

# JOURNAL

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## Waterproofing / A Roundtable Discussion

**B**efore a building owner or manager makes a major commitment to waterproofing, he must determine *why* the original system failed. Any attempt at waterproofing before the underlying cause has been found and the proper solution developed could result in wasted time, money and effort, according to the architects who took part in the roundtable.

"There is no one formula and no off-the-shelf solution for making a wet building dry," Walter Damuck told the group. "Before you can properly correct the problem, you must have all of the facts at hand."

**Editor's Note:** *Four key architects at Hoffmann Architects, North Haven, Connecticut, John Hoffmann, AIA, principal; Theodore Babbitt, AIA, Director of Architectural Services; Russell Sanders, AIA, Director of Technical Services; and Walter Damuck, AIA, Director of Building Investigations have devoted much of their careers to rehabilitating commercial, industrial, retail, hotel and theater buildings. Over the years, one of their greatest challenges has been to take leaky buildings and make them dry. Recently, the architects participated in a roundtable discussion on how to provide a long-term solution for the damp or wet building. The article which begins on this page will prove informative to building owners, managers and others who may be faced now or in the future with the economic nightmare of a wet building.*

John Hoffmann agreed: "There are no pat answers to problems of waterproofing. Questions must be asked: Did the original system fail because of age? materials? installation? or design?" He said the job of finding the cause and then developing a plan for solving the problem begins with a physical inspection of the structure. The interior as well as the exterior needs to be inspected to help pinpoint the exact source of the leaks.

The problem could be almost anywhere in the building, according to Russell Sanders. On the roof, the problem could be the flashing around roof penetrations, around mechanical systems or around drain areas. It could be the way repairs were made on the roof over the years. It could be due to age of the roof or sheer neglect.

"Weak links in the building are often found in the curtain wall and masonry, particularly at intersections or joints where the roof joins the parapet," Theodore Babbitt told the group.

Explained Mr. Babbitt, "We try to discover which materials within the waterproofing system are most vulnerable to failure. Nothing lasts forever, and if materials break down they are a source of entry for water."

Mr. Damuck pointed out, "In a brick building, mortar joints, the 'glue' that holds the building together, often leak. In one square foot of brick wall there

Photo / Rockefeller Center Management Corp.



Rockefeller Center's building envelopes are among the best constructed and maintained in the world. The Center's comprehensive maintenance program prevents most waterproofing problems before they occur.

are 13 lineal feet of mortar-brick interfacing. If each brick to mortar joint developed a hair-line crack of only 1/64th of an inch, that would result in the equivalent of a slot 1/4 inch by eight inches, and that is enough to let a lot of water into the structure."

The roundtable agreed that brick and mortar joints must be carefully inspected for problems because there are so many potential problems with this area of a building.

In this context, John Hoffmann mentioned that when a material that is no longer sold on the market is discovered within the system it must be checked very carefully.

### Studying Original Plans

Besides pinpointing the exact locations of leaks, it is also crucial to study the original plans and specifications of the structure:

- What type of waterproofing system was used?
- Are there components within that system that may be incompatible?
- Are there questionable design details within the system?

- If the job was designed properly, was it actually constructed according to the construction documents?

"We look at how the job *should* have been done and then *evaluate* if it was in fact done that way," said Mr. Hoffmann. "When we discover that the job was not done the way it should be, we often have our answer as to why the waterproofing system failed. By the time we are called to a job, the owner is usually putting out buckets to catch the water. If the job was not done right the first time, he is usually very willing to listen to how it should be done this time around."

Unfortunately, noted Mr. Babbitt, by the time the client does call us with a leaky building, chances are water has been infiltrating into the building long before it was noticed. This usually means that the building has been damaged by the water before the owner even realized it was leaking.

