PRESERVATION
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TEMPORARY PROTECTION

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Specifying Temporary Protection of Historic Interiors During Construction and Repair

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PLANNING AND SPECIFYING TEMPORARY PROTECTION

Projects involving historic interiors range from the meticulous restoration of a National Historic Landmark residence as a museum to the insertion of modern apartment units in an abandoned loft building. The size of the building, significance of the interiors, and scope of work will determine how best to protect interior finishes, features, and collections during construction work. All work involving historic buildings, however, shares the need to properly plan for and specify appropriate temporary protection measures. Without such provisions, unnecessary damage can result which will require additional funds to correct or which can lead to irreversible loss of historic fabric.

Problem

Relying on the contractor to protect interiors without specifying such protection puts historic material and finishes at unnecessary risk. Protective measures must be specified in the construction specifications for the job.

Although general contract language may make reference to "protecting existing construction" and may require that the contractor "restore any damage to its original condition at no additional cost to the

Historic interiors and collections should be protected from potential damage during construction work

owner" (or other similar language), in practice, the general nature of the language affords little *protection* to existing historic finishes or features. At best, such measures may provide a mechanism for repairing and paying for damage *after* it has occurred. Rather than provide adequate protection, some contractors deliberately elect to repair damage, believing it is cheaper.

Solution

The planning process includes three important goals: 1) protection of any collections where present; 2) fire protection; and, 3) protection of historic architectural features and finishes. Collections safety during construction applies to buildings in which collections are stored or displayed, including cases where there are historic furnishings that are not part of a formal collection. Construction operations pose a serious threat to collections, and it is nearly always desirable for the collection to be removed from the work area. While this may seem obvious, in practice, maintenance and repair activities often take place in spaces containing collections. Common examples of this include the installation of wiring for security systems, electrical upgrades, or telecommunications; repainting; and additional work undertaken after owner occupancy.

Except for the most minor repairs, as defined by the curator of collections for the institution or other responsible parties, collections should be moved out of the construction areas to a secured and safe location until *all* work has been completed. For small buildings where extensive work is taking place, the collection should be entirely moved off site to another location. This approach may also be desirable for larger buildings, depending upon the nature of the work, risks to collections, and availability of protected space on site.

Fire Protection

Fire poses the greatest risk of sudden catastrophic loss during construction activities in existing buildings. Just one of numerous examples is the 1985 Harrison Court fire in Philadelphia, in which a block-long National Register warehouse building undergoing rehabilitation burned to the ground *(see cover photo)*. The fire was caused by sparks from cutting torches that were being used during selective interior demolition work.

To address the threat of loss of life and property during construction operations, the National Fire Protection Association (NFPA) publishes NFPA 241: *Safeguarding Building Construction and Demolition Operations,* most recently reissued in 1989[1]. Although written to provide fire protection procedures for all types of building construction activities, including new construction, NFPA 241 should be a reference standard in any selective demolition specification, and a foundation for addressing fire safety on building rehabilitation sites. Additional guidance is available in NFPA 914: *Rehabilitation and Adaptive Reuse of Historic Structures.* When these are utilized as reference standards, the historic building owner should obtain and enforce their recommendations *(see figure 1)*.

Figure 1. The spontaneous combustion of cloth rags that had been used in applying a common finishing wax caused over $1 million damage to a historic government office building in 1991. Remains of the trash can where the rags had been stored overnight is indicated by the fireman's notepad. After the cause of the fire was determined, a standard specification provision was developed for future contracts requiring the contractor to remove all material contaminated with finishing products from the site at the end of the day.

The building owner and design professional should also review fire protection measures and fire fighting methods that are permitted by the standard but may be insensitive to the protection of historic finishes. Such measures and procedures should be clearly stated as "prohibited" in the specifications or construction agreement.

According to NFPA, 60% of the fire losses to buildings under construction were caused by the following: 1) portable heating equipment (25%); 2) cutting, welding, and plumbers' torches (20%); and, 3) matches and smoking (15%).

In addition to these three causes cited by NFPA, for historic buildings there is a fourth major cause—the use of heat devices to remove paint. They share a common characteristic: they are all caused by contractor operations on the site. For these reasons, full adherence to the project specifications is needed to reduce, or eliminate, these causes of fire.

