ISSUE 1/2001 ▪ VOLUME 19 ▪ NUMBER 1

Hoffmann Architects

Journal of architectural technology published by Hoffmann Architects, specialists in the rehabilitation of building exteriors.

Journal

Façade Cleaning:

For More Than Appearance's Sake

Richard P. Kadlubowski, AIA and Coleman H. Bynum, AIA

Why should a building's façade be cleaned? The issue of aesthetics first comes to mind. After all, a clean building simply looks better than a dirty building. A clean building presents a more hospitable front—and therefore a more attractive real estate prospect—to the public. Just as we put our best foot forward with a neat, kempt appearance, a building looks its best when free of the grime, pollutants and staining that shadow its most visible—and often most vulnerable—attribute, its façade.

Of course, not all building façades warrant the same amount of care and attention. A building's location, function, and geographic and atmospheric conditions all play roles in determining the level of cleaning effort necessary to achieve the desired appearance.

Consider function: Structures which house commercial activity, in business, theatre or shopping districts, often warrant a higher degree of cleanliness than do buildings that house industrial—or less public—activities. A bank building manager, for example, may choose to maintain an immaculate façade to greet clients and account holders, while a warehouse owner may find it understandably unnecessary to achieve the same level of cleanliness for his structure.

Furthermore, if and when it is decided a building's façade will be cleaned, it may be that only a portion—for instance, that which is visible from the sidewalk—will be cleaned. A skyscraper in Manhattan, for example, may be cleaned from the ground to the sixth floors only, limiting the cleaning effort to that portion of the building's façade that is visible to bustling commuters. Cleaning the ground floors only is a viable alternative when it may be costly—not to mention foolhardy in a pollutant-ridden urban locale—to clean a building's façade completely.

Finally, what it takes to clean a building situated in the country is typically far less an endeavor than if that same building were located in a metropolitan area. The rural building may warrant only water soaking to remove mild contaminants (such as dirt), while the urban building would most likely require a more in-depth cleaning effort—to remove more hazardous pollutants—to achieve the same level of cleanliness.

While aesthetics is the obvious—and primary—reason for cleaning a building façade, the effort to expose the substrate for evaluation and repair runs

(continued on page 2)

Workers pressure wash the concrete façade of a corporate office building.

Richard P. Kadlubowski, AIA and Coleman H. Bynum, AIA, Senior Architects with Hoffmann Architects, oversee a variety of façade cleaning projects for the firm.

(continued from page 1)

a close second. It is nearly impossible to gauge the condition of a masonry substrate, for example, when the façade is covered in dirt, grime and/or a coating. In order to determine those areas which need to be patched, repaired or resealed—or, in some cases, to even *properly identify* the substrate—the façade should be cleaned of any and all elements that preclude its proper evaluation.

Still another key motivation behind façade cleaning is the effort to remove damaging pollutants such as sulfur and nitrogen oxides, and other acid rain pollutants, from the façade. These pollutants serve to accelerate façade deterioration.

Case in point: moisture is the primary cause of masonry decay. When moisture is coupled with soluble salts from polluted rainwaters or with atmospheric gases, the decay is accelerated. When the soluble salt dissolves in water, it travels deep into the masonry substrate through pores or cracks. Once the moisture evaporates, the salt recrystallizes, exerting tremendous pressures which break down the masonry from within.

Additionally, atmospheric gases such as carbon dioxide, sulfur dioxide and nitrogen oxides react with dirty, wet surfaces to form corrosive liquids such as carbonic acid, sulfuric acid and nitric acid. These liquids react with various elements in the masonry and may result in the formation of hardened surface crusts and dissolution of acid-soluble cementing binders that hold the masonry together. The formation of these dense surface crusts and the washing away of acid-soluble binders, if allowed to persist, are progressive deterioration processes.

Lastly, façade cleaning opens a building's pores and allows the normal transpiration of moisture. Moisture trapped within a masonry wall, for example, will remain there if a waterproofing coating prevents its exit. In this case, as moisture is the leading cause of masonry decay, comprehensive façade cleaning to include removal of the waterproofing coating may be the key component of the design professional's effort to restore the building.

How Clean is Clean Enough?

