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We encourage you to approach each lesson with curiosity and enthusiasm as you pave your way

Chapter

8

Rehabilitation and Renovation of Older Buildings

Working in urban areas often exposes the project superintendent to construction projects involving the rehabilitation of older, often previously abandoned buildings. The recycling of a building often results in creating an upscale office building from a derelict waterfront warehouse or saving an historical structure from the wrecking ball.

These types of projects can result in either a rewarding experience or a frustrating, painful, and costly one. And rehab and renovation projects have their own idiosyncrasies and require an entirely new way of looking at how the work is to be administered. Often new drawings for these types of projects are prepared without the benefit of a partial or complete set of the original building's plans. The building in question may have been constructed decades ago and changed hands several times over the years with many unrecorded improvements or changes made to the property. The original drawings may have been misplaced or destroyed, and "as built" drawings are rare.

Architects hired by the owners of the property to prepare drawings for the current building's function may be limited in their ability to perform a thorough investigation of the standing structure by time, monetary restrictions, or lack of experience in similar projects. Trying to determine the skeleton of some older buildings without removal of substantial portions of wall, ceiling, and floor finishes is a very difficult, time consuming, and costly proposition. But without exposing the existing structural system, it will be difficult to determine how new building components and finishes can be installed with any degree of accuracy.

Recently, some architects, via the use of digital camera technology, are including photographs in their bid documents to alert bidders to key existing conditions or to further augment specific instructions or directions contained in those documents. Figures 8-1 and 8-2 are examples of digital photographs included in the

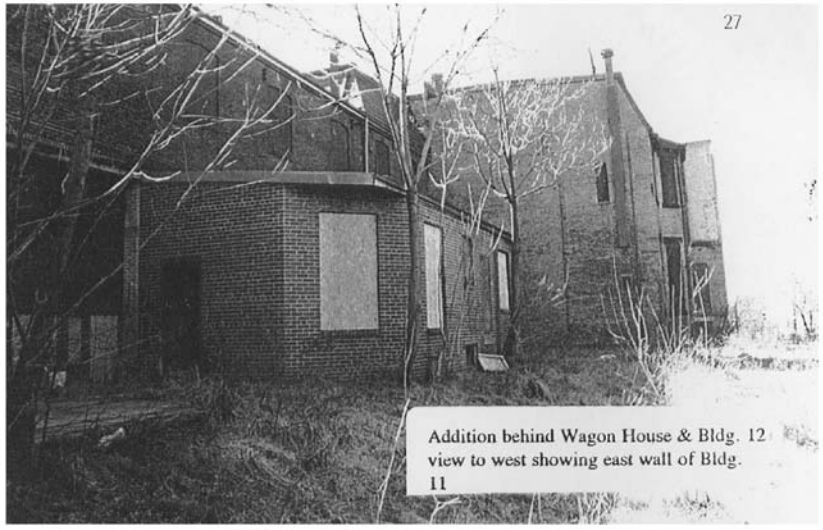

Figure 8-1 Bid document photos of existing conditions.

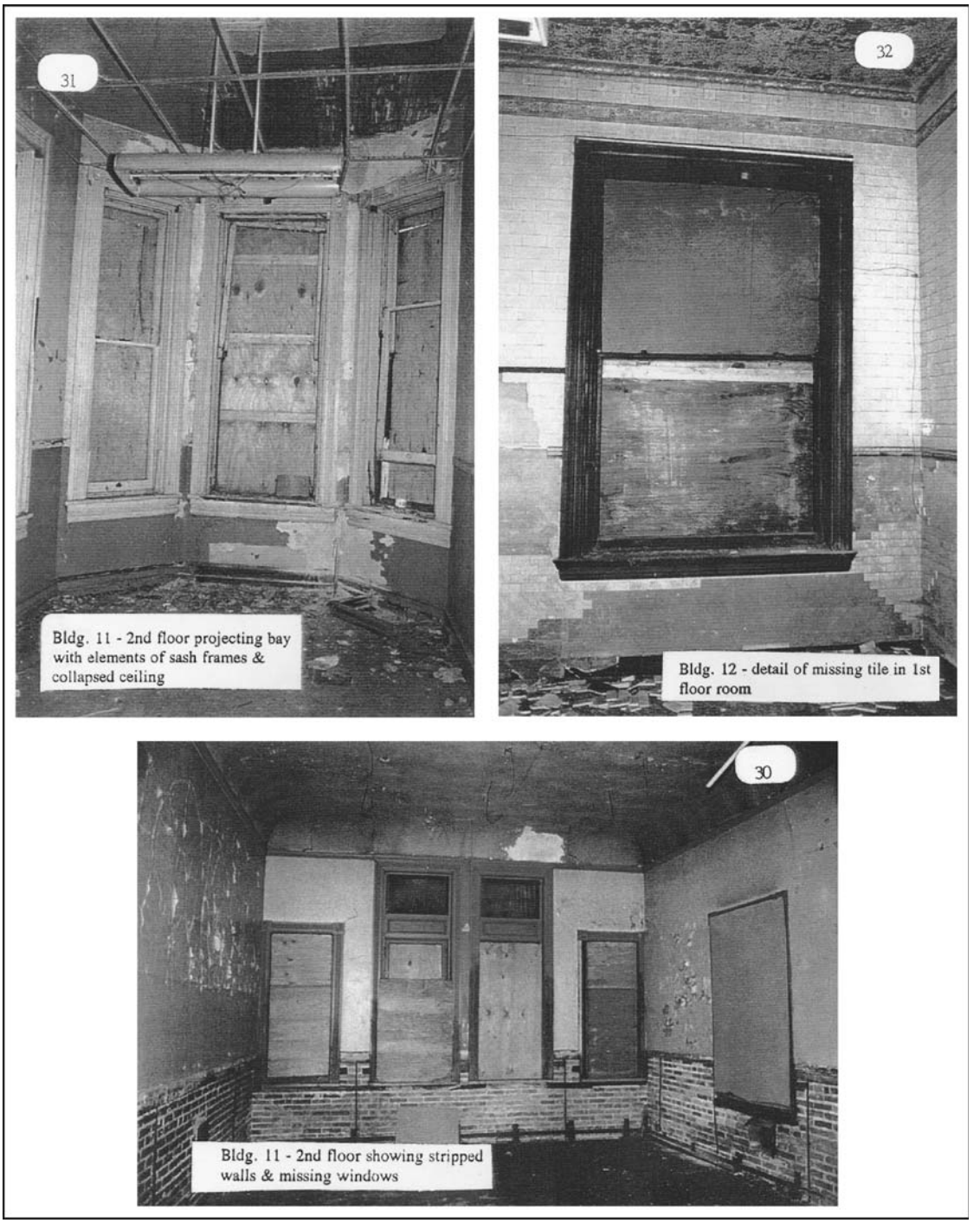

Figure 8-2 Other bid document photos of existing conditions.

bid documents of a rehab project where a local defunct brewery complex was to be converted to subsidized housing.

There are two basic types of rehabilitation projects and numerous shades of gray in between. At one end of the spectrum will be found the "gut" or total rehab project, where demolition work will remove all interior finishes back to the structural system, including removal of all existing electrical, mechanical, and plumbing systems.

The other end of the rehab spectrum is the partial rehabilitation project, where more of the finishes will be left intact and patched or repaired as required. This type of renovation or rehab work is more prevalent in projects of historical value or where important architectural features of the older building are to be retained and refurbished. Sound wood flooring, interior partitions, and ceilings may be left intact to be patched and refinished. In many instances exterior walls, ornamental cornices, and stonework and intricate carvings are to be repaired, some being used as molds for newly fabricated pieces to replace missing ones.

The reuse of existing systems and building components is limited only by building codes, life and safety issues, and financial and design considerations. In fact, some of the old building's dormant or abandoned manufacturing equipment may be refurbished in place, to add charm and character to the new structure.

More, rather than scant, investigation of an existing structure is crucial to the proper design and dimensioning of the new architectural and mechanical layouts. Often the structural system in an old building is found to differ materially from its assumed design, and if that is the case, the potential for significant dimensional differences in architectural, mechanical, and electrical drawings will present problems for the owner, designer, and contractor.

Before That Wrecking Ball Arrives

If a significant amount of demolition is required to remove old finishes or even parts of the structure, a thorough and complete review of the drawings must be undertaken to fully comprehend the extent of demolition—what is to remain and what is to be removed—and whether the initial scope of work is clearly represented by the contract plans and specifications.