### Investigating a Complex Building

Sometimes buildings are very complex and it is difficult to determine exactly where the waterproofing system has failed. Says Mr. Babbitt, "What makes a



John J. Hoffmann, AIA

building complex is the mix of materials used. On older buildings, problems often result from age or neglect. In some instances, something has been done to the building over the years to alter the original waterproofing system. In the newer buildings—and buildings with leakage problems keep getting newer and newer—we find poor design, poor construction, poor materials or all three at once. Building owners cannot believe how quickly a roof needs to be replaced. One of our clients who needed a new roof on his building commented that the roof on his house was 25 years old and in good shape."

Mr. Babbitt went on to say, and the others at the roundtable agreed, that "there seems to be a lack of knowledge among architects regarding the use of materials. I find it surprising when I talk to people how little they really know about the materials that go into buildings. Also, what contractors do to a structure can cause tremendous harm. I spoke with one person recently who uses roofing cement containing asbestos when he repairs a roof.



Walter E. Damuck, AIA

"That roofing felt is all fiberglass, but when it is replaced someone will take a core through an area and find the asbestos. Then it will become an asbestos removal project as well as a re-roofing job and costs will double, triple or quadruple. This person told me that half the people in his company use asbestos for repairs and half do not."

### Clean Design, Poor Waterproofing

Mr. Babbitt told the roundtable that on some newer projects the problem lies with the design of the building: "In an attempt to make the design so clean, the design professionals do not want to see any little pieces of metal hanging over the top of the building. They do not want to see the coping projecting beyond the smooth plane of the building. They try to clean up the design so much that there is no place for flashing. The result is water leakage into the building."



Russell M. Sanders, AIA

Mr. Damuck also noted that on newer buildings, problems could develop because of the way the windows are designed. He spoke about a building he looked at recently: "Sixty percent of the outside wall was glass and the gross

rental area is measured from the inside of that glass. The window frames were stuck out an inch-and-a-half beyond the outside face of the building to maximize the rental space. This is a very poor waterproofing detail."

Hoffmann Architects deals with other types of water problems in new buildings as well, according to Mr. Damuck. "In one new building it was 'raining' inside, but it was not raining outside. The rain started in the morning on the east wall. Mid morning, it rained inside on the south wall. In the afternoon, it rained inside on the west wall. It never rained on the north wall.

"What had happened was that the building was hermetically sealed on the outside with a lot of insulation on the inside. There was a seal between the outside and the inside wall. The water vapor on the inside condensed on the inside of the outside wall and froze. As the sun came around and heated up the wall, water cascaded down on the inside of the windows and the walls onto the floors."

Mr. Babbitt recalled a two-year old building on Long Island with water leakage problems. "We looked at the roofing detail and found three defects in that one detail. Nobody really pays attention to the roof. At Hoffmann Architects, we complete more detailing for re-roofing a small commercial building than many architects do for a brand new office building."

### The Structural Steel Solution

One reason building owners and managers have difficulty getting to the root cause of a water leakage problem immediately is that they will call in a specific contractor who will impose a solution specific to his trade. Mr. Hoffmann explains: "At a major office building in New York City, there was a

water leakage problem. The first problem that was discovered was a structural steel problem. So a structural steel contractor was called in to repair it. As that contractor went on, everything became a *structural steel* solution. If the owners had consulted a masonry contractor, everything probably would have involved a *masonry* solution. If they had called in a carpentry contractor, I am convinced everything would have required a *carpentry* solution."

### Working with Specialists

The roundtable felt it makes sense to bring in a specialist from the start to find the root problem and to develop an overall solution. Mr. Hoffmann explained: "We at Hoffmann Architects, have worked on many projects that suffered from severe water leakage problems. Even though most problems are unique, we have solved similar problems, many times. Second, many of us come from a general background in architecture so we know the systems overall. We are not looking at something as a roofing consultant; many times that problem with the roof might be caused by something else that needs to be addressed. And being architects, we can appreciate the aesthetics of it. We will not put corrugated aluminum siding on the side of a parapet to cover up the brick work because that is the cheapest way to go. We will look for an aesthetic solution. We also understand that working on new buildings and working on existing buildings are very different. Existing buildings must continue to operate with the least disruption possible to building occupants."