Once the decision has been made to clean a building's façade, the question of 'how clean is clean enough?' may arise. Generally, the primary objective should be to remove any and all contaminants from the façade. Beyond this, the question of 'how clean is clean enough?' should be answered on a case-by-case basis, with the full subjectivity of the building owner and/or manager.

In the case of older buildings, however, should they be so thoroughly cleaned as to look new? Would the Pantheon in Rome suffer in our mind's eye if its 1800-year history were somewhat forgotten in the gleam of pristinely scrubbed pozzolan [1] concrete? Indeed, many individuals involved with the preservation of historic structures argue that too much cleaning strips these buildings of "a certain dignity earned with the passage of time." [2] They assert that the dirt *patina* represents a natural process of weathering which is of "important historical significance and in character with older buildings viewed in a contemporary setting." [2]

However, the fact remains that the accumulation of surface staining goes far beyond aesthetic deformation; heavy surface deposits contribute to the progressive decay of stone, masonry and concrete surfaces. The owner, with the guidance of the design professional, must find a balance for the building's façade at which point it is free of any contaminants that may threaten the substrate while not so scrubbed as to contradict the structure's history.

To Clean Before or After Restoration/ Repairs?

Still another important factor to consider in preparing to clean a building façade is *when* to do it: before or after repairs and restoration work. As previously mentioned, it can be difficult to detect what may need to be repaired in a surface when it is heavily coated in dirt, stains, paint and/or other coatings. And, as it is best to patch/repair a clean, sound surface, it may be preferable to clean the façade *before* any repairs.

However, there are exceptions to this somewhat loose rule. For example, when a stone building has extensive leak problems, and the design professional must coordinate patching and sealant work, it may very well be a mistake to run the risk of even greater water intrusion by adding water during cleaning to already precarious areas. In these instances, the design professional may choose to patch and seal areas of water intrusion prior to the commencement of cleaning.

Protection Against Damage

To ensure a successful façade cleaning project, whether it be for stone and masonry, concrete, or aluminum, it is crucial to choose and implement the most appropriate method for the surface. Protection against damage to personnel, to the building, to the site and to the environment should be the foremost consideration in choosing and implementing the cleaning method.

[1] pozzolan: The Romans produced lime by burning limestone pieces. Mixed with volcanic ash (pozzolan) and water, it becomes a mortar. The Romans mixed this mortar with small stones, bricks and other materials to produce concrete.

Protecting personnel

Of the three general categories of cleaning methods—chemical cleaning, water cleaning and abrasive cleaning—chemical cleaning packs the highest risk quotient to the individual. The design professional should require as part of the cleaning submittals a detailed description of the proposed materials and methods of protection for preventing harm caused by the cleaning work to all persons in the cleaning area. Product data and Material Safety Data Sheets (MSDS) should be submitted for all recommended materials and chemical cleaning products.

The persons performing the cleaning must adhere to the guidelines set forth in a chemical's MSDS to protect against damage to themselves or the public. All precautionary measures should be read carefully, and first-aid instructions—in case of contact or exposure—should be reviewed. These instructions include what to do in case of eye contact, skin contact, inhalation and ingestion. Also included in the MSDS are spill and leak procedures as well as guidelines for container handling, storage and shelf life.

Chemical cleaning products are not the only potentially hazardous elements to be aware of during façade cleaning. Bird droppings and other bird-related matter offer another source of some very unhealthy effects. And, as one can well imagine, there is a distinct possibility that one will encounter a considerable amount of bird matter during façade cleaning.

Bird droppings and other bird-related matter contain substances, including agents of diseases such as *Histoplasmosis* and *Cryptococcosis*, that are harmful—and sometimes fatal—to humans. All necessary precautions must be taken to prevent workers and other people without appropriate protection from touching, ingesting, inhaling or contacting in any other way bird-related matter. Finally, the disposal of such substances must comply with applicable federal, state and local laws and regulations.