After a comprehensive review of the drawings that includes making mental and written notes of questionable items, it will be very beneficial to take a slow walk through the building with drawings in hand (preferably a reduced set) and a flashlight to check on the following:

1. Check various elements of demolition indicated on the drawings, existing surfaces to remain, and the quality of the structure. If any portion of the demolition scope of work is unclear or inconsistent, the architect should be contacted immediately for clarification and possibly requested to visit the site to walk through the building as questions are asked and answers received. Any such walk-through should be followed up with a comprehensive list of items discussed, resolved, or open to further resolution. If a list like this is

not going to be prepared by the architect, it is important that one be written by the contractor and sent to the architect for "review and comment."

2. What is involved in removing existing finishes from walls, ceilings, and other parts of the structure, as required by the contract documents? Will these finishes be easy or difficult to remove, and will the extent of removal required be achievable? Will more or fewer areas require removal due to the presence or absence of existing sound finishes?
3. Can any existing utilities be used during construction for temporary light, heat, or power, or will all new temporary utilities have to be provided? And will it take only a phone call to the local utility company to reactivate an existing service, or will a new service have to be installed from some distant point?
4. Determine whether that which is indicated on the drawings to exist does, in fact, *exist* and that which is *not* supposed to exist *does not* exist.
5. Do the contract documents correctly indicate the accurate composition of the items designated to be removed? That is, do the drawings indicate that a steel stud and drywall partition is to be removed, for example, when, in fact, the partition in question is plaster on wood lath on rough wood framing members or even possibly terra cotta block?
6. A note should be made of the condition of a surface, subsurface, or area to be refinished or to be retained. Will it be possible to apply a new finish over the existing surface as is, or will it be possible to laminate gypsum board over the existing surface, if that is what the drawings indicate?
7. Do any of the items or materials removed have any appreciable salvage or scrap value? If some items are labeled "remains property of owner and is to be removed and stored at (location)," this should also be noted and all appropriate subcontractors reminded of their obligation to remove for storage by whichever party is assigned that responsibility. In some historical buildings this is not an inconsequential item.

   An October 13, 1998, *Washington Post* article reported on the construction contract for the restoration of the Washington Monument. The contractor, by contract, was required, among other items of work, to remove and replace several damaged marble stones that formed the exterior of the Monument, including one 1200-pound slab. The contractor, by virtue of the contract language, claimed ownership and removal of all debris generated in the restoration process, including any damaged materials slated for replacement. The one 1200-pound slab removed from this historic building, cut into 1- or 2-inch squares and sold as a memento or collector's item, would reap a tidy sum. As one can see from this example, in many instances it will be important to determine ownership of debris before demolition commences.
8. Approximately how long will it take to demolish enough of the building components so that the new work can start? This kind of information will be invaluable during the preparation of the initial, or baseline, construction schedule.

9. Does there appear to be any hazardous material in the building—asbestos, old transformers or light fixtures that could contain PCBs, or peculiar odors that could portend environmental problems? Although most contracts hold the contractor harmless from dealing with such materials if the owner is unaware of their existence, hazardous materials require the services of a remediation contractor for removal, and this could seriously impact the contractor's construction schedule.

   Knowledge of the types of businesses of previous tenants or owners can be useful in determining the potential for hazardous materials being discovered at the project. But quite often this information is either not known or not made known. The writer, working on an inner-city project where demolition had been performed by the city agency involved in the development of the area, was provided documentation from the designers of the new project which spelled out all known "existing" below-grade obstructions. While excavating in one corner of the razed site at about 3:00 p.m. on a Friday evening, the big Komatsu excavator pulled the top off a 2000-gallon grease interceptor that was not shown on the contract drawings. Not only the top was torn off, but also the sides of this cement structure were split open, allowing some 2000 gallons of foul-smelling, congealed grease to ooze into the adjacent excavations. Some frantic telephone calls were made to get a tank truck to the site on a late Friday to pump out this sludge and cover over the remains, until final cleanup could be completed on Monday morning. This type of work is never without its surprises.

On-Site Inspection Tips

During this inspection, be on the lookout for areas in the building where water may have been infiltrating—through the roof, walls, and basement. If that has occurred, an inspection of the exterior walls may reveal missing or loose mortar joints, caulking joints that have failed, cracks in the exterior wall system, structural or otherwise, loose or missing flashings, or spalled masonry or concrete surfaces. Review the contract documents carefully to determine whether the contractor is required to repair any such items. Obscure notes placed strategically on drawings for new work take on added importance in rehab or renovation projects. The notes may contain detailed directions for various types of demolition work, instructions for preserving existing finishes, or directions on how to proceed if a whole host of unknowns arise. General notes, often skipped over as boilerplate on other types of construction projects, should be scrutinized carefully for rehab or renovation projects.

Look carefully at the interior surfaces of the building to see if there are any water stains, old or new. Are there rotted materials in the building that will need to be replaced, and if so, whose responsibility is it to do so? Can this be claimed as an extra to the contract? Review the drawings very carefully, and look for obscure notes that may direct the contractor to *include, exclude, leave as is, replace entirely, remove back to sound surfaces,* and so forth.

Although these conditions might not be specifically included in the contract scope of work, they might be required by the exculpatory language in the special, general, or supplementary conditions on the plans or in the specifications. Therefore these sections of the specifications book ought to be read, and important sections highlighted for quick future reference, if needed.

Cutting and Patching

Another item that should be thoroughly investigated while walking through the site in the early stages involves how much and what kind of cutting and patching will be required. If all-new mechanical and electrical systems are going to be installed and the building is multistoried, the cutting and patching may require large openings or chases for these systems. These openings and chases may require some sophisticated structural supports along with fire-safe penetrations and rated enclosures once installed.

Penetrations through thick stone or old concrete walls and foundations can be quite costly. Cutting through masonry partitions or walls so that new openings can be prepared for doors and windows will also be expensive, often requiring temporary shoring. If unsound finishes are disturbed when these penetrations are made, large chunks of lath or plaster could very well fall off the existing wall or ceiling being penetrated, and the contractor may be obliged to restore those surfaces. Generally this is done at no additional cost to the owner, unless a fully documented claim including photographs of conditions before, during, and after these operations can be presented to the owner along with a logical explanation of a request for scope increase.

Discuss these types of issues with the project manager prior to the award of major subcontracts so that some responsibility and related costs are properly assigned to the various specialty contractors performing work involving cutting and patching. It may be more economical for the general contractor to assume all the risks associated with these cutting and patching operations by performing this work himself or herself. When subcontractors prepare the estimate for work such as this, they invariably include a contingency in case unforeseen conditions are encountered. If the entire dollar amount of the contingency is not absorbed (and it is generally so liberal that it is most often not used completely), the total costs when this type of work is performed by the general contractor should be less than the subcontractor's quote.

Prior to the Start of Demolition

Some demolition crews are like the proverbial bull in the china shop. They come on the job prepared to race through their work, sledge hammers and pry bars in hand, frequently without a full understanding of the scope of their work. Often they are required to work in a dimly lighted building, making it difficult to read the drawings that they brought with them. Prior to the start of work, review any demolition drawings carefully, and read *all notes* on the architectural, structural, mechanical, and electrical drawings for both existing conditions and new work.

Often there will be small notes in out-of-the-way places on drawings, such as "If any item is shown on the existing drawings and does not appear on the new work drawings, it shall remain or be relocated as shown." This statement means that if some electrical work, for instance, is to remain, it must be identified so that it is not removed by the demolition crews. The same would hold true for architectural and mechanical items.

Fluorescent spray paint is useful in denoting all items scheduled for removal or demolition. If that procedure is followed, all crews must be made aware that anything *not* marked with bright paint is to *remain.* But make certain that there is no confusion among demolition crews about what spray-painted surfaces mean. There may be a misunderstanding between one contractor's concept of items to remain and what is to be removed; so when this work is being subcontracted, inform the subcontractor's foreman accordingly.

The Preconstruction Survey

But even before any demolition takes place, the building should be closely inspected to expose any significant or suspicious cracks, either structural or aesthetic, that existed prior to start of construction. This inspection is best performed and documented in the presence of the architect, and lots of photographs should be taken to establish the condition of the building prior to start of any work. Only when questions arise later on concerning the condition of an existing wall, floor, or finish will the project superintendent say, "I wish I had taken photos of that wall, floor, shaft, etc., before we started work in that area."

Particular attention should be paid to exterior wall surfaces that may have developed cracks or may have deteriorated from age, freeze-thaw cycles, or possibly minor structural failures over the years. Any significant areas that have cracked, spalled, or deteriorated should be identified and reported to the architect by letter as soon as these conditions are discovered, so there is no misunderstanding later as to when these cracks or failures occurred. Once again, take photographs to document the condition.

