to contents. This includes, but is not limited to protecting contents from moisture absorption, which can result in stain release, discoloration of finish, splitting of wood components in direct contact with wet surfaces (legs, bases), staining, rusting, ringing or other forms of moisture damage. If contents restrict access to walls, ceilings or other areas, the restorer should manipulate them (e.g., move, relocate, discard).

Note: For Category 1 drying procedures, proceed to Section 13.5 *Drying and Completion of the Restoration Process (Category 1 and Post Remediation Category 2 and 3).*

13.3 Remediation Procedures for Category 2 or 3

This section covers procedures for remediation of areas that contain or are believed to contain one or more types of contaminants. Remediation should occur prior to restorative drying. Contaminants are defined as the presence of undesired substances the identity, location, and quantity of which are not reflective of a normal indoor environment and can produce adverse health effects; can cause damage to structure or contents; and can adversely affect the operation or function of building systems. Contaminated environments can result from:

- Category 2 or 3 water;
- Condition 2 or 3 mold contamination;
- Trauma or crime scene; or
- Hazardous or Regulated Materials.

An environment can be contaminated as a result of pre-existing damage. The remediation procedures should not vary regardless of whether contaminants are the result of water intrusion or pre-existing damage. Restorers shall inspect the structure for the presence and location of contaminants as part of their site safety survey. Restorers shall develop a safety plan outlining how workers will be protected against hazards. Restorers should take appropriate steps to disclose known or suspected contaminants to other materially interested parties, and recommend appropriate precautions.

13.3.1 Restorer, Occupant Protection

Before entering structures that are known or suspected to be contaminated, either for inspections or restoration activities, restorers shall be equipped with appropriate personal protective equipment (PPE) for the situation encountered. Restorers can make recommendations regarding personal protection to persons entering structures, as appropriate. Restorers should refer occupants with questions regarding health issues to qualified medical professionals for advice.

13.3.2 Engineering Controls: Containment and Managed Airflow

Contaminants should not be allowed to spread into areas known or believed to be uncontaminated. Information provided in this section generally assumes the contamination level is severe (i.e., Category 3 water). The procedures in this section may be modified for less severely contaminated environments. Contaminants can be spread in many ways:

- solid and liquid contaminants can be: tracked on feet, spread on wheels or bases of equipment, carried on contents, bulk materials, or debris during manipulation or removal; and
- airborne contaminants can be spread by natural circulation, an installed mechanical system, or by using air moving equipment. When drawing moist air out of potentially contaminated cavities using negative pressure, an in-line HEPA filter should be used to remove contamination before exhausting the air into the room.

In grossly contaminated environments, restorers shall implement procedures to minimize the spread of contaminants. This can be accomplished by isolating contaminated areas, erecting containment, and employing appropriate work practices.

For details on the setup and maintenance of containment and airflow management, restorers should consult the current edition of the ANSI/IICRC S520 *Standard and Reference Guide for Professional Mold Remediation*. The principles of containment found therein, although specifically addressing mold contamination, are generally applicable to environments in which aerosolizing of other types of contaminants is likely.

AFDs used in contaminated areas should be sealed at the air intake side upon turning off to avoid releasing contaminants. Filters should be replaced as necessary following manufacturer's guidelines to maintain performance efficiency. Restorers should ensure that contaminated equipment is cleaned and decontaminated, or contained prior to moving through unaffected areas, transported, or used on subsequent jobs.

13.3.3 Bulk Material Removal and Water Extraction

Bulk contamination (e.g., solid waste, silt, debris) should be removed to expose structural surfaces or assemblies for further inspection and evaluation, prior to demolition or detailed cleaning. When extracting contaminated water or vacuuming contaminated dry material, restorers should take appropriate steps to prevent contaminants from becoming aerosolized in work areas or other parts of a building by using HEPA vacuum systems or directing a vacuum's exhaust to unoccupied areas of the building's exterior.

Tools and equipment should be cleaned and decontaminated, or contained on the job site before being loaded for transport away from the site. Extracted water shall be disposed in accordance with applicable laws and regulations. Normally, this means disposal into a sanitary sewer system or, especially where HAZMAT is involved, at an appropriately licensed disposal facility.

