Hoffmann Architects

Journal of architectural technology published by Hoffmann Architects, specialists in exterior rehabilitation.

JOURNAL

Third Issue 1990 Volume 8 Number 3

Reroofing Options / A Guide to Selecting the Right System

Russell M. Sanders, AIA

Building owners and managers who need to replace an old roof have a wide range of systems from which to choose. With the advent of new single ply roofing systems, the choices today range from the standard bituminous built-up roof to the polymer-modified bitumen roof to the polymer-based thermoplastic or thermoset roofs.

These choices raise important questions:

- Do the newer systems save money or time over the older system?
- Does one system have application advantages over another?
- In short, are the newer single ply roofing systems superior in any way to the time-tested conventional built-up roofing systems?

Photo / Roofing Industry Educational Institute

Installation of hot applied built-up roof membrane.

Built-Up Roof

The built-up bituminous roof is made of a continuous, semi-flexible membrane consisting of plies of saturated felts, coated felts, fabrics, or mats assembled in place with alternate layers of bitumen. Because of its sensitivity to ultraviolet light and chemicals, the built-up roof requires a surface of mineral aggregate, bituminous material, or a granule-surfaced sheet. There are two categories of built-up roofing:

- Asphalt bitumen which occurs in nature and is obtained in petroleum processing;
- Coal-tar bitumen which is produced from the destructive distillation of coal.

Single Ply Roofing

Unlike the built-up roof, usually applied in four layers, the single ply roof goes on in one layer and in one application. There are two main categories of single-ply: the elastomerics systems and the thermoplastic systems. Modified bitumen is a third type of roofing which technically falls into the single ply category.

Elastomerics. EPDM (Ethylene Propylene Diene Monomer) is a synthetic rubber based in ethylene, propylene, and a small amount of non-conjugated diene to provide sites for vulcanization. EPDM features excellent heat, ozone, and weathering resistance, and low temperature flexibility.

Thermoplastics. Thermoplastics such as PVC (Polyvinyl Chloride) get their elasticity from plasticizers.

Modified Bitumen. The modified bitumen roof has become very popular in the market because of the familiarity with bituminous materials used in stan-

As Director of Technical Services, Mr. Sanders oversees roof, facade and plaza rehabilitation projects for Hoffmann Architects.

Application of bonding adhesive for fully adhered, EPDM single ply roof membrane.

dard built-up roofs over the years. This system is a single ply roof with characteristics of a built-up roof. It is a rolled membrane which has an asphalt coating but is put down in one application like a single ply. It is either torch applied or mopped down.

Single ply roofing is installed in three different ways. It can be totally bonded with a contact adhesive which bonds a membrane to a substrate. With the totally adhered system, the roofer puts down an insulation board and then the membrane is adhered to the top of that insulation board.

A second type of single ply installation is the ballasted system. In a ballasted system, every component is loose. The insulation is put down loose, the membrane is put down loose, and then the roofer puts down a ballast: either a paver or stone that actually weighs the system down.

A third type of system, less commonly used, is the mechanically attached system. In this system, insulation board is put down and a membrane placed on top. Then the material is attached with screws at the seams or in the field of the membrane.

Built-Up vs. Single Ply Systems

Although both the built-up and single ply systems have certain advantages and disadvantages, we generally recommend one of the single ply systems for most roofing applications.

Because the built-up roofing system has been used for so long, there is a great deal of familiarity with the system in the market which probably accounts for its continuing popularity. Built-up roofing installations, however, require very close monitoring during application which can be a major disadvantage.

In working with a hot-applied process, temperatures must be within a critical range when the materials are being applied. The system is also very susceptible to moisture on the surface of the deck. Even a slight drizzle during application causes small blistering on the surface. Built-up roofing is a tedious and exacting process which often is not given proper attention.

"Are newer single ply roofing systems superior in any way to the time-tested conventional built-up roofing systems?"