This *preconstruction survey* is often conducted not only on the building in question, but also on any nearby or adjacent structures, particularly if any heavy equipment or extensive demolition will be employed in close proximity to those buildings where excessive vibration could cause damage. It is not unheard of for occupants or owners of the building next door claim that some damage to their property was caused by excessive vibration or shock arising out of the demolition activities in the building under construction, but the "damage" they report had existed for months or years before construction actually started. These types of claims should be resolved as they arise and not left for resolution later on. A close inspection of the "damage," if on the exterior, may reveal mold or moss growing in the "new crack," indicating that this condition existed long before any construction began. Close inspection of interior "damage" may also show signs that the cracks or loose plaster were existing and not new as alleged. Documentation by high-resolution photographs may

prove to be invaluable. Be sure to orient the photographs so that their exact location can be pinpointed at a later date, if necessary.

Interior Demolition Tips

When plaster walls and/or ceilings are to remain, tap the surfaces to determine whether these surfaces are sound. Any investigation revealing loose plaster should be reported to the architect, because the surface might loosen further or might fall off completely while demolition is taking place in adjacent areas. Before you send a letter to the architect, scan the drawing carefully to determine whether there are instructions for dealing with situations like this, such as a note stating, "When a portion of an existing surface is to be removed, but adjacent surfaces are not sound, those removals must extend to sound surfaces." These types of instructions often appear in out-of-the-way places on the drawings. Make certain that no such instruction exists before firing off that letter to the architect.

However, even if such a restrictive clause exists, consider whether this condition would have been *apparent* during the prebid site inspection or whether this condition could have *reasonably* been assumed. Just because restrictive clauses do exist, don't preclude the possibility of claiming an extra if extensive additional work was required that could not have been *reasonably* anticipated.

When portions of exterior walls are to be demolished and the building is located in or near densely populated areas, a water source should be available to wet down portions of the building to be demolished. Reducing dust problems before neighbors complain will create good public relations and possibly avoid future problems.

Fire extinguishers should be available in areas where open-flame torches are used to cut metals inside the building. Remember that fires can smolder for hours undetected in walls behind areas that have been exposed to open flame; therefore, a fire watch should be established when such cutting takes place.

Safety Concerns

Safety hazards abound in rehabilitation work. In addition to the obvious dangers from falling debris during demolition, there are many other areas in which accidents can occur. Floor openings created during demolition should be either secured by covering with temporary plates or barricaded. Air compressor hoses and electric power cables snake through the demolition area like spaghetti and can easily become tripping hazards. Other tripping hazards are created by failure to cut off protruding pipes, conduits, or other projections flush with the floor level when these types of removals are taking place. Water used in conjunction with cutting tools or dust control can also create slippery floors.

Cutting through active electric cables is always a danger, especially when some panels must remain active to provide temporary lighting and power for tools. And in older buildings not all lines are easily traceable to their respective panels, so they can be deactivated. Always err on the side of safety. If you are unsure whether an electric cable is alive or dead, assume it is active until the electrician determines otherwise.

The tendency to allow debris to accumulate before removal can also be the cause of many accidents. Boards ripped off walls or floors may have exposed nails, and these nails should be either removed or bent over to prevent injury to feet or hands. Prior to the start of demolition it is a good practice to assemble all workers and their supervisors and to conduct a safety meeting, pointing out the dangers inherent in rehab and renovation work and stressing the fact that proper procedures must be followed. At this safety meeting the use of appropriate personal safety equipment is stressed. The use of hard hats, safety goggles, and ear protection, when necessary, will be enforced, and the penalties for failure to comply should be firmly established—and enforced. The use of proper footwear is also important; thin sole shoes, sneakers, running shoes, or work shoes, without safety toes are strictly forbidden.

Shirts of synthetic fiber are not to be worn by anyone using open flames or cutting torches since these materials have a tendency to continue to burn and melt when ignited. Cotton shirts, if set afire by sparks, tend to extinguish themselves rather rapidly.

A "get tough" safety policy ought to be initiated and strictly enforced. Violators must be directed to leave the work area immediately if they lack the proper personnel protection equipment and must not be allowed to return to work until they are in full compliance with the safety program.

Problem Areas during Construction

In the early stages of the demolition process, the job will require a great deal of close supervisory attention. Questions concerning what stays and what is to be demolished will arise hourly and daily, even though the areas to be demolished have been spray-painted. Questions will arise when conditions different from those specified in the contract documents are discovered and immediate resolution is required to maintain job progress.

When partial electrical and/or mechanical systems are to remain in the building and portions of each type are to be removed, demolition can be accomplished in one of two ways. The mechanical or electrical contractor can disconnect the conduit and cable or piece of equipment, so that the demolition contractor or general contractor can complete the removal; or the mechanical or electrical contractors can perform the entire removal process themselves. Since they will use a combination of mechanics and helpers, it may be more cost-effective to have the higher-paid mechanics make the disconnects only and leave the removal and disposal of the debris to laborers earning lower hourly rates.

Electric cables and conduits will probably be found where they are not supposed to be, and the electrical subcontractor should be readily available during the entire demolition process to deal with these unexpected events. This may be true of the plumbing contractor as well when some existing water lines are to remain active for fire and dust control or in the event that a gas line is discovered where none was indicated.

The problem with active versus inactive electrical conduits usually can't be resolved by disconnecting all electric lines in a rehabilitated building project. Electricity will be needed for power tools during demolition and will be required for temporary lighting; to disconnect *all* power would mean that another temporary service, independent of the existing one, has to be brought into the building. On the other hand, if the removals are complicated and safety is the key factor, another electrical service may be the best solution.

Existing Conditions—The Problem Area

Many project contract documents for these rehab and renovation projects will designate existing conditions or systems on a separate set of drawings frequently entitled "Existing Conditions" or some other words to that effect.

The portions of the building that are to remain will generally be shown on the applicable "new" architectural, structural, mechanical, and electrical drawings. To somewhat ease the supervisory burden on the project superintendent, the project manager should include a stipulation in the appropriate subcontract agreement that requires each subcontractor to monitor the work for that trade, especially those items that are required to remain and those that are scheduled for demolition. The appropriate subcontractor can tag, paint, or otherwise identify these items in some way that is easily recognizable. To carry out this responsibility, the subcontractor(s) may have to have a mechanic on the job to assist the demolition crew in identifying which items are which. No matter how well the work slated for removal is marked, invariably the demolition crew will have many questions throughout the entire process.

Verify the dimensions for new work. If a great deal of interior demolition is to take place, stop and check dimensions once demolition has progressed to the point where some new work layout can begin. Do the dimensions of the exposed areas agree with the dimensions on the contract drawings? Are they greater or smaller? If the mechanical and electrical drawings were based upon dimensions that are no longer valid, all drawings referring to new work must be carefully reviewed, and if major discrepancies are uncovered, the architect must be notified immediately, first verbally, then followed up by a written memo.

Too often the architect, in the early stages of design, either can't commit forces to conduct a thorough investigation of the existing structure or has not included a detailed investigation due to an owner's budget constraints. But absent such a complete and thorough investigation, which includes considerable poking around, how can the architect define and create the new space?

A Case Study of a Severe Dimensional Problem

The author once had an experience that vividly dramatizes this point. He was the project manager on a project involving the recycling of a late-1920s hotel into units for subsidized elderly housing. The old hotel was a cast-in-place concrete

structure, reportedly one of the oldest of its kind in New England. The building was 14 stories high with four step-backs in the structure and façade as the building progressed upward. The exterior walls were brick, and the interior walls were terra cotta with wood lath and plaster finishes. The ceilings on the underside of the concrete decks were plaster.

This project was a gut rehab, and all interior finishes were to be removed back to the concrete structure. All concrete slabs, columns, and beams were to be stripped of finishes. All existing mechanical and electrical systems were to be removed along with two huge coal-fired furnaces currently under 10 feet of water in the subbasement. The two old traction elevators were to be removed, and new elevators fitted into existing shafts. All windows were to be replaced with new insulated, glazed aluminum double-hung units. Apparently a set of original structural drawings existed, but the new owners of the building refused to purchase them from the previous owner who, assuming he had a good thing, was asking a fortune for them. Instead, the drawings prepared for the project were based on an *assumed* system of columns, beams, and slab thickness, and the dimensions of these structural components were determined by the design team by poking through plaster surfaces around selected beams and columns on only a few floors. Needless to say, many of the design assumptions arrived at by this cursory investigation proved to be wrong, but were only verified when the actual structural components had been fully exposed during the demolition process.