13.3.4 Pre-remediation Evaluation and Assessment

Following the bulk removal of contaminants and water extraction, restorers should evaluate remaining materials and assemblies as specified in Chapter 10*, Inspections, Preliminary Determinations, and Pre-restoration Evaluations*. Further assessment may be necessary and should be performed by an indoor environmental professional (IEP) or other specialized expert as dictated by the situation.

13.3.5 Humidity Control in Contaminated Structures

The priority for restorers is to complete remediation activities before restorative drying. However, the restorer should control the humidity in contaminated buildings to minimize moisture migration, potential secondary damage, and microbial amplification. Restorers should maintain negative pressure in relation to uncontaminated areas. Maintaining negative pressure in an affected area can increase the dehumidification capacity needed to maintain desired psychrometric conditions. This may be implemented before, during, or after decontamination. Restorers should limit the velocity of airflow across surfaces to limit aerosolization of contaminants. Restorers should complete the drying process after the remediation has been completed.

13.3.6 Demolition and Controlled Removal of Unsalvageable Components or Assemblies

During demolition, contaminants can be easily dislodged or aerosolized. Restorers should minimize dust generation and aerosolization by using appropriate engineering controls.

The cutting depth of saw blades should be set so that they do not penetrate past wallboard materials. This can avoid possible damage of plumbing, electrical or other components within the cavity. Wet or contaminated insulation should be removed carefully and bagged immediately, preferably in 6-mil disposable polyethylene bags. A razor knife or utility knife is recommended for cutting rather than tearing or breaking it into pieces.

Contaminated materials should be double-bagged if they are going to pass through uncontaminated areas of the building. Sharp items capable of puncturing polyethylene material should be packaged before being bagged or wrapped in a manner that prevents them from penetrating packaging material.

13.3.7 Pockets of Saturation

Restorers should open assemblies (e.g., walls, stairs, flooring, wall base areas, voids, built-ins) to access pockets of saturation and remove unsalvageable, contaminated materials and components. Exposed materials that remain in place should be cleaned and decontaminated, as appropriate.

13.3.8 HVAC System Components

In projects where Category 2 or 3 water has directly entered HVAC systems, they should be contained and disassembled, and affected HVAC system components should be removed. Restorers should plan for component cleaning, using a specialized HVAC contractor as appropriate, followed by system reinstallation after structural restoration and remediation has been completed. Restorers should consult specialized experts when HVAC system removal, restoration, or replacement is complex or outside their area of expertise.

13.3.9 Cleaning and Decontaminating Salvageable Components

Decontamination should be accomplished to the extent possible by cleaning. Restorers should employ cleaning methods that minimize aerosolizing contaminants while maximizing complete removal. However, low pressure washing to flush contaminants from salvageable components may be appropriate. Wastewater from cleaning processes should be collected and properly disposed. It is recommended that when decontamination cannot be practically completed by cleaning alone, that appropriate antimicrobial (biocide) or mechanical means be employed.

13.4 Antimicrobial (biocide) Application

13.4.1 Antimicrobial (biocide) Risk Management

Restorers who use antimicrobials (biocides) shall be trained in their safe and effective use. Safety data sheets (SDS) for chemicals used during a water restoration project shall be maintained on the job site and made available to materially interested parties upon request. Restorers should obtain a written informed consent from the customer before they are applied, and occupants should be evacuated prior to application. Restorers shall follow label directions and comply with federal, state, provincial, and local regulations.

13.4.2 Customer "Right to Know" when using Antimicrobials (biocides)

Restorers should brief customers before antimicrobials (biocides) are applied. This can include providing customers with the product information label and obtaining informed consent of product use in writing. If a customer requests the product label or safety data, the restorers shall provide it. Written documentation should be maintained for each antimicrobial (biocide) application (e.g., type, application method, time, quantity, and location).