Some roofers contend that the built-up roof is somewhat forgiving. They say that if one of the plies does not go down right, there are always three more plies. This type of thinking reveals a major disadvantage, not an advantage, of the system: misapplication of even one ply affects the whole system.

With built-up roofing, detail areas on the roof are hard to handle. In essence, there is a three-foot wide strip of felt which is difficult to work around protrusions and corners. There are restrictions on flashing details as well.

Since the oil shortage of the 1970s, the processes for manufacturing coal-tar pitch and asphalt have changed. Manufacturers began to add cut-back materials to their products. Building owners sometimes say: "I have a coal-tar pitch roof and it has lasted for many years. Why can't I have another one just like it?"

The answer is that the same material is not being used today. Manufacturers have actually cooked some of the waterproofing characteristics out of the material. Further, it is difficult to find people to work with coal-tar pitch because it has become recognized as a carcinogen.

A premium is always paid for that type of work.

Hoffmann Architects likes to work primarily with the single ply EPDM or rubber system. It weathers better and is easier to work with, especially around difficult flashing situations. We advocate EPDMs over thermoplastic because the thermoplastics have had problems in the past with plasticizer migration which causes the material to shrink over a period of time. In addition, the thermoplastic roofs do not weather as well as the EPDM roofs.

There are good modified bitumen products on the market which we have used to repair roofs. One of the restrictions of the product, at least the torch applied product, is that in New York City the code prohibits the use of propane tanks on the roof of an occupied building.

Photo / Roofing Industry Educational Institute

Torch-heated application of a modified bitumen roof.

Rolling in the seam of an EPDM single ply roof membrane.

The system Hoffmann Architects uses most is the totally adhered system, followed by our second choice, the ballasted system. The reason for using an adhered system, especially with EPDM, is that the membrane is exposed. If the membrane is exposed and the roof develops a leak, it is much easier to locate the problem. If there is something on top of the membrane, such as pavers, the roofer must take off all of that material before he can begin to look for the leak.

In many buildings, another advantage of the adhered system is that these structures are simply not designed to take the added weight of a ballasted system.

Because the totally adhered single ply roofing system is cold applied, it does not require the same level of monitoring as built-up roofing. Single ply systems, unlike built-up roofing systems, are not as subject to temperature differences during application. With built-up roofing, the roofer must try to stay away from wintertime installations because it is difficult to control the temperature. While he should not apply single ply roofs in the rain, he can apply them at almost any temperature. The single ply system is very flexible and very forgiving.

It is difficult to estimate which type of roof will last the longest. A good built-up roof could last up to 20 years. Today's single ply systems do not have the same track record in this country as built-up roofing so no one is really sure how long they last. Hoffmann Architects' oldest single ply installation is 12 years old and holding up quite well. The standard warranty on most single ply roofs is 10 years. Some manufacturers now offer a 15-year full systems warranty.

Tear Off the Existing Roof

Whether an owner uses a single ply or built-up roofing system, we recommend a complete tear off of the existing roof right down to the deck for the most effective installation. That way, the deck can be inspected to determine what is rusted or deteriorated and what needs attention. Taking off the old roof removes old, wet insulation along with any moisture that might have been trapped there.

Removing the existing roof does add to the cost of a job. On a highrise project in New York City, it can add tremendous amounts of money, but it is money well spent. Removing the old roof offers these advantages:

- Any trapped moisture, which could migrate to the new roof, will be removed;
- No new weight is added to the roof structure;
- The new roof will last longer and its performance will be better.

Saving Money on Reroofing

Generally speaking, if the old roof is removed, a built-up or single ply system will cost about the same with some variations. Initially, money can be saved by not tearing off the old roof, but the new roof will be more effective and last longer if the old roof is removed.

What often becomes the governing factor in the cost of taking off the old roof is the logistics of removing the old materials from the building. The costs are very low for removing an old roof from a one-story warehouse building in the suburbs; the cost of removing a roof from a New York City highrise building is high.