Demolition progressed from the basement up, with one crew, while another demolition crew worked from the penthouse elevator down. The plan of attack was to get to the basement and subbasement areas, pump out the boiler room, cut up and remove the old boilers, remove the coal chute, and in general clean out the entire area so that new equipment locations and piping layouts could commence as quickly as possible, allowing the appropriate long lead time for equipment to be ordered. In the meantime, demolition starting from the top down would allow room layouts to proceed and mechanical and electrical risers to be located. This, in turn, would permit concrete floors to be cored or saw-cut so that mechanical piping and duct risers could be plumbed down on a floor-to-floor basis.

After the three top floors had been stripped back to the structure, centerlines were established along the north-south and east-west building axes. From these centerlines, partition layouts in accordance with the dimensions shown on the architectural drawings began. The centerline of one floor was transferred to the floor below by coring a 2-inch hole in the slab and dropping a plumb bob on piano wire through this opening to the lower floor, thus marking the centerline on that lower floor.

Suddenly it became apparent that dimensions were just not adding up, and all kinds of dimensional discrepancies came to light. A thorough investigation of the three uppermost floors began by comparing actual dimensions with those shown on the architectural drawings. It appeared that, among other things, the structural columns and beams on the top three floors were smaller in section than those which had been exposed on the lower floors. This seemed logical since the

upper floors were carrying less dead load than the floor below. However, the architectural drawings did not reflect the dimensional differences in the structural beams and columns because, as it was later determined, the architectural team did not probe these upper-floor members when they made their initial, spotty investigation. All columns and beams on the new drawings, with just a few exceptions, were shown to be the same size. The actual size of the beams and columns, when stripped completely of their plaster coating, changed dimensionally every other floor.

Also, some structural columns in the exterior walls were found to be wider and deeper than the new drawings indicated. The mechanical drawings indicated hot water baseboard heat to be installed on the exterior walls, but did not take into account the space occupied by the columns that protruded into the room. The minimum square footage of each apartment had to be maintained in order to comply with the Department of Housing and Urban Development's (HUD's) minimum property standards, and these dimensions were very tight to begin with. It appeared that some of these structural columns would have to be notched at the base to allow the baseboard heat piping to be installed, in order to maintain minimum clear dimensions in the room. However, the structural engineer issued a directive *not* to notch the columns, and a chase wall had to be created, taking more valuable inches away from the bedroom areas, which were already dangerously close to the minimum size allowed by HUD.

And these exterior columns varied in size on every other floor, so that any new plans being developed had to be created for the seven apartment configurations on the floor, which in turn affected bathroom and kitchen dimensions and, of course, all mechanical and electrical riser sizes and locations.

Except for demolition, all other work stopped while a systematic review was made of each apartment on each floor by the project manager, project super, and the owner's entire design team. Subcontractors whose field experience would be called upon from time to time were also invited to join the group.

Most apartments had to be completely redesigned, and the uncovering of a number of junior beams, which were never indicated to exist in the structural system, added more problems since many were located directly above areas designated for mechanical and electrical risers and chases.

Drawings were revised on the spot and cost estimates for the changes hurriedly assembled for both architect's and owner's review and approval so work could start. The entire process was both time consuming and costly. Since there was a liquidated-damages clause in the construction contract, the documentation of all delays placed another burden on the project superintendent and project manager.

The job finally got back on track, but a lot of crisis management was involved in getting it there. The lesson to be learned is that when this type of construction is undertaken, time must be spent early on to check all dimensions and wall thicknesses for even such things as hollow metal door frames and replacement window sizes. If variances are discovered and there are conflicting dimensions, at least these disparities can be picked up and corrected at an early stage via shop drawings.

Varying Conditions

When conditions are at variance with the contract documents or differ substantially or materially from those normally encountered, the architect should be notified immediately with a written confirmation follow-up. For example, the contract drawings may have indicated that a specific wall is to be removed, and the wall was noted to be nonbearing; however, upon investigation during construction, the wall was determined to be a bearing wall requiring substantial structural modifications before it could be removed. The project superintendent, after alerting the architect, should request in writing that the structural engineer visit the site as soon as possible and should issue a sketch reflecting the necessary structural modifications. All costs for the modifications outlined in the engineer's directive need to be submitted for approval quickly; better yet, the project superintendent should request authorization to proceed with the work on a time-and-materials basis.

All such delays should be reported to the project manager and documented promptly. Remember, the delay clock starts ticking when the discrepancy is discovered and may not stop until the modification work has actually been completed.

When corrective action or changes are required due to field conditions, they can be reported quickly by phone; but they can be just as quickly documented by issuing a Request for Information (RFI) or Request for Clarification (RFC), or simply a memo by email or via fax.

If the architect's response is slow in coming and work must cease in the affected area, send another email or fax, notifying the receiver of this condition and its potential impact on job progress. But if authorization does not immediately flow, possibly because costs are being reviewed, request authorization to start the work and determine final costs based on the basis of a construction change directive concept in Article 7.3 of the General Conditions Document A201.

All parties need to work closely together in a rehabilitation project. The relationship that must be established with the design team and the owner is that of a team effort. And all subcontractors must also join the "team" to gain their full cooperation for what will doubtless be a daunting project.

Because of the vagaries almost always present in the contract documents when you are dealing with these kinds of projects, the project superintendent/project manager must clearly communicate with the designers this team concept and that the contractor is not embarking on a campaign to generate change orders. The sole purpose of these change orders is to assist the architect in thoroughly investigating the conditions of the existing structure and to help solve problems quickly and in the most cost-effective manner.

If there are extra-cost items of work to be undertaken, perhaps options to change other items of work and effect tradeoffs can be considered. Because of the nature of rehabilitation and renovation work and the problems that will inevitably arise, everyone must attack the problems as expeditiously, harmoniously, and equitably as possible.

The use of contingencies

Normally an owner will include a contingency sum in the estimate for the total project, in anticipation of encountering additional costs for conditions unknown or unanticipated. The owner may not wish to divulge the contingency, assuming that the general contractor may see this as an untapped source for change orders. If it is suspected that the owner, generally one who is dealing with the first construction project, has not included a contingency in the construction budget, the owner should be made aware of the need to create one because it will be needed. It is a rare rehab or renovation project that doesn't need additional funds to cover the cost of unanticipated problems and related costs. Depending upon the nature of the project, the contingency set aside by the owner should be at a minimum 5 percent of total construction costs or, better yet, 10 percent of the total cost of construction.

Water Leaks and Other Concerns

Prior to the installation of new drywall partitions in the rehab or renovation project, a walk around the exterior of the building and an inspection of the existing roof are in order. If the scope of the contract work does not include any exterior façade restoration work, the exterior should be inspected to determine whether any areas might have the potential for water infiltration. And even though a new roof is scheduled for completion at some future date, an inspection of the existing roof or skylight might point out some areas that need immediate attention and patching to temporarily keep out water.

Not only will any leaks that are prevented keep the new drywall work from becoming damaged, but also when new finishes are applied and new flooring work is started, the extra money spent making the building watertight will certainly pay off. Wet or moist conditions present prior to the application of any wall system, except perhaps concrete masonry unit (CMU) walls, may result in the growth of mold and mildew with their real or imagined concerns.

If any appreciable demolition work is to be performed requiring heavy equipment inside the building, the structural engineer should be contacted to determine whether shoring will be required under the areas where this equipment will be operating. If permission to proceed is granted, a letter must be received from the engineer stating the conditions under which certain types of equipment can be employed.

Job progress photographs have a special purpose in rehab and renovation projects: They can reflect the condition of various parts of the structure prior to the application of new finishes or new wall openings in progress or completed. When a photograph is used to show unusual or uneven surfaces, a method of measurement should be introduced into the photo; for example, a carpenter's ruler can be inserted to indicate the degree of variance or thickness of an existing surface. Other forms of documentation take on added importance in these types of projects. With the proper attention to detail and cooperation from subcontractors and consultants, the project superintendents can gain experience

while enjoying a great deal of satisfaction by knowing that they have kept the wrecker's ball away from a building worth keeping.

Encountering Hazardous Materials

Unless explicitly included, most construction contracts exclude the contractor from responsibility to deal with hazardous materials discovered during construction. AIA Document A201, General Conditions, 1997 edition, requires the contractor to notify the owner and architect when hazardous materials are found, and the contractor is to immediately cease work in the suspected area.