Temporary Heat

During the normal operation of a building, the heating plant—boiler or warm air furnace—is placed at a remote location (usually in a fire-rated room); set in a stationary position; equipped with a fresh air supply and non-combustible exhaust flue; and supplied with fuel piped from a remote oil tank or by a natural gas pipe brought into the building. In the case of construction projects involving historic buildings, temporary heating devices are frequently utilized. These devices are inherently dangerous because they are portable and often unstable; have movable and nearby fuel tanks; and often exhaust into the space being heated.

Electric temporary heaters are considered the safest temporary heating devices, but require heavy conductors and power supplies which are not always available at desired locations when temporary heat is needed. As a result, these are generally not used. One alternative is a propane heater, which is safer and cleaner in operation than the oil-fired temporary heating unit, and has greater output and portability than the electric heater. Oil-fired temporary heaters should be avoided unless they can be vented directly to the building's exterior, or be placed in a completely open space of a building that is of non-combustible construction.

Cutting, Welding, and Plumbers' Torches

The second most important cause of fire during construction operations is the use of open flame cutting, welding, and soldering equipment. Cutting and welding in existing buildings should be conducted with adequate supervision, fire watches, and emergency fire protection apparatus to assure that sparks or drops of hot metal do not start fires. Cutting and welding should be controlled by requiring a new permit each day, issued by the general contractor or construction manager, for each location where cutting or welding is to occur. A permit should not be issued until the following conditions are satisfied:

1. It has been determined that cutting and welding can be safely conducted at the desired location;
2. Combustibles have been moved away or safely covered;
3. Fire watchmen with extinguishers are posted for the duration of the work and for 30 minutes after work completion; and
4. Cutting and welding operations cease 2 hours prior to the close of construction each day to minimize the risk of undetected smoldering fire.

Permits and the inspection and maintenance of fire protection systems should be managed by a fire protection manager employed by the contractor or construction manager. (For small projects, the construction foreman may fill this role.) In addition to issuing and logging-in the cutting and welding permits, the fire protection manager should routinely inspect cutting and welding locations, all temporary heating equipment in operation, existing fire protection systems and exits, and first aid fire fighting equipment. ("First aid" fire fighting equipment refers to fire extinguishers and available water sources available at the job site for providing the "first aid" in fighting a fire.) At the end of each work shift, the fire protection manager should file a written report with the construction manager or contractor and the owner. Any violations or unsafe conditions relating to fire protection should be immediately reported to the construction project manager for action, including halting unsafe operations, improving fire protection measures, and notification of the owner.

A *fire watchman* reporting to the fire protection manager should be stationed at each cutting or welding location. The fire watchman's responsibilities include watching the work area for falling sparks and molten metal; covering combustible materials with fire blankets and maintaining such protection; and inspecting and maintaining first aid fire fighting equipment. For smaller projects, the construction fireman or other designated people should be assigned the responsibility of inspecting of each cutting and welding location frequently during the day *(see figure 2)*.

The extent of first-aid fire fighting equipment is dependent on the size and type of building and scope of project work. At a minimum, even for restoration work in a small house museum, one or two ABC-type fire extinguishers should be placed in plain sight on each floor of the building where work is taking place. The available water supply should be located and clearly marked, maintained, and provisions made for its ready use.

For all rehabilitation projects, the provision and/or maintenance of exits is of critical importance, both for life safety of construction personnel, and for fire fighters' access to work areas. For major rehabilitation projects in large and tall buildings, the handling of exit stairways is of great importance. Existing exit stair towers should be maintained, and construction priority given to the completion of new exit stairways. Where an existing fire door requires replacement, the old door should be removed and the new door and hardware installed immediately. While perhaps not as efficient as removing all doors in one phase and installing all new doors in a second phase, replacement on a one-for-one basis ensures that no more than one fire tower door is out of operation at any time during construction.

Prior to the commencement of any major rehabilitation on the small or large historic property, the owner and construction manager or contractor should meet with the local fire marshal to plan site and building access in the event of fire. The extent of fire department coordination is dependent on the size and location of the project, the significance of the structure, and the type of hazardous operations included in the project scope. Access paths for heavy fire fighting equipment should be laid out and maintained. Free access from the street to fire hydrants and to outside connections for standpipes, sprinklers or other fire extinguishing equipment should be provided and maintained.

The third most common cause of fire during construction is smoking and matches — entirely a construction management issue. Construction specifications for rehabilitation work should always prohibit smoking within the building, and enforcement of the prohibition is a priority responsibility of the contractor or construction manager.