The best way to keep roofing costs under control is to inspect the structure frequently over the life of the roof. By catching little problems early and repairing them, building owners and managers can usually add many years of useful life to the structure. ■

Built-up vs. Single Ply: Pinpointing the Problems

The National Roofing Contractors Association conducted a survey among its members to identify the most common problems with roofing membranes.

For single ply membrane roofs, lap defects led in the total number of problems observed and reported by survey respondents. On average, flashing defects and membrane shrinkage accounted for about 11 percent and 9 percent of deficiencies, respectively. Punctures and tears, wind-related problems, blistering, and material embrittlement followed in descending order.

Respondents underscored "other problems" such as "abuse" and "wet insulation." The more common "other problems" were related to the thermal insulation component of the roof system. Next in line were complaints dealing with the fasteners or with fastener-related deficiencies. Moisture condensing and collecting under the membrane was frequently cited. In addition, a recurring complaint was of general or localized leakage resulting from unidentified sources.

The modified bituminous membrane systems also elicited major complaints related to "delamination." These problems included separations between insulation and base sheets and the delamination of the aluminum skins and various surface coatings from the modified sheet. Lap separation, fish-mouthing and membrane splitting were mentioned in a number of cases.

For bituminous built-up roofs, interply blistering and membrane splitting deficiencies continued to dominate the problems observed in these systems. Blistering accounted for about 25 percent of the problem roofs, followed closely by splitting failures at 21 percent. Wrinkling and ridging were ranked at 13 percent while flashing defects were reported at 10 percent of the problem roofs. Slippage and wind uplift-related problems were rated at about 3 percent and 5 percent, respectively.

Like single-ply systems, built-up roofs elicited numerous complaints about "abuse" and "wet insulation." Interply separation was also a frequently mentioned defect, often occurring between the insulation and the sheet membrane. This separation was followed closely by apparent blistering at the same location. General leakage for unexplained reasons was another complaint. Respondents also described a number of deficiencies related to mopping and surfacing bitumen.

Selection of the appropriate roofing system, preparation of detailed construction documents and proper construction supervision can prevent or minimize most of these problems with built-up and single ply roofs. ■

Problem areas of built-up and single ply roofing: Interply blistering, membrane splitting and wrinkling and ridging were the most frequent complaints about built-up roofing while lap defects, flashing defects and membrane shrinkage headed up the list in the single ply area. *(See chart on opposite page.)*

PLANNING YOUR REROOFING JOB: Timing Is Everything

- **Proper planning of reroofing projects can increase roof life expectancy while decreasing time and money expenditures.**
- **Since roof replacement and repairs require warm to moderate temperatures, construction should occur between early spring and fall in the northeast.**
- **To accommodate this schedule, construction documents must be prepared well in advance, no later than winter of the previous year.**
- **The ideal time for bidding and contractor selection is between December and February when contractors' schedules are not full for the coming year.**
- **Planning and budgeting should be done on an ongoing basis, preferably in the fiscal year prior to construction.**
- **Once the reroofing project has been completed, a comprehensive inspection and maintenance program should be established to minimize or prevent problems before they occur.**