The discovery of hazardous materials may occur when least expected, and a project superintendent ought to have some working knowledge of some common hazardous materials most likely to be encountered.

The asbestos problem

Even with the government-mandated program in 1997 directing the abatement of asbestos in public schools, not all these materials were physically removed. Some were encapsulated behind nonhazardous materials, and others were enclosed in partitions or chases. Thus the potential for encountering asbestos in older schools during construction work today cannot be dismissed.

As late as 1981, one-half of all asbestos consumption in the United States derived from the manufacture of roofing felts, felt-backed sheet flooring and tiles, asbestos-cement pipe and fittings (*transite*), as well as being woven into some types of clothing. A survey conducted by the Environmental Protection Agency (EPA) some years ago revealed that 733,000 buildings in this country contained this hazardous material. According to the EPA, buildings constructed in the 1960s are most likely to have sprayed on or troweled on fireproofing materials containing asbestos. Older buildings are more likely to have asbestos pipe and boiler insulation.

Although the project superintendent may never encounter asbestos materials in any rehab or renovation project, the potential for meeting up with some form of this material cannot be dismissed. Therefore some background information may prove helpful.

Friable and nonfriable asbestos materials. Asbestos in building construction materials can take two forms: friable and nonfriable. *Friable* asbestos is the type that can be crumbled, pulverized, or turned into a powderlike substance by crushing in the hand. Pipe insulation is a common form of friable asbestos. *Nonfriable* asbestos consists of asbestos fibers and a bonding matrix whereby the fibers will not be disturbed or released into the air until the product is cut, sawed, drilled, or sanded. Examples of nonfriable asbestos are vinyl asbestos tile, which contains about 21 percent asbestos; roofing felts, which contain anywhere from 10 to 15 percent asbestos fibers; and siding shingles, which contain 12 to 14 percent asbestos.

When the presence of asbestos in older buildings is known, it is usually identified in the bid documents along with an environmental consultant report allowing the contractor enough information to prepare an estimate for its removal. Most contracts nowadays exclude hazardous materials from the contractor's responsibility, stating the precaution

> If asbestos, PCBs, other hazardous materials, are encountered on the site by the Contractor, the Contractor shall upon recognizing the condition, immediately stop work in the affected area and report the condition to the owner and architect in writing.

Other materials may resemble asbestos when viewed by the naked eye, but the presence of asbestos can only be confirmed by subjecting the sample to laboratory analysis. The spearlike fibers of the material can be positively identified under an optical microscope. In fact one study criticized the method of establishing fiber count solely by optical microscope inspection because that instrument picks up fibers larger than 0.2 micrometer, whereas potentially dangerous fibers can be as small as 0.02 micrometer. The latter are detected only by using an electron microscope.

Once it has been determined that asbestos is present, the material can be removed, encapsulated, or enclosed. Encapsulation can be accomplished by coating the asbestos with a bonding-type sealant that will penetrate and harden. The asbestos can also be covered with a protective material, which is placed over it, sealed over, and seamed around all edges. Enclosing asbestos involves constructing an airtight enclosure around all surfaces that contain asbestos. The enclosures are to be built of an impact-resistant material, and signs are required to be placed on the exterior of the enclosure, warning that asbestos is contained therein.

When removal of asbestos-bearing materials is to take place, environmental remediation firms contracted to perform the work will be required to file documents with local, state, or federal agencies prior to removal. The EPA regulates the removal and/or disposal of asbestos-bearing materials, and the Department of Labor's OSHA division has regulations on restrictions of worker exposure to the material; so both agencies will become involved in any removal process.

Lead-based paint

Prior to World War II, lead was a common ingredient in exterior and interior paints, adding luster, longevity, and durability to the product. Before 1940, according to a study by the Department of Housing and Urban Development (HUD), 18.9 million residences contained lead paint; and during the period from 1960 to 1979, this total increased to 22 million homes. Figure 8-3 lists the percentage of lead-based paints by year and application.

With the advent of fast-drying and durable latex, alkyd, and acrylic-based paints, coupled with the federal government's enactment of a law in the mid-1970s mandating the content of lead in paint to be reduced to 0.06 percent, lead-based paints faded out of the picture. Most of the structures still containing lead paint today can be found in older inner-city commercial structures

Component Category	Interior	Exterior
Walls/Ceiling/Floor		
1960–1979	5	28
1940–1959	15	45
Before 1940	11	80
Metal Components[1]		
1960–1979	2	4
1940–1959	6	8
Before 1940	3	13
Nonmetal Components[2]		
1960–1979	4	15
1940–1959	9	39
Before 1940	47	78
Shelves/Others[3]		
1960–1979	0	—
1940–1959	7	—
Before 1940	68	—
Porches/Others[4]		
1960–1979	—	2
1940–1959	—	19
Before 1940	—	13

[1] Includes metal trim, window sills, molding, air/heat vents, radiators, soffit and fascia, columns, and railings.

[2] Includes nonmetal trim, window sills, molding, doors, air/heat vents, soffit and fascia, columns, and railings.

[3] Includes shelves, cabinets, fireplace, and closets of both metal and nonmetal.

[4] Includes porches, balconies, and stairs of both metal and nonmetal.

Figure 8-3 Percentage of lead-based paint by year and application.

and residential areas. Cases of brain-damaged children who had eaten flaking lead-based paints have been well documented and are testimony to one of the dangers created by this material. Cumulative exposure to lead damages the brain, blood, nervous system, kidneys, bones, heart, and reproductive systems and contributes to high blood pressure.

Because of its widespread use decades ago, older buildings being rehabilitated or renovated might well have been painted with lead-based paints. And in some cases the original lead-based paint is covered over by multiple coats of nontoxic paint, thereby hiding the real culprit. Being alert to the potential for uncovering lead-based paints will be another of the project superintendent's responsibilities when working in a rehab or renovation environment.

Vacuum blasting to remove lead paint. Various removal options are being offered by certified lead abatement contractors, as outlined in Fig. 8-4. The system of vacuum blasting is widely used on exterior metal surfaces. Use on masonry may require a test panel or two to determine whether this abrasive method of paint removal will erode too much of the surface of the masonry unit. This method of directing a high-pressure stream of an abrasive through the inner nozzle of a sand blasting type of machine, while applying a vacuum around the outer surface of the nozzle, is effective in both removing the lead paint and containing most of the hazardous dust generated by the process.

	Containment	Relocation	Recommended Practices	Cleanup
Demolition	Use plastic sheeting to prevent airborne dust migration. Interior Worksite Prep. Level 4; Exterior Worksite Prep. Level 3	No residents in dwelling during any work.	Wet surfaces, use covered containers to move debris; best subcontracted to abatement contractor, or a demolition contractor certified for abatement.	HEPA vacuum, wet mop, and HEPA vacuum.
Repainting	Floors and ground covered with 6-mil plastic. Interior Worksite Prep. Level 4; Exterior Worksite Prep. Level 3	No entry into work area during interior work.	Wet scrape, wet sanding, HEPA-filtered vacuum power tools.	Daily cleanup with HEPA vacuum, wet wash, HEPA vacuum.
Floor Sanding	Full containment of rooms, negative air recommended if leaded dust hazard identified.	No entry into work area during work.	Sanding lead-containing floors should be completed by abatement contractor, or other contractor certified for abatement.	HEPA vacuum of entire house may be needed.
Plaster Repairs	Localized containment for walls, entire room for ceiling. Usually Interior Worksite Prep. Level 1 or 2 for small jobs	No entry into work area.	Wet prior to removing.	HEPA final cleanup.
Window Replacement	Localized containment around each opening.	No occupancy during removal and initial cleaning and sealing.	Seal interior with plastic. Remove window from exterior if possible.	HEPA vacuum all areas with replaced windows.
Carpet Removal	Do dust sampling to determine contamination level. Usually Interior Worksite Prep. Level 3 or 4.	No occupancy during removal and initial cleaning.	Carefully remove and package carpet and pad in 6-mil plastic with taped seams. Wet down carpet before removal or disturbance.	HEPA vacuum floor after carpet bagged and prior to removal.