Protecting the building

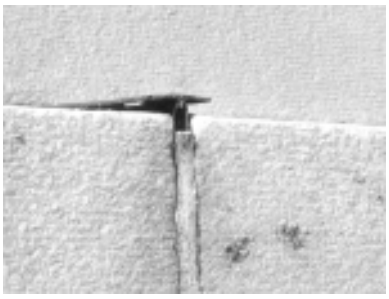
In protecting against damage to the building during façade cleaning, the design professional should submit in advance a detailed description, including drawings and diagrams, of proposed materials and methods of protection for preventing harm, damage or deterioration caused by the cleaning work to all building elements, materials and finishes.

To protect surfaces of the building intended to remain without cleaning, the design professional instructs the contractor as to the specified protection materials to protect all glass, metal, wood and/or painted surfaces that should not be affected during masonry cleaning, for example. These specified protection materials may include masking products that are sometimes part of a manufacturer's chemical cleaning system.

Additionally, all windows and doors and other existing openings should be temporarily sealed to prevent liquid and particulate entry. Again, materials used to do this must be those specified by the design professional. Window and door hardware should be checked for operability at the conclusion of the work.

Test cleaning a patch of the façade is a critical element of the façade cleaning process. It is essential not only in ensuring that the cleaning effort will have the desired results but also in ensuring that the chosen method will not damage the façade. Prior to initiating a full masonry cleaning project, for example, test cleaning should be conducted for

Points of water infiltration that should be repaired prior to façade cleaning:



End of a copper joint cover is open in a joint in a projecting course.

Lead joint cover has been pushed out of the joint. Caulking in joint is brittle and not bonded to the stone.

100 square feet for each substrate and for each cleaning method specified. Full cleaning should not proceed until the test patch has been reviewed and accepted by the design professional and the building owner.

Prior to test cleaning, it must be assured that the work of other trades that might affect the cleaning work is fully complete. Cleaning should not commence until all other work has ceased. When performing the test patch, only the cleaning methods specified by the design professional for each type of material and location should be used. Each cleaning method indicated should be performed in a manner which results in uniform coverage of all surfaces,

(continued on page 4)

[2] *Boyer, David W., Author, "Masonry Cleaning-The State of the Art," Cleaning Stone and Masonry. 1986.*

(continued from page 3)

including corners and moldings, and which produces an even effect without streaking or damage to the surface.

Finally, planning around Mother Nature is essential in protecting against damage to the building during façade cleaning. The weather can make or break a façade cleaning project. If it is too cold, liquid cleaning products and water will freeze to sheets of ice. Conversely, if it is too warm, a chemical product's drying time may accelerate, so it may not have time to work as it should and may not wash off properly. Furthermore, wind may cause additional problems with vapor and overspray. The design professional should specify stipulations on how to work around the weather *prior* to commencement of the façade cleaning project (i.e., A cleaning specification may require that masonry cleaning work not be performed when temperatures may drop below 50 degrees-or soar above 90 degrees-Fahrenheit within 24 hours of the work.).

Protecting the site

To protect the site during façade cleaning, plans must be implemented to confine dust, liquids, overspray and debris to prevent detrimental effects to adjacent properties and to the public. Temporary protection such as barriers, enclosures, netting or other protection as needed should be provided and erected to prevent harm to personnel and adjacent portions of the building.

Once the work of the cleaning operations has ceased, all temporary protection should be removed.

Furthermore, the design professional should ensure minimum interference with streets, walks and other adjacent facilities. For example, the flow of water from soaking and cleaning operations should be continuously monitored to avoid damage to the building and surrounding areas, and excessive amounts of water should not be permitted to flow across walkways. Also, plywood trafficways may be necessary for all surfaces such as roofs or terraces that will receive pedestrian traffic during cleaning. The plywood should be free of splinters, fasteners and any other irregularities that may damage the existing surface.

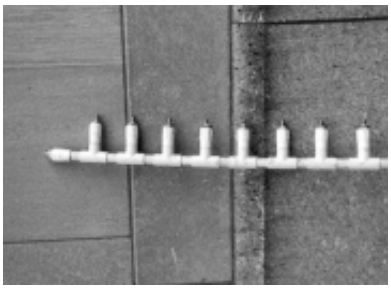
Protecting the environment

The design professional should plan in advance any necessary precautions to prevent hazardous material from entering the environment. All means necessary should be utilized to prevent contaminated water, chemicals, chemical fumes and abrasive particles from flowing into drains or entering air intakes and exhausts. Protection and waste collection systems should be in place before general cleaning begins.