A fourth cause of fire in historic buildings is the use of heating devices to remove paint. Due to the high fire risks, the use of open flame devices to remove paint should be prohibited in the specifications. Special precautions should be delineated when allowing heat plates and especially hot air guns. In addition to the possibility of igniting the wood, there is the even greater risk of ignition of flammable debris commonly found in wall cavities and behind cornices *(see Preservation Tech Note Number 18)*. Where heat devices are permitted, their use should be prohibited from cornice soffits or other similar conditions where friable combustible material may be exposed to heat through cracks and open joints. Additionally, paint removal work should stop at least two hours prior to the site being vacated each evening, to increase chances of early detection of any smoldering fire. The area of the day's work must also be carefully inspected. Construction specifications should also require that temporary fire detection devices be installed in close proximity to the specific work area and that the alarm system be directly monitored.

Figure 2. Because of the fire risks, open flame cutting and welding deserves careful attention both in the preparation of specifications and during the work. As much welding as possible should be done off site. For example, at the Nightingale-Brown House, several large trusses were assembled off site, then carefully hoisted through a window for installation. Photo: Irving B. Haynes and Associates.

Protection of Historic Interior Features and Finishes

An important difference between protecting historic interior features and finishes and protecting new interior features and finishes during construction is in the timing of the construction schedule. In new work, important and fragile casework and finishes are installed late in the construction schedule, after mechanical and electrical

systems and other high impact work are completed, thus not exposing the finishes to major construction operations. In preservation work, however, existing interior finishes are exposed to all the high impact and potentially damaging construction phases of the project, except to the extent that such finishes are temporarily protected or separated from construction work.

Important architectural features which are easily removed should be stored off site, if possible, to protect them from vandalism, theft and damage during construction. Lighting fixtures, fireplace mantels, and interior doors are typical examples. Less movable architectural material or finishes such as wallpaper are often best retained in place but may require custom-designed protective measures developed and monitored by a conservator *(see figure 3)*.

Access by construction personnel to spaces with significant features and finishes should be restricted, except for their work relating directly to the preservation of such spaces. Spaces with restricted access should be identified by the planning team and indicated in the construction documents in order to allow the contractor to include any associated costs in his price proposal *(see figure 4)*.

For spaces such as halls and lobbies, it may not be practicable to limit access, and for all interior spaces, some construction work may be required. In such circumstances, interior finishes must be physically isolated from construction operations by means of protective barriers and coverings. Such surfaces aregenerally limited to flooring, walls up to approximately 6 foot height, and special construction such as staircases. Only under unusual circumstances do ceilings or upper wall areas require physical protection during construction. Examples are walls with historic wallcoverings or fragile ornamental ceilings that are at risk to physical abuse or to vibration damage caused by construction activities.

Flooring should be protected from damage caused by abrasion, falling objects, dust and dirt, and spilled liquids *(see figure 5)*. If work in, or traffic through, a particular space does not involve one or more of these risks, temporary protection may be reduced. Damage caused by abrasion can be controlled by means of protective coverings such as canvas tarps or resilient wood fiber panels. Canvas tarps should overlap and be taped at all joints. Resilient wood fiber panels should be carefully fitted with tight seams and laid continuously wall to wall. Joints should be taped to avoid displacement of the panels after setting. For added safety, resilient panels left exposed should also be fire-retardant treated to achieve a UL Class A listing for flame spread and smoke developed. Such a readily available product is N.C.F.R Homasote.

For greater protection from physical force, a layer of plywood can be applied over the Homasote panel underlayment, with joints staggered to stabilize the assembly. In this double layer assembly, the top plywood should be treated with a fire-retardant, but the underlayment need