	Method										
	Removal							Enclosure			
Attributes	**HEPA Needle Gun**	**Heat Gun**	**HEPA Vacuum Blast**	**HEPA Sand**	**Remove/ Replace**	**Caustic Paste**	**Offsite Stripping**	**Plywood Paneling**	**Gypsum**	**Prefab Metal**	**Wood, Metal, Vinyl, Siding**
Capital Required	High	Low	High	Moderate	Moderate	Low	Low	Low	Low	High	Moderate
Worker Protection Required	High	High	High	High	Moderate	High	Moderate	Low	Moderate	Low	Low
Finish Work Required	Tentatively high	Moderate	Tentatively high	Moderate	Low	Moderate	Moderate	Wide	Wide	Limited	Wide
Product Availability	Limited	Moderate	Limited	Limited	Wide	Moderate	Limited, strip shops decreasing	Moderate	Moderate	Long	Long
Durability	Long	Long	Long	Long	Long	Long	Long	Moderate	Moderate	Moderate	Moderate
Labor Intensity	High	High	High	High	High	High	Moderate	High	High	High	High
Overall Safety	Moderate	Moderate	Moderate	Moderate	Very high	Moderate	High-high	High	High	High	High
Surface Preparation	None	None	None	None	None	Minimal—adjacent areas	Minimal—hardware removal	Minimal	Minimal	Minimal	Minimal
Cost	High	High	High	High	High	High	High	Moderate	Moderate	High	Moderate

Figure 8-4 Various methods of lead abatement.

In many cases lead-based painted doors, windows, trim will simply be removed and disposed of off-site, in accordance with the appropriate local, state, and federal regulations. Power sanding to remove lead-based paints should be avoided since it releases a great deal of harmful dust that will find its way into every nook and cranny of the building and is virtually impossible to vacuum away.

Various types of chemical stripping compounds can also be used to remove lead paint, and this method is often used when only limited quantities of lead paint are to be removed. The residue stripped off the existing surfaces must be carefully contained and disposed of in accordance with prevailing federal and state rules and regulations.

PCBs, VOCs, hydrocarbons, and other hazardous materials

The previous occupant of an abandoned or razed building can provide an alert project superintendent with clues to the potential existence of hazardous materials on the site.

PCBs. Was the previous owner or occupant engaged in the electrical manufacturing or electrical repair business? Are there old fluorescent light fixtures installed or discarded ones stored on the property? Polychlorinated biphenyls (PCBs) were banned in 1979, so the age of the facility will be a tip-off to their possible presence in the building.

Polychlorinated biphenyls can be found in old electrical transformers and in the ballasts of older fluorescent lighting fixtures. This chemical degrades very slowly and is considered a dangerous health hazard. PCB received a great deal of notoriety when, in mid-2001, the federal government, under pressure from the state of New York, began a $500 million cleanup of the upper Hudson River. Under the aegis of the Superfund Act, the state was to contract to dredge approximately 1 million pounds of PCB-laden silt from the riverbed. This material had been legally discharged from General Electric's Hudson Falls plant at Fort Edward, New York, from 1940 to 1977, and the battle over responsibility for its total removal lingers on.

VOCs. Volatile organic compounds (VOCs) include solvents such as acetone and methyl ethyl ketone (MEK). Hardware stores and paint shops that sell any of these products may, over the years, have dumped leaking containers down the drain; and those drainpipes may have broken, allowing hazardous materials to leach into the soil. Any previous occupants of the building that had a need to use these solvents, say, an autobody repair shop, should serve as a red flag and require some poking around to determine if any residues of these chemicals are present. A sniff test will prove effective.

TPH. These initials stand for *total petroleum hydrocarbons*—fuel oil, gasoline, and kerosene. Gas stations and automotive repair shops would have been users of these products. In 1984 a federal law, referred to as LUST for *l*eaking

*u*nderground *s*torage *t*anks, was enacted to enforce the replacement of leaking underground fuel tanks. In 1988, the Resource Conservation and Recovery Act (RCRA) established a 10-year window on these replacements. Owners were given three options:

1. Replace older tanks with new, government-approved designs.
2. Upgrade older tanks by adding spill and overfill prevention accessories and corrosion protection.
3. Abandon them.

According to the federal government, there are at least 1.5 million known underground tanks, but there are probably millions more of *unknown* tanks.

In July 2000, the writer was working with a contractor-developer on an abandoned city block parcel previously owned by the city of Baltimore. All buildings but one small one had been demolished, and the site had been leveled and graded. No mention was made of the existence of any underground tanks. Well, during the digging with a big Caterpillar 235 excavator, a 1000-gallon tank leaking fuel oil was pulled from the ground. As everyone scurried to contain the oil spill, the excavator continued to work, only to uncover another tank about 10 feet away, this one of 1500-gallon capacity, leaking oil and water as it was raised out of the ground. The state EPA was immediately called to the site. With a lot of fast talking and a demonstration that the leaks were minor in nature and swiftly contained, only a warning was issued by that agency.

This is a prime example of the principle that a project superintendent cannot discount encountering underground hazards or hazardous materials when working in an urban environment or on a previously occupied building site. So be alert.

Chlorinated hydrocarbons

This family of hazardous liquids includes degreasing agents and paint strippers. Trichloroethylene and trichlorethane are metal degreasers used in machine shops and metalworking shops. Perchloroethylene was once a very common dry cleaning solvent, and methylene chloride is a component in many paint strippers. All four chemicals are to be avoided, and long-term inhalation is a serious health hazard. Once again, the presence of these chemicals may be detected by applying the sniff test.

Even buildings previously containing landscaping and gardening shops are not immune from scrutiny, because they probably stored and sold dangerous herbicides and insecticides such as DDT.

Mold Problems in Older Buildings

Today's project superintendent must be aware of the dangers posed by mold and mildew in existing buildings not only to protect worker's health but also to avoid lengthy and expensive lawsuits that can damage their employer's financial

health. Older buildings that have been unoccupied for a lengthy period of time are ripe candidates for mold infestation.

Mold is a microscopic fungi that grows in the form of multicellular forms. This is different from single-cell mold, called yeasts. Mold is only visible when an interconnected group of fungi form to create a colony known as a *mycelium* and appears as a furry or downy coating.

Indoor mold requires four conditions in order to grow:

- Spores, which are present in every indoor and outdoor environment.
- Food (spores need food to survive and an indoor environment provides plenty), wood, paper, cardboard, fabric, even dust.
- Moisture.
- Time—mold growth begins anywhere from 24 hours to 10 days after these three conditions have been met.

Not all mold is visible or obvious. In abandoned buildings where all of these conditions have been met, mold can be found behind drywall, wallpaper, paneling, on top of ceiling tiles, in pipe chases, on the underside of carpet and pads, in utility tunnels, in condensate drain pans, inside air handling units, on insulation batts, and inside ductwork.

Molds produce allergens that can cause allergic reactions and, in some cases, more serious health hazards.

Mold and wood products

Because wood is organic, it contains sugars, starches, and proteins, any one of which can serve as a food source for mold. According to the Western Wood Products Association in Portland, research by Oregon State University discovered that Douglas fir sapwood became colonized by 45 different species of fungi within six weeks of sawing at the mill. Molds that typically grow on wood discolor the wood by producing yellow-, green-, orange-, or black-colored spores. Stain fungi are slightly different than mold because they penetrate deeply into the wood creating a blue colored stain as they age.

Molds on lumber are generally a collection of spores on the surface of the wood and can be removed by scrubbing or wiping, but this process can release the spores into the surrounding environment and it is better to spray the wood before wipe-down to avoid the spores from becoming airborne.

The U.S. Centers for Disease Control recommend using a solution of 10 parts water to 1 part bleach to clean mold. The U.S. Forest Products Laboratory suggests 1 part household detergent to 10 parts bleach to 20 parts warm water, applied with a sponge or bristle brush.

Many contracts relating to rehab building work contain sections that either require the contractor to hire the services of a professional health and remediation firm to remove mold, or indicate that the owner will assume this responsibility. These assignments of responsibility often show up in a contract article dealing with hazardous materials and generally follow this pattern:

If after commencement of the work, hazardous material is discovered on the work Site, the Contractor shall immediately stop work in the suspected area and report the condition to the Owner, the architect/engineer or, if applicable, the government agency with jurisdiction.

Evaluating a building for mold growth

When a project involves a building that has been vacated for an extended period of time and displays a history of water leaks, mold should be suspected either on the surface or in concealed spaces. Laboratories with an AIHA EMLAP accreditation can be brought in at that time to conduct a survey of the property.

These surveys or audits, as they are sometimes called, have become an accepted practice in the industry when the potential for mold and mildew exists in a new or old buildings.

The most common indoor fungi

Although many of these indoor fungi have somewhat mild health effects on limited exposure, to one who is hypersensitive to mold, even slight exposure can lead to serious effects.

The most common fungi encountered on a construction site could be one of these types:

Alternaria—This fungus is very common, found on plants, wood, wood pulp, textiles, and food. The allergens of *A.alternata* can induce reactions at low concentrations in sensitized individuals, and can cause "hay fever" or hypersensitive reactions that can lead to asthma.