To prevent cleaning chemicals or particles of dirt or mortar from flowing into drains, for example, the design professional may instruct that appropriate precautions be taken.

Cleaning Stone, Masonry and Architectural Concrete

Basically, all façade cleaning projects fall into one of four categories: chemical, non-chemical, abrasive and those that may require a combination of these methods. For example, though a



Water soaking is one of the least intrusive façade cleaning methods:

◁ *(Left)* Water-soaking nozzles assembled to clean a limestone façade.

▽ *(Below)* A worker scrubs and removes softened soil from the water-soaked limestone façade.

masonry façade cleaning project may partially succeed with a non-chemical water soaking procedure to loosen dirt and wash it away, it may be necessary to supplement this method with an appropriate cleaning agent (chemical) to treat areas of heavy stains.

The building owner and/or manager should consult with the design professional to arrive at the façade cleaning method that is best suited to their building.

Water cleaning methods

Water Soaking: A slow, steady stream of water[3] is used to loosen dirt and wash it away, a very effective method as the dirt becomes swollen and soft. A manifold of piping and nozzles is constructed for this purpose. Hand scrubbing with brushes or rinsing with 400 psi (pounds per square inch) water spray may follow the water soaking.

For each water soaking façade cleaning project, the design professional determines the appropriate:

a) duration of soaking (in hours);
b) number of gallons of water per minute per nozzle; and
c) nozzle spacing.

This method is very effective on stone, especially limestone, and glazed brick. However, there are possible limitations related to this procedure—as there are with any procedure—that must be taken into consideration:

- Prolonged exposure results in oxidation of natural components of masonry and transports harmful salts deep into the masonry.

- Saturated masonry takes several weeks to dry.

- Cleaning of the masonry façade must be scheduled for times when there is no threat of freezing.

- Continuous cascading of water results in erosion.

- There exists the possibility that interior surfaces, furnishings and equipment may be damaged.

- Water run-off must be controlled.

Pressure Washing: Pressurized water, measured in pounds per square inch (psi), blasts contaminants away from the façade. This procedure is effective on stone, masonry and concrete for the removal of light to moderate atmospheric and organic staining. This method utilizing heated water (not to exceed 160 degrees Fahrenheit) may prove effective for removal of grease and oil stains.

Sometimes referred to as power washing, pressure washing is specified by the design professional according to four parameters:

a) pressure rating (psi);
b) water flow rate;
c) spray tip (type and size); and
d) distance from the substrate.

Limitations associated with this procedure are as follows:

- Pressure washing alone will not remove severe staining.

- High pressures are abrasive and may partially remove mortar and etch stone.

- Oxidation of masonry may result.

- Saturated masonry takes several weeks to dry.

- Cleaning must be scheduled when there is no threat of freezing.

- Water may find its way through small openings and cause premature decay.

- Water run-off must be controlled.

- This method is not a replacement for hand labor.

- This method should NOT be used to apply chemical cleaners, as the chemicals will be driven deep into the masonry.

Chemical cleaning methods

Manufactured by companies to conquer the "tough" façade stains, chemical cleaning products work by dissolving the stains, allowing them to be rinsed away. Generally, chemical cleaners fall into one of four categories: *acidic cleaners*, *alkaline cleaners*, *organic solvents*, and special *non-sudsing detergents*.

The list of available commercial chemical cleaners for different types of façade surfaces is long and varied: Some are designed to remove efflorescence and salt staining. Others are used primarily to remove excess mortar, grout stains and dirt. Still others are best suited for use on brick that may have high metallic content.

There are restoration cleaners designed to combat extremely dirty and heavily carboned masonry typically found in large cities or high pollution areas. Commercial *poultices*, designed for areas in which the contaminant has penetrated into the substrate, as opposed to being on the surface, are available for different types of surfaces. Strippable masking materials are available to protect glass, metal and polished stone surfaces from the damaging effects of acidic brick cleaners.