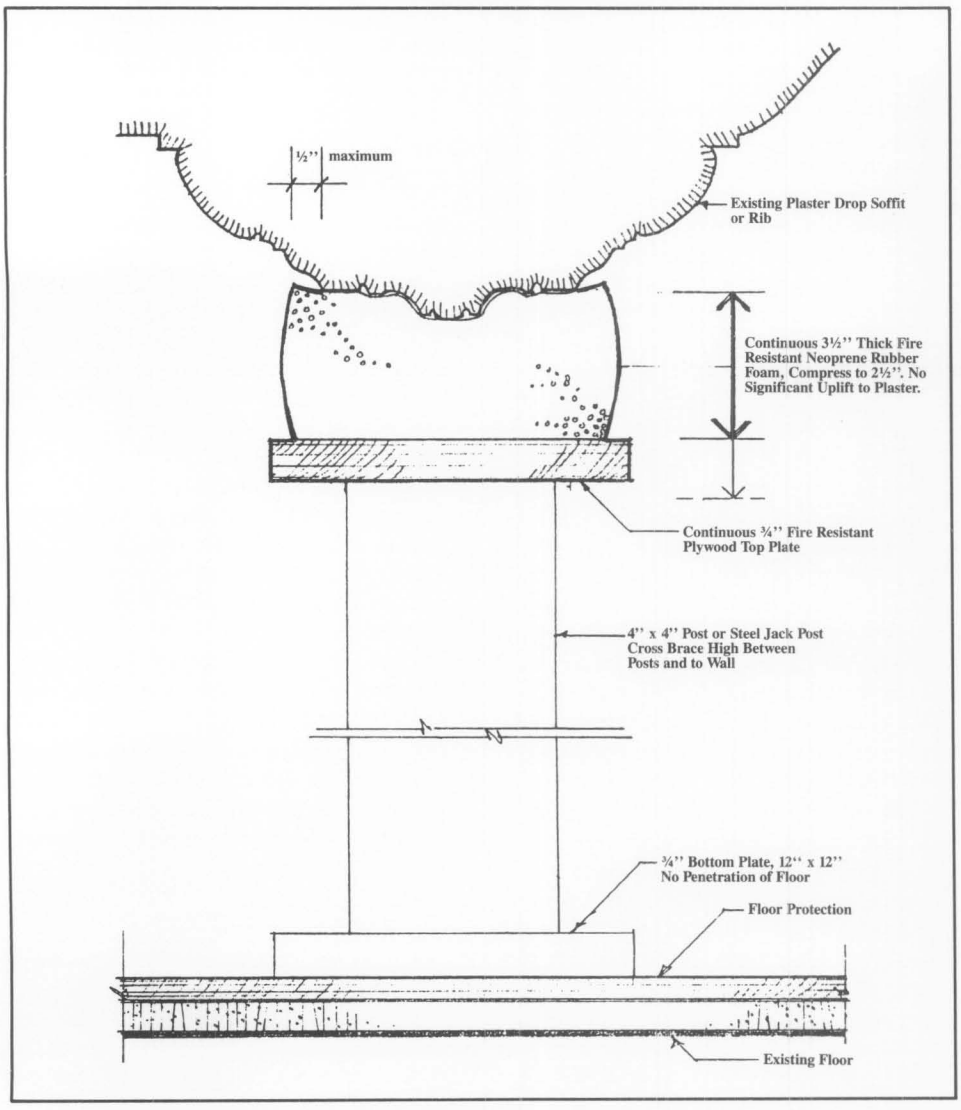


Figure 3. Vibrations generated during construction may necessitate the installation of temporary support for such fragile features as plaster ceiling cornices and soffits. Drawing: Villard Houses — courtesy of Emery Roth & Sons Architects. P.C. Photo: The Octagon, Lonnie Hovey, AIA.

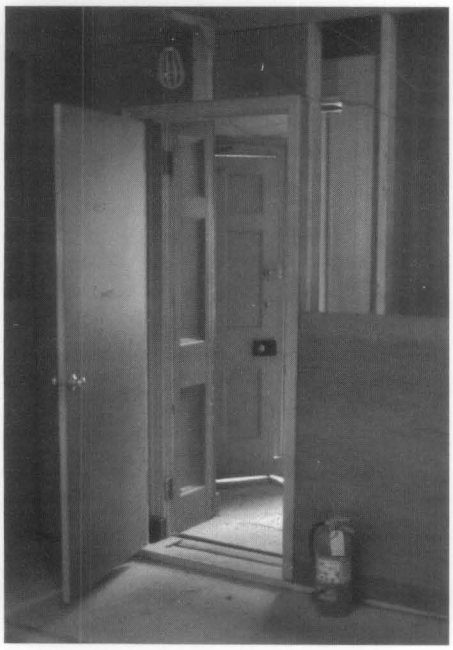


Figure 4. Temporary protection during construction can involve covering historic features, such as floors and walls, as well as using temporary doors to control the passage of workers and the inevitable dust and dirt. Prominently located fire extinguishers are mandatory. Photo: Lonnie Hovey, AIA, The Octagon.