Aspergillus—There are 182 species of this fungus, but only 40 occur in any frequency and are more common in warmer climates. The *A.veriscolor* variety can lead to diarrhea and upset stomach.

Cladosporium—This form is found on wood, wood pulp, textiles, and food. *C.sphaerospermum* is the type found on building materials. This is the most common form of "black mold" and can cause an infection when it comes in contract with small cuts or abrasions.

Penicillium—Can bring on Type 1 allergies such as "hay fever" or, in more severe cases, asthma. Like many other forms of fungi, penicillium has an industrial use, one of which is a Roquefort and Camembert cheese starter.

Safety on the Job Site

It is the project superintendent's responsibility to ensure that workers in the building are protected against the effects of mold and to take the steps necessary to prevent its growth during the construction phase. The project super must have clear instructions on where the authority lies to ensure a healthy

indoor air environment for the workers; does it rest with the owner or with the general contractor?

Because water or humidity are main contributors to the mold problem, tracing and eliminating the source of water leading to high humidity conditions should be high on the "to do" list.

Major mold clean-up operations will probably be subcontracted to a laboratory certified for remediation, but mold clean-up measures usually involve one or more of the following procedures:

1. Wet vacuum to collect excess water but used only when there is sufficient water to be vacuumed or else the process may spread spores. And after use, the vacuum and hoses must be thoroughly cleaned to kill the mold and mold spores that cling to the interior surfaces of the vacuum tank and hoses.
2. Damp wiping hard surfaces with water and a detergent can eliminate some mold, but, after cleaning, the surfaces must be dried to discourage new growth. Porous materials will most likely have to be discarded, because the mold will infiltrate the material.
3. HEPA vacuums are recommended for final clean-up of dust that may have settled on surfaces outside the remediation area. Caution must be taken to ensure that the HEPA filter is correctly placed in the vacuum so that spores picked up are not reintroduced into the environment after bypassing the filter.
4. Discard the materials contaminated with mold growth that are not easily salvaged for remediation. Discarded contaminated materials need to be double bagged using 6 mil polyethylene sheeting.

Personal protective equipment—PPE

According to the U.S. government's Environmental Protection Agency (EPA), the primary function of PPE is to avoid the inhalation of mold and mold spores and avoid mold contact with the skin and eyes. EPA cautions individuals using PPE equipment that they must be trained in its use, have medical clearance and must be fit-tested by a trained professional before embarking on any remediation work.

Long gloves extending over the forearm are recommended. If using a biocide such as chlorine bleach, the gloves should be of natural rubber, neoprene, PVC, or polyurethane. To protect the eyes, properly fitted goggles or a full-face respirator with a HEPA filter is recommended.

Respirators used for cleaning small areas should be the N-95 respirator that covers the nose and mouth and will filter our 95 percent of the particulates in the air. Half face or full face air purifying respirators (APR) are equipped with a HEPA filter cartridge and contain both inhalation and exhalation valves.

Disposable clothing is required for both limited and full remediation purposes. Disposable paper overalls can be used for limited work, whereas mold impervious disposable head coverings and a body suite of breathable material such as Tyvek should be used for full remediation work.

The U.S. Environmental Protection Agency produces a series of guidelines for mold remediation in schools and commercial projects.

Tables 8.1 and 8.2 contain valuable information for the project superintendent engaged in projects requiring renovations or rehabilitation.

Glossary of Terms

Allergen—a substance such as mold that can create an allergic reaction

Antimicrobial—an agent (chemical or other substance) that kills mold or other organisms

Biological contaminants—living organisms such as viruses, bacteria, or mold; either the remains of living organisms or the debris from pieces of dead organisms. These contaminants can be small enough to inhale causing many types of allergic reactions and respiratory disorders

Biocide—substances or chemical that kill organisms such as mold

Fungi—a separate kingdom consisting of living things that are neither animals or plants and include mold, yeast, mushrooms, and puffballs

Fungicide—a substance or chemical that kills fungi

HEPA—high efficient particulate air (filter)

Hypersensitivity pneumonitis—a group of respiratory diseases that cause inflammation of the lung. Many forms of hypersensitivity pneumonitis are caused by the inhalation of organic dusts, including molds

Mold—a term interchangeable with fungi

mVOC—microbial volatile organic compounds; a chemical made from mold that is a gas at room temperature and may have a moldy or musty odor

Mycotoxin—a toxin produced by a mold

Remediate—fix

Spore—the means by which molds reproduce. Spores are microscopic and vary in shape and size from 2 to 100 microns. Spores travel by passively moving in a breeze or water drop, or by being mechanically disturbed by the passing movement of a person or animal

Toxigenic—producing toxic substances

Environmental Audits

The Environmental Protection Agency has a responsibility to promulgate and enforce regulations regarding the management of hazardous materials. It has several pieces of legislation at its command to enforce actions. At the state level, additional laws and regulations may have been enacted to effect more stringent regulations.

The Resource Conservation and Recovery Act (RCRA) was designed to promote the protection of human health and the environment and to conserve valuable resources. This act is the backbone of the EPA. In response to the need to clean up

TABLE 8-1 Water Damage—Cleanup and Mold Prevention

Table 8-1 presents strategies to respond to water damage within 24-48 hours. These guidelines are designed to help avoid the need for remediation of mold growth by taking quick action before growth starts. If mold growth is found on the materials listed in Table 8-1, refer to Table 8-2 for guidance on remediation. Depending on the size of the area involved and resources available, professional assistance may be needed to dry an area quickly and thoroughly.

Guidelines for Response to Clean Water Damage within 24-48 Hours to Prevent Mold Growth*	
Water-Damaged Material†	**Actions**
Books and papers	For non-valuable items, discard books and papers. Photocopy valuable/important items, discard originals. Freeze (in frost-free freezer or meat locker) or freeze-dry.
Carpet and backing - dry within 24-48 hours‡	Remove water with water extraction vacuum. Reduce ambient humidity levels with dehumidifier. Accelerate drying process with fans.
Ceiling tiles	Discard and replace.
Cellulose insulation	Discard and replace.
Concrete or cinder block surfaces	Remove water with water extraction vacuum. Accelerate drying process with dehumidifiers, fans, and/or heaters.
Fiberglass insulation	Discard and replace.
Hard surface, porous flooring‡ (Linoleum, ceramic tile, vinyl)	Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary. Check to make sure underflooring is dry; dry underflooring if necessary.
Non-porous, hard surfaces (Plastics, metals)	Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary.
Upholstered furniture	Remove water with water extraction vacuum. Accelerate drying process with dehumidifiers, fans, and/or heaters. May be difficult to completely dry within 48 hours. If the piece is valuable, you may wish to consult a restoration/water damage professional who specializes in furniture.
Wallboard (Drywall and gypsum board)	May be dried in place if there is no obvious swelling and the seams are intact. If not, remove, discard, and replace. Ventilate the wall cavity, if possible.

(*Continued*)

TABLE 8-1 Water Damage—Cleanup and Mold Prevention (*Continued*)

Window drapes	Follow laundering or cleaning instructions recommended by the manufacturer.
Wood surfaces	Remove moisture immediately and use dehumidifiers, gentle heat, and fans for drying. (Use caution when applying heat to hardwood floors.) Treated or finished wood surfaces may be cleaned with mild detergent and clean water and allowed to dry. Wet paneling should be pried away from wall for drying.

* If mold growth has occurred or materials have been wet for more than 48 hours, consult Table 8-2 guidelines. Even if materials are dried within 48 hours, mold growth may have occurred. Items may be tested by professionals if there is doubt. Note that mold growth will not always occur after 48 hours; this is only a guideline.

These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage, or chemical or biological pollutants, then Personal Protective Equipment and containment are required by OSHA. An experienced professional should be consulted if you and/or your remediators do not have expertise remediating in contaminated water situations. Do not use fans before determining that the water is clean or sanitary.

† If a particular item(s) has high monetary or sentimental value, you may wish to consult a restoration/water damage specialist.

‡ The subfloor under the carpet or other flooring material must also be cleaned and dried. See the appropriate section of this table for recommended actions depending on the composition of the subfloor.

Source: U.S. Environmental Protection Agency.

and reclaim hazardous sites, Congress enacted the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), more commonly known as the Superfund. CERCLA was enacted to provide a system for identifying and cleaning up hazardous material releases and to establish a fund to pay for the cleanup where no responsible parties could be found.