As is evidenced by the aforementioned examples, chemical products are

[3] Water for façade cleaning should be from the municipal water supply and clean at the time of use. In some cases, the water used for cleaning building façades may need to be pre-treated with an ion-exchange water softening system in order to avoid staining, efflorescence and other problems.

(continued on page 7)

representative projects

Façade Cleaning

Hoffmann Architects has developed and implemented façade cleaning programs for a number of its clients. The following narratives briefly discuss the diverse plans prepared for some of these clients.

Rockefeller Center

New York, New York
(Rockefeller Center Management Corporation)

As part of an overall rehabilitation plan, the design professionals of Hoffmann Architects implemented water soaking followed by scrubbing with brushes to clean the Indiana Limestone façades of the landmark Rockefeller Center complex. The water soaking, which did not threaten to etch the stone, was initiated *after* repairs so as not to allow water to enter open joints. Absolutely no chemicals were used during the cleaning process.

Hoffmann Architects scheduled the cleaning work so as not to impede the pedestrian traffic along the busy block that lies between New York City's 5th and 6th Avenues and 48th and 51st Streets—and so that water runoff did not pose any problems. Most of the cleaning work was therefore completed during the night when relatively few people were in the area.

Our Lady of Angels Motherhouse and Chapel Enfield, Connecticut. Hoffmann Architects cleaned the facades of existing water repellents to enable the brickwork to breathe.

Radio City Music Hall at Rockefeller Center
New York, New York (Rockefeller Center Management Corporation)

Southern New England Telephone (SNET)

Hartford, Connecticut

Hoffmann Architects initiated a repair and cleaning effort to rehabilitate the limestone façades at SNET's Hartford facility.

A combination of chemical and non-chemical methods was used to achieve the desired cleaning results for the structure. The cleaning effort began with long periods of water soaking (12- to 24-hour soaks) followed by scrubbing with clean, natural bristle brushes to remove

stains. Lastly, a chemical cleaning product was used to remove heavy stains.

The Prudential Insurance Company of America
Eastern Operations Office
Dresher, Pennsylvania

As part of a comprehensive restoration effort, Hoffmann Architects implemented a plan to clean the concrete façades of Prudential's Eastern Operations Office. No chemicals were used during the cleaning process. To ensure successful results during pressure washing of the facade, consistent parameters—for type and size of tip, pressure rating (psi), water flow rate and distance from the substrate—were maintained from the beginning to the end of the project.

Chase Manhattan Centre
1201 Market Street
Wilmington, DE

Hoffmann Architects utilized a combination of methods to clean the polished granite and concrete facades of Chase Manhattan's one-block-square office complex.

Both the polished granite water table and the concrete façades were water soaked for 12- to 24-hour periods. The water table was further low-pressure washed at two to four hundred psi. Areas of heavy stains—such as the concrete above the loading dock that carried the exhaust from countless trucks—were treated with a chemical cleaning agent.

Other Façade Cleaning Projects:

The Hartford Insurance Company Corporate Headquarters
Hartford, Connecticut

Vassar College
Vassar Observatory
Poughkeepsie, New York

Congregation Rodeph Sholom
Bridgeport, Connecticut

New York Stock Exchange
New York, New York

Verizon Communications
New York, New York

Xerox Corporation
Corporate Headquarters
Stamford, Connecticut

Xerox Document University
Leesburg, Virginia

United States Capitol
Washington, District of Columbia
(The Architect of the Capitol)

Fred French Building
551 Fifth Avenue
New York, New York
(Metropolitan Life Insurance Company)

Our Lady of Angels Motherhouse and Chapel
Enfield, Connecticut
(Felician Sisters of the Order of St. Francis)

Chrysler Building
New York, New York

250 Broadway
New York, New York

MetLife Building
New York, New York
(Metropolitan Life Insurance Company)

Mattatuck Museum
(Bank of Boston Building)
Waterbury, Connecticut

(continued from page 5)

numerous and designed to solve a variety of cleaning issues. It is essential to follow the design professional's guidelines set forth in the submittals and the manufacturer's guidelines outlined in the Material Safety Data Sheets when implementing a chemical façade cleaning method. Handling and storage, clean-up and disposal, and safety and first-aid information should be reviewed in advance.