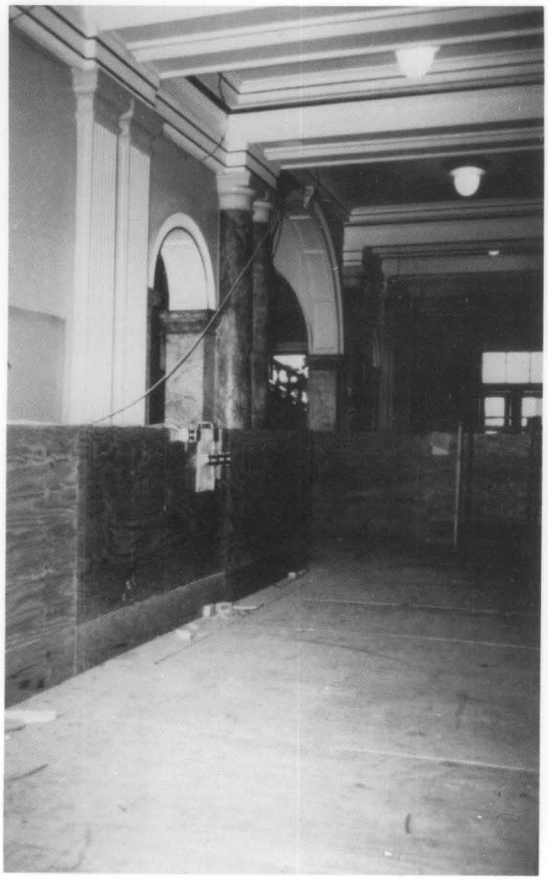
not be. Where protection from spilled liquids is required, a layer of polyethylene sheeting should be applied between the Homasote panels and the plywood top layer. Care should be taken in planning the protection assembly to ensure that moisture from spilled liquids is not trapped against the historic flooring. Otherwise, the staining, splitting, wood-grain raising, or stone-finish destruction could potentially go undetected for months while concealed from view under the protection assembly. Care should also be taken to avoid sheet coverings such as building felt, which could potentially stain the historic flooring.

Wall protection is typically fabricated from fire-retardant treated plywood attached to wood framing. The assembly should be self-supporting and self-bracing, secured at its base to the floor protection assembly. Struts and walers need to be provided, as required, to brace the assembly without installing fasteners into the historic wall finish. Careful assembly includes using screw fasteners in order to eliminate hammering during assembly and ripping damage during disassembly. Where wood framing, furring, or panels abut historic wall materials, the back side of the protective assembly should also be padded using strips of neoprene or strips of Homasote board, glued to the protective assembly member.

Historic stairways, balustrades, balconies, fireplaces, door surrounds, window surrounds, and other components will also need to be protected from construction damage by combining the techniques described for floors and walls *(see figure 6)*. Horizontal surfaces should be protected as floors, and vertical assemblies treated as walls, with the major difference being the complexity of the framing required.

Specifying Protection

Detailing and specifying temporary protection of historic interiors during construction is the responsibility of both the architect and contractor. Most general conditions of a construction contract contain language similar to *AIA Document A201, General Conditions of the Contract for Construction:* "The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the work."[2] The same document in a later paragraph states, "The