The Superfund Amendments and Reauthorization Act (SARA) was the first major revision of CERCLA. It established a fund to clean up leaking underground storage tanks, a program to maximize the safety of workers engaged in hazardous material cleanup, and a new radon gas and indoor air quality (IAQ) research program.

Protection of Archeological and Paleontological Remains and Materials

Contractors have to be alert these days to another problem—the potential of unearthing archeological, paleontological (fossils), or historical materials while excavating in urban, suburban, and even some previously undeveloped areas. If there is reason to believe that any of these materials might surface during the excavation of a site, they may be of significance in the recording of historic or

TABLE 8-2 Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water

Table 8-2 presents remediation guidelines for building materials that have or are likely to have mold growth. The guidelines in Table 8-2 are designed to protect the health of occupants and cleanup personnel during remediation. These guidelines are based on the area and type of material affected by water damage and/or mold growth. Please note that these are guidelines; some professionals may prefer other cleaning methods.

If you are considering cleaning your ducts as part of your remediation plan, you should consult EPA's publication entitled, Should You Have the Air Ducts in Your Home Cleaned? If possible, remediation activities should be scheduled during off-hours when building occupants are less likely to be affected.

Although the level of personal protection suggested in these guidelines is based on the total surface area contaminated and the potential for remediator and/or occupant exposure, professional judgment should always play a part in remediation decisions. These remediation guidelines are based on the size of the affected area to make it easier for remediators to select appropriate techniques, not on the basis of health effects or research showing there is a specific method appropriate at a certain number of square feet. The guidelines have been designed to help construct a remediation plan. The remediation manager will then use professional judgment and experience to adapt the guidelines to particular situations. When in doubt, caution is advised. Consult an experienced mold remediator for more information.

In cases in which a particularly toxic mold species has been identified or is suspected, when extensive hidden mold is expected (such as behind vinyl wallpaper or in the HVAC system), when the chances of the mold becoming airborne are estimated to be high, or sensitive individuals (e.g., those with severe allergies or asthma) are present, a more cautious or conservative approach to remediation is indicated. Always make sure to protect remediators and building occupants from exposure to mold.

Carpet and backing	1, 3		
Concrete or cinder block	1, 3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1, 2, 3		
Non-porous, hard surfaces (plastics, metals)	1, 2, 3		
Upholstered furniture & drapes	1, 3		
Wallboard (drywall and gypsum board)	3		
Wood surfaces	1, 2, 3		

MEDIUM - Total Surface Area Affected between 10 and 100 (ft^2)

Books and papers	3	Limited or full Use professional judgment, consider potential for remediator exposure and size of contaminated area	Limited Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area
Carpet and backing	1,3,4		
Concrete or cinder block	1,3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1,2,3		
Non-porous, hard surfaces (plastics, metals)	1,2,3		
Upholstered furniture & drapes	1,3,4		
Wallboard (drywall and gypsum board)	3,4		
Wood surfaces	1,2,3		

(*Continued*)

TABLE 8-2 Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water (*Continued*)

LARGE - Total Surface Area Affected Greater Than 100 (ft^2) or Potential for Increased Occupant or Remediator Exposure during Remediation Estimated to be Significant

Books and papers	3	Full Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area	Full Use professional judgment, consider potential for remediator exposure and size of contaminated area
Carpet and backing	1,3,4		
Concrete or cinder block	1,3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1,2,3,4		
Non-porous, hard surfaces (plastics, metals)	1,2,3		
Upholstered furniture & drapes	1,2,4		
Wallboard (drywall and gypsum board)	3,4		
Wood surfaces	1,2,3,4		

*Use professional judgment to determine prudent levels of Personal Protective Equipment and containment for each situation, particularly as the remediation site size increases and the potential for exposure and health effects rises. Assess the need for increased Personal Protective Equipment, if, during the remediation, more extensive contamination is encountered than was expected. Consult Table 8-1 if materials have been wet for less than 48 hours, and mold growth is not apparent. These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage, or chemical or biological pollutants, then the Occupational Safety and Health Administration (OSHA) requires PPE and containment. An experienced professional should be consulted if you and/or your remediators do not have expertise in remediating contaminated water situations.

†Select method most appropriate to situation. Since molds gradually destroy the things they grow on, if mold growth is not addressed promptly, some items may be damaged such that cleaning will not restore their original appearance. If mold growth is heavy and items are valuable or important, you may wish to consult a restoration/water damage/remediation expert. Please note that these are guidelines; other cleaning methods may be preferred by some professionals.

Cleanup Methods

Method 1: Wet vacuum (in the case of porous materials, some mold spores/fragments will remain in the material but will not grow if the material is completely dried). Steam cleaning may be an alternative for carpets and some upholstered furniture.
Method 2: Damp-wipe surfaces with plain water or with water and detergent solution (except wood—use wood floor cleaner); scrub as needed.
Method 3: High-efficiency particulate air (HEPA) vacuum after the material has been thoroughly dried. Dispose of the contents of the HEPA vacuum in well-sealed plastic bags.
Method 4: Discard—remove water-damaged materials and seal in plastic bags while inside of containment, if present. Dispose of as normal waste. HEPA vacuum area after it is dried.

Personal Protective Equipment (PPE)

Minimum: Gloves, N-95 respirator, goggles/eye protection
Limited: Gloves, N-95 respirator or half-face respirator with HEPA filter, disposable overalls, goggles/eye protection
Full: Gloves, disposable full body clothing, headgear, foot coverings, full-face respirator with HEPA filter

(*Continued*)

TABLE 8-2 Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water (*Continued*)

Containment

Limited: Use polyethylene sheeting ceiling to floor around affected area with a slit entry and covering flap; maintain area under negative pressure with HEPA filtered fan unit. Block supply and return air vents within containment area.
Full: Use two layers of fire-retardant polyethylene sheeting with one airlock chamber. Maintain area under negative pressure with HEPA filtered fan exhausted outside of building. Block supply and return air vents within containment area.

Table developed from literature and remediation documents including Bioaerosols: Assessment and Control (American Conference of Governmental Industrial Hygienists, 1999) and IICRC S500, Standard and Reference Guide for Professional Water Damage Restoration, (Institute of Inspection, Cleaning and Restoration, 1999).

Please note that Table 8-1 and Table 8-2 contain general guidelines. Their purpose is to provide basic information for remediation managers to first assess the extent of the damage and then to determine whether the remediation should be managed by in-house personnel or outside professionals. The remediation manager can then use the guidelines to help design a remediation plan or to assess a plan submitted by outside professionals.

Although this document has a residential focus, it is applicable to other building types.

Source: U.S. Environmental Protection Agency.

prehistoric events, and the contractor may be required by local law to cease work immediately and notify the proper authorities. In the late 1990s when the protection of archeological remains was just beginning to attract wide attention, while constructing a road in New Mexico, the contractor unearthed some American Indian religious tribal remains and had to cease work until the tribe to which these remains belonged was identified. Work could not continue until such time as the rightful owners, once established, could have access to those remains. Other instances of encountering similar remains have halted construction work around the country.

When such instances do occur, the contractor is to contact the architect immediately, notify her or him of the possible historical value of the unearthed materials, and await further instructions. The contractor is required to make every effort to preserve the site until further direction is given and may, in fact, have to reschedule or redirect the work, or possibly abandon work until a final resolution is achieved. Since the potential for lengthy delays is evident, the contractor should request a "stop work" order which will stop the "construction" clock and start the "delay" clock with its related and forthcoming array of costs.

Saving an historic or architecturally important building can be a gratifying experience if the work is carefully planned; if open communications exist between owner, designers, and subcontractors; and if all parties are willing to assume some portion of the risk inherent in this type of work.

Murphy's law is alive and well in rehabilitation and renovation projects. Always expect the unexpected, and you will hardly ever be disappointed.

End of Lesson Wrap-Up

Congratulations on completing this lesson! You've taken another important step in your journey to becoming a certified professional in the construction industry.

Up Next: Quiz Time

Before we move forward, there's a short quiz waiting for you. Remember, this quiz isn't designed to trip you up but to reinforce your understanding of the concepts we've covered. It's a way to ensure that you have grasped the essential elements of the lesson and are ready to build on this knowledge in subsequent modules.

You're Doing Great!

You're doing an excellent job so far, and we encourage you to keep up the momentum. Every quiz and lesson is a building block towards your ultimate goal of certification and professional advancement.

See You in the Next Lesson!

We are excited to continue this journey with you and look forward to seeing you in the next lesson. Keep up the great work and stay motivated—your future in construction management looks promising!

Keep learning, keep growing, and remember, we are here to support you every step of the way. See you soon for more learning and development

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