The roundtable was questioned as to why calling in a qualified consultant is not the first step for many owners or managers. Mr. Hoffmann answered: "An owner's first thought is that a consultant just adds to the cost. On the



Theodore F. Babbitt, AIA

the newer building, first he goes back to the original architects or engineers and when he has exhausted that, he brings in a contractor. When that does not work, then he decides to bring in someone who does this type of work for a living."

Mr. Damuck interjected: "When an owner sees water coming in, his first reaction is to call a roofer. The roofer goes up on the roof with a big bucket of 'stuff'. Wherever he thinks there is a problem he smears it on. He often smears it on weep holes that are supposed to drain water from the parapet walls which create problems later."

Mr. Hoffmann continued: "In many of these situations, particularly new buildings, the architect was hired for his design abilities. There are architects who say they will take care of the design and someone else will take care of the documents. Their responsibility is to make sure that the building is attractive, the spaces work together, and space is efficiently used based on the budget. Those are all extremely important and if they do not work then the building does not work for the

client. These design firms spend time making sure the conference room works, that the atrium meets code. But for actual detail work—the way things go together in the building—the only thing they are concerned about is appearance."

Mr. Hoffmann suggested that many architects, hired strictly for their design skills, do not know a great deal about how systems work together. He told the roundtable: "If it were up to the people maintaining the buildings, they would probably never hire some of these design firms again because the maintenance people have to handle the problems that result from some of these designs. Generally, however, they have no input into corporate decisions.

"What usually happens is that the chairman of one company calls up the chairman of another company who just had a new headquarters built and asks how the building is working out. The other chairman says 'great', he loves it, his office is comfortable. Yet if the maintenance people in the building were asked about the building, they might tell a different story.

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"**There are no pat answers to problems of waterproofing.**"  
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"In one new building I know of, the interior courtyard is surrounded by glass and there are bridges at various levels going from one side to the other. If the windows in the courtyard get dirty there is no efficient way to clean them. The maintenance staff has to put together rolling scaffolding, rolling stations to clean the glass. But every 20 feet there is a break and they must

take the scaffolding down and re-erect it on the other side of the bridge. To wash the glass on the bridge, they must go up to another level and erect a scaffold on the bridge. This is a substantial on-going maintenance expense. Another item that often gets overlooked is how watertight the building is. The maintenance staff gets tied into that as well."

### Building Substructures

Mr. Damuck said to the roundtable: "We have talked about the top of the building but we have not said a word about waterproofing problems at the feet of the building...the area of the building that is underground. It is a special study. It is a special study because no one wants to do the obvious which is to dig a trench around the building and waterproof the outside of it."

Said Mr. Hoffmann: "The basement of a building is one of those areas where one seldom gets a second chance to do a good waterproofing job. The thing is this type of work is not difficult to do right the first time around, but in urban areas it is tremendously expensive to do a second time. There is a tremendous cost and tremendous inconvenience to the public involved because sidewalks must be ripped up and the building must be excavated down three or four stories."

Mr. Damuck responded somewhat tongue-in-cheek: "By the time you get municipal permits to do this type of work, the people who owned the building have died."

"Waterproofing basements reminds me of taking ceramics in college," said Mr. Hoffmann. "I would spend hours sanding a piece of ceramic that did not come out just right. But two days before, that material was soft clay and it could have been easily changed."

In concluding the roundtable, the four architects stressed that to provide a long-term solution for a leaky building, the underlying reason for the failure of the waterproofing system must be uncovered and fixed. ■

## Waterproofing Tips

**B**efore attempting to make a wet building dry, the most critical step is to determine why the system failed. A minimum of three steps should be taken to determine the cause of failure.

1. Inspect the inside of the structure and pinpoint the exact location of interior leakage. On walls and floors this is a relatively easy task. On ceilings, the job is more difficult. For example, stains on suspended ceilings will not always be immediately under the leakage point. Water may be flowing along a beam or a construction joint for some distance before it drips off. Remember also that pinpointing the location of the interior leakage does not guarantee that the entry point through the waterproofing system is directly above. Water may be entering the waterproofing and traveling laterally under the waterproofing.