13.4.3 Biocide Use, Safety and Liability Considerations

Antimicrobials (biocides) can harm humans, pets and wildlife if used improperly. When using antimicrobials (biocides) in water damage restoration activities for efficacy, safety, and legal liability reasons, restorers shall follow label directions carefully and explicitly. In some countries, such as the United States, it is a violation of law to use these products in a manner inconsistent with the label. In order to minimize potential liability, restorers shall:

- Comply with applicable training, safety, use, and licensing requirements in their respective jurisdictions;
- Train and supervise employees and agents handling biocides;
- Ensure that proper PPE is available to restorers who are engaged in antimicrobial (biocide) use and application;
- Not use such products in any heating, ventilating, air-conditioning, or refrigeration systems unless:
    - the product is specifically approved by the appropriate federal/state regulatory authority;
    - trained heating, ventilating, air-conditioning, or refrigeration systems technicians apply it and remove its residual;
    - the heating, ventilating, air-conditioning, or refrigeration systems system is not operating; and
    - occupants and animals have been evacuated;
- Apply products strictly in accordance with label directions;
- Dispose of remaining antimicrobials (biocides) according to label directions; and
- Determine whether or not the local government agencies where the antimicrobial (biocide) is to be applied has adopted laws or regulations further restricting or regulating the use of the specific antimicrobial (biocide) in question, and if so, follow those specific use restrictions and regulations;

In addition, restorers should:

- Discuss potential risks and benefits with the customer, make available product information including the label and the SDS, and obtain a written informed consent with the customer's signature before applying any antimicrobial (biocide).
- Inquire about any pre-existing health conditions that might require special precautions.
- Advise customers to remove occupants and animals from the product application site, particularly children and those with compromised health.
- When antimicrobials (biocides) are used, document all relevant biocide application details.
- Refrain from making statements or representations to the customer beyond those stated on the product label or in the efficacy claims made by the product and approved by the applicable government agency.
- Ask questions when in doubt. Consult the appropriate federal, state, provincial, or local governmental agency. In the United States, the Antimicrobial Division within the Office of Pesticide Programs of the USEPA, the respective state agricultural department, or other state agency with pesticide jurisdiction, should be consulted when there is a question about a specific antimicrobial (biocide) product, or its use and regulation.
- Clean treated surfaces of antimicrobial (biocide) residues as part of the remediation process.
- Apply products that have been tested and registered by appropriate governmental agencies.

13.4.4 Post Restoration/Remediation Verification

Where the following elevated risk factors are present, an IEP should be retained by one of the materially interested parties. An independent IEP should conduct required post-restoration or post-remediation verifications. Considerations can include, but are not limited to:

- occupants are high risk individuals; (refer to Chapter 3, *Health Effects from Indoor Exposure to Microbial Contamination in Water-Damaged Buildings*);
- a public health issue exists (e.g., elderly care or child care facility, public buildings, hospitals);
- a likelihood of adverse health effects on workers or occupants;
- occupants express a need to identify a suspected contaminant;
- contaminants are believed to have been aerosolized; or
- there is a need to determine that the water actually contains contamination.

13.5 Drying and Completion of the Restoration Process (Category 1 and Post Remediation Category 2 and 3)

13.5.1 Controlling Spread of Water

Excess water should be absorbed, drained, pumped or vacuum-extracted. Excess water removal may be required on multiple levels, in basements, crawlspaces, stairwells, interstitial spaces, HVAC systems, utility chases, or elevator shafts. Repeatedly extracting materials and components may be required as water seeps out of inaccessible areas, especially in multi-story water restoration projects.

13.5.2 Controlling Humidity

Humidity within the structure should be controlled as soon as practical, just as steps are taken to control the spread of water. While a spike in the humidity is not uncommon at the outset of a drying project, if it persists beyond the first day, this can indicate an adjustment is necessary (e.g., additional ventilation, dehumidification equipment). Ventilating the structure during the initial stages of processing may be an effective way to reduce the build-up of excess humidity.

13.5.3 Controlled Demolition, as Necessary, to Accelerate Drying

It is recommended that consideration be given to whether demolishing and removing structural materials is appropriate in setting up the drying system. Materials that are unrestorable or that pose a safety hazard should be removed as soon as practical.

Controlled demolition should be done safely and removed materials should be disposed of properly. In some jurisdictions, firms performing demolition or other work practices may require licensing. If lead or asbestos-containing material (ACM) or presumed asbestos-containing material (PACM) are encountered, restorers shall comply with federal, state, provincial, and local laws and regulations regarding material inspection, handling, and disposal. See Chapter 8, *Safety and Health*.

13.5.4 Final Extraction Process

Multiple extractions of salvageable materials often are required to decrease drying time, especially for porous materials, such as carpet and cushion. Excess water that may have been inaccessible during the initial extraction process often seeps out of systems or assemblies into locations or materials where it can be extracted later.