Handling of cleaning wastewater

The runoff from chemical cleaning and rinsing operations falls into three categories: non-hazardous wastewater, acidic/alkaline wastewater that can be neutralized on site, and wastewater classified as special or hazardous waste.

Non-hazardous wastewater may be released to sanitary sewers, storm sewers, or by soaking into the ground.

Acidic/alkaline wastewater must be contained and neutralized prior to release to sanitary sewers—it should never be released to storm sewers per Environmental Protection Agency (EPA) regulations; the design professional should verify in advance the "industrial wastewater pretreatment program" of the municipality.

Hazardous wastewater that contains compounds such as methylene chloride (a paint stripper) must be contained, pumped into storage tanks and taken to a licensed Transport, Storage and Disposal (TSD) facility.

Abrasive cleaning methods

Of the various methods to clean stone, masonry and concrete, abrasive cleaning is unique in that it is designed to completely remove the outer portion of the substrate on which the stain sits, rather than merely dissolving and washing away the stain. For this reason,

(continued on page 8)

(continued from page 7)

abrasive cleaning is generally not recommended for restorative facade cleaning projects. Grit blasting, grinding wheels, sanding disks, sanding belts and wet sandblasting (grit blasting combined with high pressure washing) all fall into the category of abrasive cleaning. New methods, using very small (20- to 100- micron) grit and containment of the cleaning area, are available which are far less intrusive to the substrate. While abrasive cleaning methods are effective in removing a variety of surface stains, the limitations associated with the various techniques are numerous:

- Removal of masonry surface exposes a softer substrate to more rapid deterioration.

- Abrasive cleaning techniques are ineffective in removal of subsurface staining.

- The significant amount of dust created by abrasive techniques makes the monitoring of progress difficult.

- Airborne silica dust present safety hazards; sandblasting is banned in many municipalities.

- Abrasive cleaning opens the surface area of the treated substrate to atmospheric corrosion, water absorption and other decay processes.

- Grit blasting may increase the need for repointing.

Cleaning Aluminum

Cleaning architectural aluminum is a relatively simple process. As the strength and durability of aluminum is not materially affected by dirt or oxidation, cleaning is generally necessary only as an aesthetic measure. Therefore, the frequency of cleaning is primarily determined by the desired appearance of the structure. Other maintenance with which aluminum cleaning may be conveniently combined and local atmospheric conditions also play roles in determining the frequency of aluminum façade cleaning.

Mild cleaners, solvent and emulsion cleaners, abrasive and etching cleaners, steam cleaners and power-driven brushes are among the methods used to clean aluminum façades. The building owner and/or manager should consult with the design professional to arrive at the aluminum façade cleaning method that is best suited to their building. Cleaner concentration and application time instructions, as well as the manufacturer's safety precautions, should be followed carefully to ensure a safe and effective façade cleaning project.

JOURNAL is a publication of Hoffmann Architects, specialists in the rehabilitation of building exteriors. The firm's work includes investigative and rehabilitative architecture/engineering services for the analysis and resolution of problems within roofs, facades, glazing, and structural systems of existing buildings, plazas/terraces, and parking garages.

Please send news, technical information, address changes, or requests for free subscriptions to Editor, Hoffmann Architects *JOURNAL*, 432 Washington Avenue, North Haven, Connecticut 06473. For answers to specific questions or for information on the services Hoffmann Architects offers, please contact Sandra Matheny at (203) 239-6660.

432 Washington Avenue
North Haven CT 06473-1309
203 239-6660

500 Fifth Avenue, Suite 830
New York NY 10110-0899
212 789-9915

1001 Connecticut Avenue NW
Washington DC 20036-5525
202 530-1100

For more information on the topics discussed in this article, visit us on the web at www.hoffmannarchitects.com, or contact us at email@hoffmannarchitects.com.

Editor: Maryellen Apelquist
Graphic Services: Maryellen Apelquist

Hoffmann Architects

432 Washington Avenue
North Haven, Connecticut 06473

ADDRESS SERVICE REQUESTED

PRSRT STD
U.S. POSTAGE
PAID
PERMIT NO. 1090
NEW HAVEN, CT