2. Study the original plans and specifications. Determine what type of waterproofing system was used in the original construction. Are there components which may be incompatible? Are there any questionable design details which may have interfered with good waterproofing practice? Could there be

## The Facility Manager's Bookshelf: Waterproofing

### A. Basic References

1. ASTM  
*Roofing, Waterproofing, and Bituminous Materials* (Volume 04.04 of 1990 Annual Book of ASTM Standards) 474 pages. \$47.00. Order number: PCN: 01-040490-57. No shipping charge for prepaid orders.  
By phone: (215) 299-5585 (Amex, Mastercard, or Visa)  
By mail: ASTM, 1916 Race Street, Philadelphia, PA 19103-1187 (check payable to ASTM)  
By FAX: (215) 977-9679
2. FGMA: Flat Glass Marketing Association  
*FGMA Glazing Manual* (\$9.00; \$1.65 postage) 1986  
*FGMA Sealant Manual* (\$9.00; \$1.45 postage) 1983  
By mail: FGMA, 3310 Harrison, Topeka, KS 66611
3. NRCA: National Roofing Contractors Association  
*NRCA Roofing & Waterproofing Manual*, 3rd Ed. (\$118.00)  
*NRCA Waterproofing Manual*, 3rd Ed. (included in above item; \$27.00) (item 214)  
*Roofing Materials Guide* (subscription for 2 issues per year, \$95.00; Item 401)  
By mail: Roofing Resource Center, NRCA, P.O. Box 3129, Oak Park, IL 60303  
Handling charge: \$2.00

### B. Compilations of Product Literature

1. *Waterproofing and Dampproofing Materials and Systems*. Concrete Sourcebook, October 1989. \$10.00 including postage.  
Inquiries: (800) 323-3550 or (312) 543-0870  
By mail: The Aberdeen Group, 426 South Westgate, Addison, IL 60101  
By FAX: (312) 543-3112
2. *Masonry Products for Historic Buildings*. 1988. \$7.00; check payable to: Center for Architectural Conservation.  
By mail: Center for Architectural Conservation, College of Architecture, Georgia Institute of Technology, Atlanta, GA 30332  
Inquiries: (404) 894-3390.
3. See also section 07100 in *SWEETS Catalog Files*, General Building and Renovation.

### C. General Reading

1. *The Applicator*, newsletter.  
By mail: Sealant, Waterproofers, and Restoration Institute, 3101 Broadway, Suite 300, Kansas City, MO 64111.  
By phone: (816) 561-8230
2. ASTM (for ordering information see part A above.)  
*Moisture Migration in Buildings*. Edited by Loeff & Trechsel. 291 pages, 1982. (STP 779). \$39.00. Order Number: PCN: 04-779000-10
3. NRCA (for ordering information see part A above.)  
*Practical Guidelines to Control Water Damage*, \$4.00. Item 222.
4. "Waterproofing and the Design Professional" by Brent Anderson. *The Construction Specifier*, March 1986, pages 84-97.  
For article copies, write to: Construction Specifications Institute, 601 Madison Street, Alexandria, VA 22314-1791  
Inquiries: (703) 684-0300. Price per copy \$4.00. Minimum order \$10.00. ■

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Compiled by Alan Eddy, Technical Librarian

In waterproofing, there are pros and cons to applying the waterproofing system on the *positive side* (the side of applied hydrostatic pressure) and pros and cons to applying it on the *negative side* (the side opposite to applied hydrostatic pressure). What follows is a discussion of the advantages

## Positive Side vs. Negative Side Waterproofing

and disadvantages of each system. The same waterproofing applications which might be employed with relative ease and cost effectiveness during new construction often become unfeasible or cost prohibitive during rehabilitation of an existing structure.

### Negative Side Waterproofing

Negative side waterproofing involves placement of a waterproof barrier on the side *opposite to applied hydrostatic pressure*.