Extracted water shall be disposed of in accordance with applicable laws and regulations. Normally this means disposal into a sanitary sewer system or, especially where HAZMAT may be involved, at an appropriately licensed disposal facility.

13.5.5 Determining and Implementing the Appropriate Drying System

13.5.5.1 Using Outside Air in the Drying Process

When considering the use of outside air in the drying process, restorers should determine if the outside environment is favorable to their drying effort or can be used as a means of quickly reducing the humidity levels in the space temporarily. The decision on the approach to use is generally based on:

- prevailing weather conditions anticipated over the course of the project;
- humidity levels inside the affected area that are present or can be maintained; and
- job logistics or other concerns (e.g., ability to maintain security, expected energy loss, owner preferences, potential outdoor pollutants).

The three system approaches are:

13.5.5.1.1 Open Drying System

An open drying system introduces outdoor air without mechanical dehumidification to reduce indoor humidity or remove evaporated water vapor. This ventilation can be beneficial when outdoor humidity is significantly lower than indoor humidity, especially at the very beginning of the job. If indoor humidity level increases, (1) a greater rate of exchange may help; (2) supplemental dehumidification can be installed, converting to a combination drying system; or (3) the outdoor air exchange can be stopped, converting to a closed drying system.

13.5.5.1.2 Closed Drying System

Closed drying systems are commonly used as they provide the greatest amount of control over the drying environment and the best protection from varying outdoor conditions while preserving building security. Restorers should isolate the building or affected area from the outside, and install dehumidification equipment. When appropriate, the existing building's HVAC system can provide some dehumidification, though in many cases, it is not sufficient to achieve optimum conditions for restorative drying. A closed drying system is recommended when outdoor humidity levels (i.e., humidity ratio) are not significantly lower than indoor. A closed drying system is also employed when building security, changing weather patterns, energy loss, outdoor pollutants, available ventilation, or other issues cannot be overcome.

13.5.5.1.3 Combination Drying System

A third approach is to use a combination of the above, especially at the beginning of a project when indoor humidity levels are at their highest. Restorers may consider ventilating the moist air to the outside while bringing in the drier air. This is often done at the time debris removal, extraction, and initial cleaning are performed, since security is not typically an issue during the early stage of a project while restorer is actively working onsite. Once closed up, drying equipment can then be used to create the conditions needed.

Restorers may also consider a continuous use of outdoor air while dehumidification systems are deployed, when conditions are appropriate.

Air exchange and heat-drying equipment may be used in conjunction with dehumidification to provide dry, warm air to a space while maintaining security and filtering the incoming air. This combination should be considered when the use of an air exchange and heat system alone is insufficient to maintain proper drying conditions.

Depressurizing the workspace can lower the humidity ratio by drawing in drier, outdoor air. Excessive depressurization or the improper placement of air moving equipment (e.g., airmovers, AFDs) within a structure can create safety hazards by potentially causing backdrafting of combustion appliances such as water heaters or furnaces, and thereby create possible carbon monoxide hazards or contamination problems by pulling contaminants into the structure from crawlspaces or other areas.

13.5.5.2 Using the Installed HVAC System as a Drying Resource

Restorers can use the installed HVAC system as a resource; provided contaminants will not be spread or the drying effort will not be negatively impacted. The HVAC system can add energy or remove it from the environment being dried. Although HVAC systems can help restorers gain control of ambient humidity, they generally do not create the conditions necessary for drying of the building and contents. In addition, they may not be able to control ambient humidity quickly enough to prevent secondary damage.

13.5.6 Controlling Airflow, Humidity, and Temperature to Promote Drying

Restorers should control airflow (i.e., volume, velocity), humidity (i.e., dehumidification, ventilation) and temperature (i.e., vapor pressure differential) to work towards the drying goals. These conditions should be managed throughout the drying process.

13.5.6.1 Controlling Airflow

Airmovers should be set up to provide continuous airflow across all affected wet surfaces (e.g., floors, walls, ceilings, framing). In order to achieve this, it is recommended that restorers position airmovers to:

- ensure adequate circulation of air throughout the drying environment,
- direct airflow across the affected open areas of the room,
- account for obstructions (e.g., furniture, fixtures, equipment and structural components), if their presence prevents sensible airflow across the affected surfaces,
- deliver air along the lower portion of the affected wet wall and edge of floor,
- point in the same direction with the outlet almost touching the wall, and
- deliver air at an angle (e.g., 5-45°) along the entire length of affected walls.