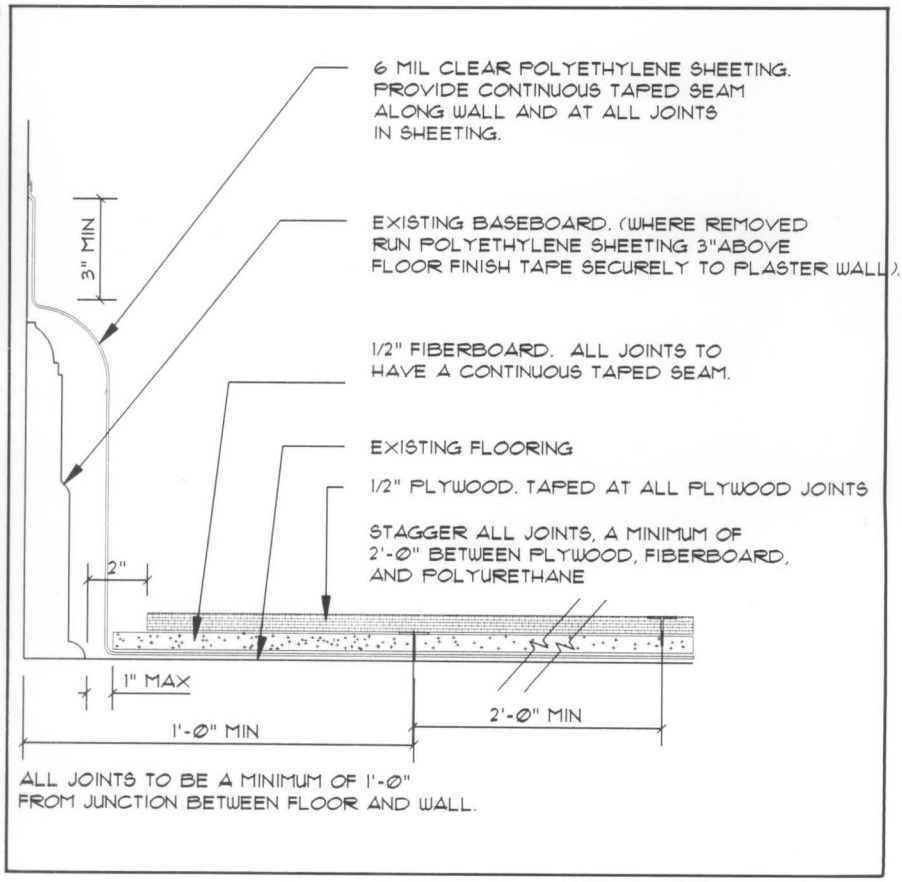


Figure 5. To provide for adequate floor protection in the New Jersey State Capitol, this area was swept clean, then covered with polyethylene sheeting to protect against spills and dirt abrasion. Fiberboard (1/2'' thick) was placed over floors and the joints sealed with tape. Finally 1/2'' plywood was laid with all joints taped. This floor protection system has been successful over many years of use and is recommended in major construction areas, and where tile, marble, parquetry wood, or other historic flooring is involved. Photo and drawing: Ford Farewell Mills and Gatsch Architects.