Typical negative side interior applications are for foundations, pits, tunnels, shafts and slab toppings below grade. Negative side applications are also effective on structures where the foundation is placed directly against the rock, thereby making a positive side, exterior application impossible. Negative side applications on the exterior include sealing waterholding structures from the outside.

Exposed applications from the negative side may require additional material properties such as traffic, abrasion, erosion and puncture resistance. Since many negative side applications are interior and below grade where they are left exposed, they are often specified with various colors and finishes.

Only a few types of special, rigid membranes and other waterproofings are effective on the negative side, such as cementitious membranes and metallic oxide waterproofings. Since these materials are rigid, close attention must be given to joints and structural stability and rigidity.

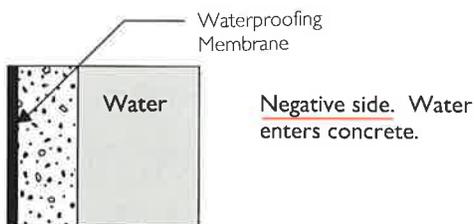
### Advantages of Waterproofing from the Negative Side

- Concrete remains moist cured.
- Elimination of drying shrinkage due to continuous moist curing.
- Continued increase in concrete strength due to moist curing.
- No waterproofing excavation cost incurred for interior application.
- Early backfilling in new construction and no possible damage from backfilling.
- Easy location and repair of damage for exposed barrier applications.

### Disadvantages of Waterproofing from the Negative Side

- No protection of substrate if water contains corrosive chemicals.
- No protection from freeze/thaw damage for above grade concrete.
- Limited to the use of rigid barrier systems.

Adapted from materials courtesy of *U.S. Waterproofing*



### Positive Side Waterproofing

Positive side waterproofing involves placement of a waterproof barrier *on the side of applied hydrostatic pressure*.

Typical positive side applications include waterproofing the exterior of accessible below-grade structures and above-ground roofs, plazas and decks. Positive side applications on the interior include planters, fountains, dams and other waterholding structures.

Some of the positive side applications are left exposed to a harsh environment. These exposed applications, especially above-ground applications, also may require special properties such as traffic, abrasion, erosion, weathering, chemical and ultraviolet resistance. In addition, exposed applications may require waterproofing with a specific color and finish.

Many types of positive side waterproofings, such as bentonite, cannot be used in those areas subjected to moving or running water, or earth settlement which may cause the waterproofing to wash away, erode, shift, settle, tear or come apart at seams. In addition, clay waterproofing is not effective in areas where the water contains certain chemicals. Certain elastomeric membranes significantly change properties when exposed to extreme temperatures, ultraviolet, weathering and normal aging. Cementitious membranes require special treatment and consideration in areas subject to movement due to their rigid nature.

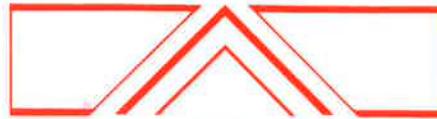
### Advantages of Waterproofing from the Positive Side

- Protection from chemical attack if water contains corrosive substances.
- Protection from freeze/thaw damage for above grade structures.
- Utilization of both rigid and elastomeric barrier systems.

### Disadvantages of Waterproofing from the Positive Side

- Water is blocked from entering the concrete causing it to dry out, resulting in drying shrinkage and cracking.
- Lack of continuous moist curing stops further concrete strength development.
- Excavation costs incurred to make the exterior surface accessible for barrier application on below grade structures may be additional.
- For below grade applications, the barrier may be inaccessible for repairs after backfilling or placement of topping slabs. ■





# REPRESENTATIVE PROJECTS

## Corporate Headquarters Buildings

Hoffmann Architects specializes in the rehabilitation of the exteriors of existing facilities.

Its professional architects and engineers diagnose the causes and design the solutions for deterioration and water infiltration problems within roofs, facades, windows and structural systems.