Upon initiating the restorative drying effort, restorers should install one airmover in each affected room. In addition, add one airmover:

- for every 50-70 SF of affected wet floor in each room (to address floors and lower wall surfaces up to approximately 2 feet),
- for every 100-150 SF of affected wet ceiling and wall areas above approximately 2 feet, and
- for each wall inset and offset greater than 18 inches.

Within the ranges stated above, the quantity of airmovers needed can vary between projects depending upon the build out density, obstructions to airflow, and amount and type of wet affected materials.

In circumstances where water migration has primarily affected lower wall sections and limited flooring (e.g., less than 2 feet of migration out into the room or area), restorers should install a total of one airmover for each 14 affected linear foot of wall. This calculation is independent of the above SF calculation, and is not meant to be used in the same room or area.

When a calculation for a room or space results in a fraction, the indicated number of airmovers should be rounded up. In small rooms (e.g., closets, pantries under approximately 25 SF) a single airmover may be adequate, especially if upper walls and ceilings are not affected.

In Class 4 intrusions involving significant water absorption into low evaporation materials and assemblies, once surface water has been evaporated, vapor pressure differential should be increased (e.g., increase temperature of wet materials; reduce humidity of the surrounding air; or a combination of both). In these circumstances, it can be beneficial to decrease the velocity of airflow

After the initial installation, restorers should inspect and make appropriate adjustments (e.g., increase, decrease, reposition) to the number, type and placement of airmovers based on materials' moisture readings. The first of these inspections to monitor and make adjustments should be performed no later than the day following the initiation of restorative drying. The frequency of subsequent monitoring should be daily until drying goals have been met, but may be adjusted by the agreed scope of work, potential for secondary damage, job site accessibility, or by agreement between the materially interested parties.

13.5.6.2 Controlling Humidity and Determining Initial Dehumidification Capacity

When a closed drying system using mechanical dehumidification equipment is planned, restorers should establish an initial dehumidification capacity. Initial dehumidification capacity refers to the amount of humidity control needed for the estimated evaporation load, and may be modified at any point after setup based on psychrometric readings. The restorer should document factors considered to determine the initial dehumidification capacity. Considerations may include but are not limited to:

- types of building materials, assembly and build-out characteristics
- class and size of the affected area
- prevailing weather conditions over the course of the drying effort
- power available on the project
- type and size of drying equipment available

Two examples of calculation methods to determine initial dehumidification capacity can be found in the Reference Guide (refer to Chapter 13, *Structural Restoration).* Following the implementation of an initial calculation, the restorer should consider other factors that may require adjustments. This information may include but is not limited to:

- an imposed deadline to complete the drying process
- power is known to be less than adequate to serve the indicated inventory of equipment
- the building will be occupied during the drying process; potentially causing equipment cut-off, frequent opening of doors, higher moisture load

- an unusual schedule within which the restorer must work (e.g., retail store that wants to remain open each day)
- required pressure differential to achieve contaminant control

After the initial installation, appropriate adjustments (e.g., increase, decrease, reposition) in dehumidification equipment capacity should be made based on psychrometric readings. In Class 4 intrusions involving significant water absorption into low evaporation materials and assemblies, it can be beneficial once surface water has evaporated to reduce airflow velocity across the surfaces and the vapor pressure differential should be increased (e.g., increase temperature of wet materials; reduce humidity of the surrounding air; or a combination of both). Refer to Chapter 5, *Psychrometry and Drying Technology* for more information on falling drying rate stage adjustments.

13.5.6.3 Controlling Temperature to Accelerate Evaporation

The temperature within a work area, and the temperature of wet materials themselves, also impacts the rate of evaporation significantly. Increasing the temperature of wet materials can be accomplished by using the sensible (thermal) energy gained by airmovers, dehumidification, or heating equipment. The greater the temperature of wet materials, the more energy is available for evaporation to occur.

Restorers should consider the impact of high temperatures on building components and contents. Manufacturer's instructions and safety precautions shall be followed to reduce the potential for fire hazards and occupant safety issues. Restorers should be familiar with drying equipment and how ambient temperatures affect their performance.