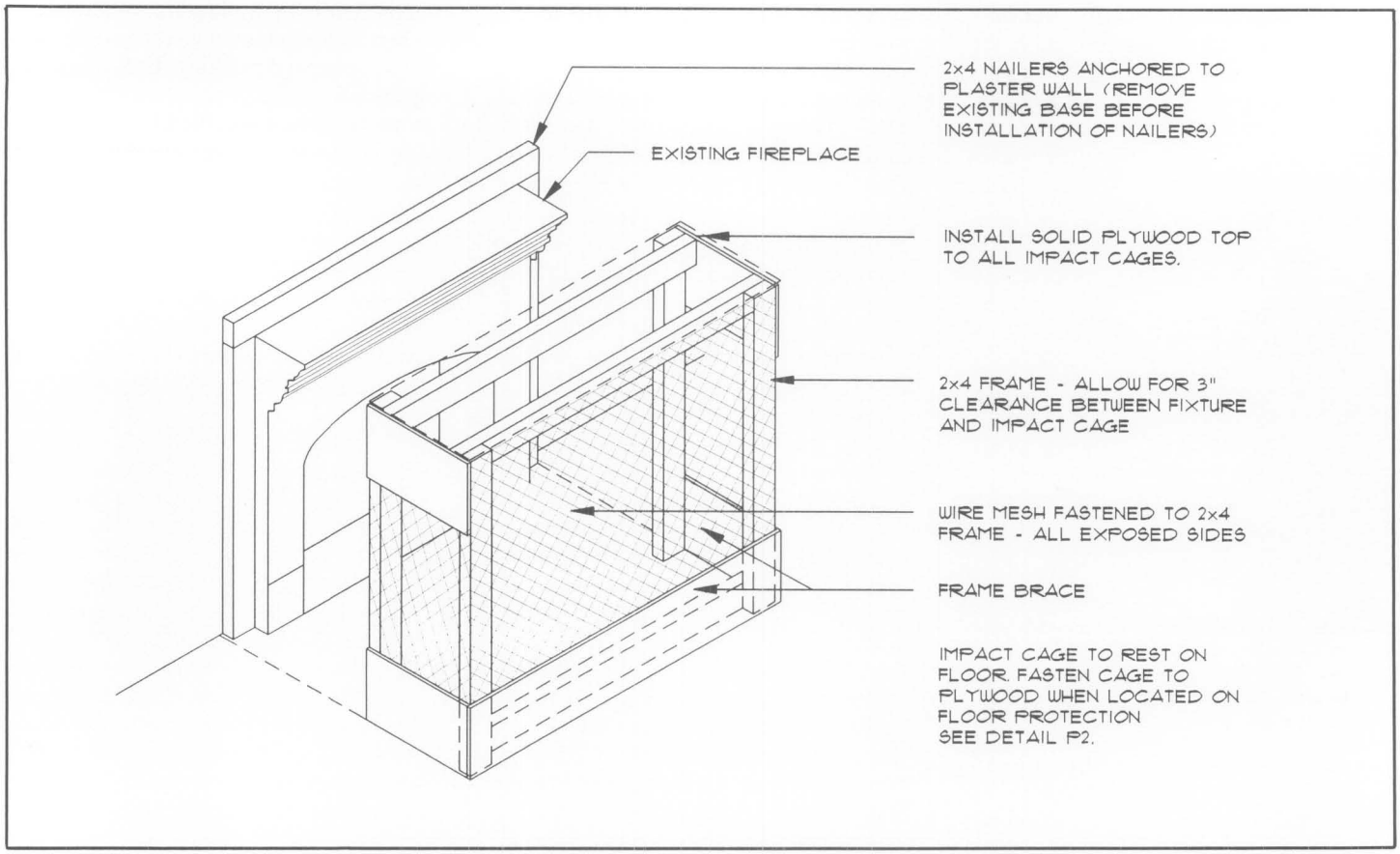


Figure 6. A self-supporting impact cage utilizing wood and wire mesh protects the fireplace. In this project, the long construction process required bidders to have visible access to features such as the fireplace. The wire mesh also facilitated monitoring during the lengthy construction. Photo and drawing: Ford Farewell Mills and Gatsch Architects.

Architect will not have control over or charge of and will not be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the work."[3] And, directly related to temporary protection, "The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to. . . other property at the site or adjacent to. . . not designated for removal, relocation, or replacement in the course of construction."[4] Thus, the contractor is responsible for the means and methods of construction, including protection of public and property. The courts have reinforced this concept by holding an architect liable for construction injuries where the architect took an active role in enforcing construction safety practices.

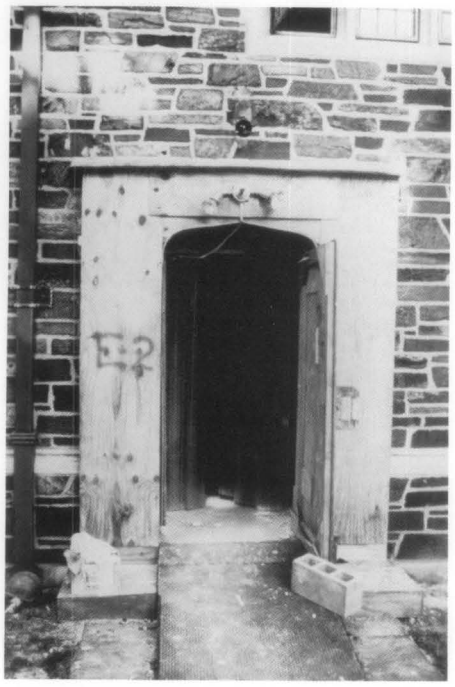


Figure 7. A contractor's solution to protecting the limestone door surround consisted of thin foam sheeting, secured with wood nailed to the masonry. This protection was rejected as inadequate by the architect, and a full plywood enclosure constructed. In the architect's solution, it should be noted that a temporary door is used while the original door is stored for safe keeping during construction. Photo: Ford Farewell Mills and Gatsch Architects.

The above notwithstanding, architects routinely specify temporary facilities including temporary utilities, temporary construction and support facilities, and security and protection services. For preservation projects, it is recommended that temporary protection of historic interiors during construction be specified in a separate Division 1 specification section entitled "Special Project Procedure" or "Restoration Project Procedures" to ensure that required provisions are not overlooked by bidders because they appear in the often lengthy Section 01500 — Temporary Facilities. Under competitive bidding circumstances, bidders logically seek to minimize the cost to the project for providing temporary facilities, including temporary protection of historic interiors. By creating a separate section in a price proposal, the bidder will be inclined to treat the "special project procedures" as an added cost rather than a part of the temporary facilities required for any alteration project. The contractor's project manager can thus anticipate making reasonable expenditures for providing specified temporary protection during construction. To ensure the adequacy of temporary protection measures in projects involving a construction manager, temporary protection is often best provided by the construction manager, who normally works for the owner on a cost-plus-fee basis *(see figure 7)*.