The firm conducts Building Condition Surveys, prepares Construction Documents and provides Construction Contract Administration services for waterproofing and rehabilitating exteriors.

Hoffmann Architects has provided services for some of America's largest corporations, including work on the following Corporate Headquarters Buildings:

**General Electric Company**  
Fairfield, Connecticut

**Union Carbide Corporation**  
Danbury, Connecticut

**CBS Inc.**  
New York, New York

**Shawmut Bank, N.A.**  
Boston, Massachusetts

**Associated Press**  
New York, New York

**Chesebrough-Pond's Inc.**  
Greenwich, Connecticut

**Exxon Corporation**  
New York, New York

**The Gillette Company**  
Boston, Massachusetts

**Pennwalt Corporation**  
Philadelphia, Pennsylvania

**Simon & Schuster Inc.**  
New York, New York



**Southern New England Telephone Company Headquarters Building,**  
New Haven, Connecticut

**Bank of New England Corporation**  
Boston, Massachusetts

**GE Capital Corporation**  
Stamford, Connecticut

**Heublein Inc.**  
Farmington, Connecticut

**National Broadcasting Company Inc.**  
**GE Building,** formerly RCA Building  
New York, New York

**Southern New England Telephone Company**  
New Haven, Connecticut

**American Cyanamid Company**  
Wayne, New Jersey

**Warner Communications, Inc.**  
New York, New York

**Unilever United States Inc.**  
**The Lever House**  
New York, New York ■



**Union Carbide Corporation Headquarters Building,** Danbury, Connecticut

## Staff News

### Professional Accomplishments:

**John J. Hoffmann, AIA** was elected President of the Building Owners and Managers Association of Southern Connecticut.

**Russell M. Sanders, AIA, Theodore F. Babbitt, AIA, Amy C. Kilburn, AIA** and **John J. Hoffmann, AIA** serve as instructors in BOMA Southern Connecticut's newly developed RPA Program.

**Theodore F. Babbitt, AIA** continues to serve on the Industry Practices Committee of the Connecticut Building Congress.

**Brian W. Schafer** continues his involvement with BOMA New York. He serves on the Membership and Seminar Committees and was recently appointed Vice Chairman of the BOMA NY Professional Members Committee.

**Hoffmann Architects JOURNAL** won Honorable Mention in the 1989 Society for Marketing Professional Services Award Program. **Ann M. Prokop**, editor of the **JOURNAL**, accepted the award at the SMPS National Convention in Boston.

### New Staff:

Hoffmann Architects is pleased to introduce the following new staff members: **John D. Kennedy**, Project Manager; **Stuart H. Radin, PE**, Project Engineer; **Darrick M. Potter**, Drafter/Project Representative; **Janusz P. Sawko**, Drafter/Project Representative; **M. Christine Burr**, Bookkeeper; **Alan P. Eddy**, Technical Librarian. ■

### ▶ Waterproofing Tips

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problems associated with expansion joints or the lack of expansion joints? Are drains properly located? A study of plans and specifications is unlikely to answer the question of what caused failure, but it may be valuable in establishing probable causes. It will help guide the actions in the final and most revealing step.

3. Excavation and inspection must be done in order to reliably understand the nature of the problem. Results from Steps 1 and 2 will help in developing a plan for excavation or removal of overburden and inspection. Care should be taken during excavation or removal of overburden. Under the best of conditions, it may be difficult to be absolutely sure of the cause. If the point of water entry is not found, further excavating will be needed. ■

*Courtesy of W.R. Grace and Company*

*JOURNAL* is a publication of Hoffmann Architects, specialists in investigative and rehabilitative architecture/ engineering, including the analysis and solution of problems within roofs, exterior walls, glazing and structural systems of existing buildings, plazas and parking garages.

Please send news, technical information, address changes or requests for free subscriptions to Ann Prokop, Editor, Hoffmann Architects/*JOURNAL* at 432 Washington Avenue, North Haven, Connecticut 06473.

For answers to specific questions or for information on the services we offer, please call Brian Schafer at (203) 239-6660.