After the initial installation, appropriate adjustments (e.g., increase, decrease, reposition) in heat producing equipment should be made based on subsequent monitoring readings. When drying low evaporation materials, once surface water has evaporated, it can be beneficial to reduce velocity of airflow across the surfaces and the vapor pressure differential should be increased (e.g., increase temperature of wet materials; reduce humidity of the surrounding air; or a combination of both). Refer to Chapter 5, *Psychrometry and Drying Technology* for more information on falling drying rate stage adjustments.

13.5.7 On-going Inspections and Monitoring

Normally, psychrometric conditions and MC measurements should be recorded at least daily. Relevant moisture measurements normally include: temperature and relative humidity outside and in affected and unaffected areas, and at dehumidifier outlets. Also, the moisture content of materials should be taken and recorded. Because differences in calibration occur from one instrument to another, restorers should use the same meter throughout a project or establish an in-house method to verify that the meters used are within a reasonable tolerance of each other. It is recommended that the restorer record readings at the same locations until drying goals have been met and documented. On each visit, if monitoring does not confirm satisfactory drying, restorers should adjust the drying plan and equipment placement, or possibly add or change equipment to increase drying capability.

13.5.8 Verifying Drying Goals

Restorers should use appropriate moisture meters to measure and record the moisture content of specific structural materials and contents. Drying equipment should remain in operation on site until it has been verified and documented that the drying goals have been achieved in the materials being dried.

13.5.9 Post Restorative Drying Evaluation

Restorers should evaluate structural materials, assemblies, and contents that have been cleaned and dried to ensure pre-determined goals have been met. In some cases, items that have been dried may need additional services including cleaning, repair or additional appearance enhancement. In some circumstances, structural materials, assemblies, and contents cannot be successfully restored and replacement or reconstruction is necessary despite a restorer's effort to salvage the items.

13.5.10 Reconstruction/Repair

After completing thorough drying and other procedures discussed above, qualified and properly licensed persons should perform authorized and necessary structural repairs, reconstruction or cleaning.

13.5.11 Final Cleaning

Throughout the restoration and reconstruction process, foot traffic and settling of aerosolized particles results in the accumulation of soils on surfaces. As necessary, surfaces should be cleaned following reconstruction using appropriate methods.

13.5.12 Contents Move-back

The final step in the restoration process is usually returning contents to their proper location in the structure; see Chapter 15, *Contents Evaluation and Restoration*.

14 Heating, Ventilating and Air Conditioning (HVAC) Restoration

14.1 The Relationship between a Building and Its HVAC System

Heating, Ventilating and Air-Conditioning (HVAC) systems, when directly contacted by water, can cease to operate, or they can function inefficiently or spread excess humidity throughout both affected and unaffected areas of a structure. If contacted directly by Category 2 or 3 water, they can spread contamination to unaffected areas. Even if an HVAC system is not directly contacted by water, when operating, it can spread humidity or contamination from affected to unaffected areas. Further, microbial growth from other causes can be carried to the interior of HVAC system components where it can accumulate and degrade HVAC component operation.

In addition, HVAC systems can have a major impact on controlling the conditions that lead to secondary damage. The design, installation, operation, and maintenance of HVAC systems can be important factors in controlling microbial growth and dissemination. This can lead to the spread of contamination by the system and increase the scope of the microbial problem by dispersing contaminants throughout a building.

Types of HVAC systems include residential, commercial, and industrial. In a typical system, the fan or blower circulates air from occupied space through the air filter, return grills, return ducting, heating or cooling coils, and through the supply ducting into occupied space. The system's mechanical components can be located in various areas of the occupied space, outdoors, or in other locations. Residential systems vary in configuration and type from one part of North America to another; however, within each region HVAC systems are generally similar in design.

Contaminated HVAC systems should not be used for dehumidification purposes during water damage restoration. The restorer shall comply with any applicable laws or regulations prior to servicing an HVAC system.

In addition to the HVAC system, it is useful to understand other mechanical systems in a building, including: plumbing; gas appliances; chimneys; fireplaces; air-exchange systems; vents in kitchens and baths; clothes dryer vents; recessed light fixtures and central vacuums. These systems can create varying pressure differentials (i.e., positive, negative, neutral); which should be considered during restoration projects. For more information on the environment's impact on the HVAC system, see Section 13.5.6.1.3.