Temporary protection should generally be specified rather than detailed, with details provided by the contractor as shop drawings. Materials permitted and prohibited, fasteners, attachment to existing construction, descriptions of assemblies, and other provisions should be specified in adequate detail to enable the contractor to prepare shop drawings for specific field conditions. More detailed requirements may be involved where a conservator's plan is required for select items or rooms due to their special significance.

The temporary protection of historic interiors during construction is also affected by other specification sections. In Section 01045—Cutting and Patching, it should be clearly stipulated *who* is to perform cutting and patching in spaces involving historic interiors. This is particularly important in multiple prime contracts, where each contractor is responsible for his own cutting and patching. Unless carefully specified, all the positive temporary protection work specified in Section 01100 may be lost to damage done during cutting and patching work. In Section 01500—Temporary Facilities, requirements for trash chutes affect fire protection, as do requirements for field offices, materials storage and site access. Additionally, dust control, whether specified in Section 01500 or in Section 02070—Selective Demolition, must not be permitted in historic buildings by means of water sprinkling.

Conditions prior to commencement of construction should be photographically documented by the contractor. For large preservation projects, project specifications

Special Hazards Involving Large Buildings

The rehabilitation of large buildings demands the greatest planning for fire safety. Although structural components are typically noncombustible, other building assemblies, stored materials, and finishes are not. A number of special hazards are created during rehabilitation that could cause major damage to the historic building. Alterations to fire stairs and elevators may create unvented, unprotected multi-story shafts which behave as flues in the event of a fire. Alterations to fire stairs, fire separations, and fire sprinkler systems may require the deactivation or partial deactivation of such systems during construction work. Building heat and water are often turned off during major building rehabilitation, introducing the hazard of temporary heat while reducing the protection afforded by a quickly accessible water supply. And finally, the rehabilitation of major structures typically involves large construction equipment, including those powered by internal combustion engines within or immediately adjacent to the buildings.

For large, non-combustible construction structures requiring the use of internal combustion engines indoors, fuel storage, equipment operation, and equipment service should be addressed in the specifications. Except for propane-fueled "bobcat" loaders, all exhausts should discharge to the building exterior. Fuel for internal combustion engines should not be stored and equipment should not be serviced within the building.

may require a professionally prepared videotape survey of the entire building interior. For small projects, a videotape survey may also be an effective supplement to existing conditions photographs. The owner may wish to document existing conditions independent of the contractor in order to avoid any future dispute regarding damage caused by construction operations as opposed to pre-existing damage.

Conclusions

Temporary protection of historic interiors during construction, an essential component of any preservation project, is largely a construction management issue. A successful protection program is the result of careful pre-planning, thorough project-specific specifications, owner vigilance, contract enforcement, and contractor diligence. Cost savings can be realized by minimizing damage to the historic structure in the course of construction work. Even more importantly, a successful protection program controls risks and hazards that could otherwise result in the loss of significant historic materials and finishes — or an entire building.

NOTES

[1]NFPA 241 is available from the National Fire Protection Association, Quincy, Massachusetts, telephone 800-344-3555.

[2]AIA Document A201, General Conditions of the Contract for Construction, Paragraph 3.3.1.

[3]AIA Document A201, Paragraph 4.2.3.

[4]AIA Document A201, 10.2.1.3.

For further reference, see *Preservation Tech Notes* Number 18 on paint removal and Number 10 on temporary protection of historic stairways.

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PRESERVATION TECH NOTES are designed to provide practical information on traditional and innovative techniques for successfully maintaining and preserving cultural resources. All techniques and practices described herein conform to established National Park Service policies, procedures and standards. This Tech Note was prepared pursuant to the National Historic Preservation Act, as amended, which direct the Secretary of the Interior to develop and make available to government agencies and individuals information concerning professional methods and techniques for the preservation of historic properties.

Comments on the usefulness of this information are welcomed and should be addressed to Tech Notes, Preservation Assistance Division, National Park Service, P.O. Box 37127, Washington, D.C. 20013-7127.

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