	1983	1984	1985	1986	1987	1988	Max.	Min.	Avg.	Std. Dev.
Built-up Problem Areas	233	202	231	221	272	195	—	—	—	—
Wind Related	1.3	3.2	4.6	2.1	1.9	3.7	4.6	1.3	2.8	1.2
Flashing Related	5.4	6.5	5.6	13.9	15.3	13.3	15.3	5.4	10.0	4.2
Interply Blistering	27.1	29.4	22.2	23.7	25.4	22.2	29.4	22.2	25.0	2.6
Membrane Splitting	21.2	21.4	21.3	19.9	19.4	23.7	23.7	19.4	21.1	1.4
Wrinkling & Ridging	13.4	12.0	16.7	13.4	13.4	10.4	16.7	10.4	13.2	1.9
Membrane Slippage	2.1	3.2	5.6	5.9	4.8	5.2	5.9	2.1	4.5	1.4
Other Than Above	29.5	24.3	24.1	21.1	19.9	21.5	29.5	19.9	23.4	3.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	—	—	—	—
Single Ply Problem Areas	165	253	255	475	617	518	617	165	381	
Membrane Shrinkage	1.4	7.9	9.3	11.4	12.0	12.9	12.9	1.4	9.1	3.8
Lap Defects	26.1	19.9	25.3	22.5	23.6	24.7	26.1	19.9	23.7	2.0
Embrittlement	0.0	0.0	0.0	6.9	5.8	5.4	6.9	0.0	3.0	3.0
Blistering	6.2	7.6	4.3	3.5	3.7	2.5	7.6	2.5	4.6	1.7
Wind Related	4.7	5.4	6.2	4.5	5.3	5.9	6.2	4.5	5.4	0.6
Puncture & Tear	1.9	0.3	1.2	11.7	12.5	12.7	12.7	0.3	6.7	5.6
Flashing Defects	5.2	10.3	8.0	15.6	13.1	12.3	15.6	5.2	10.8	3.4
Other Problems	54.5	48.6	45.7	23.9	23.9	23.6	54.5	23.6	36.7	13.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	142.4	57.5	100.0	

Chart / National Roofing Contractors Association's "Project Pinpoint Analysis"

Rockefeller Center Wins National Preservation Award

Hoffmann Architects took great pride in nominating Rockefeller Center for a 1990 National Preservation Honor Award.

The National Trust for Historic Preservation designated Rockefeller Center an award winner for its restoration of the roof and ceiling of Radio City Music Hall, the marquees and awnings of the GE Building, the interior of the Rainbow Room, and the roof gardens and art work along Fifth Avenue.

John Hoffmann was on hand at the National Preservation Conference in Charleston, South Carolina when Rockefeller Center received the award. ■

L to R: James V. Reed, Director, Marketing Communications, Rockefeller Center Management Corporation; John J. Hoffmann, AIA, Principal, Hoffmann Architects; Alan M. Hantman, RA, Director, Architecture/Planning/Construction, Rockefeller Center Management Corporation.

The Facility Manager's Bookshelf: Roofing

A. Basic References

1. ANSI: American National Standards Institute
ANSI A58.1-1982 ***Minimum Design Loads for Buildings and Other Structures*** ($14.00, plus $4.00 shipping and handling)
By mail: American National Standards Institute, 1430 Broadway, New York, NY 10018 (enclose check payable to ANSI)
Inquiries: (212) 642-4900

2. FM: Factory Mutual Engineering Corporation
Factory Mutual Approval Guide (Item No. P7825, $25.00)
Loss Prevention Data for Roofing Contractors (order by title, $55.00)
By mail: Factory Mutual Engineering Corporation, Attn: Publications Orders Processing, 1151 Boston-Providence Turnpike, P.O. Box 9102, Norwood, MA 02062 (enclose check payable to Factory Mutual Eng. Corp.)
Inquiries: (617) 762-4300 Ext. 2152

3. NRCA: National Roofing Contractors Association
NRCA Roofing & Waterproofing Manual, 3rd Ed. ($118.00)
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)
Note: NRCA has many publications relating to roofing; write for their publications catalog.

4. UL: Underwriters Laboratories
Building Materials Directory (annual publication)
Fire Resistance Directory (annual publication)
For current price list, write to: Underwriters' Laboratories, Attn: Publications Stock, 333 Pfingsten Road, Northbrook, IL 60062
Inquiries: (708) 272-8800 Ext. 2612, 2622

B. Directories

1. Infraspection Institute
Directory of Infrared Thermographers (free)
By mail: Infraspection Institute, Attn: Publications Dept., 33 Juniper Ridge, Shelburne, VT 05482
Inquiries: (802) 985-2500

C. General Reading

1. CSI: Construction Specifications Institute
The Construction Specifier (monthly journal, $50.00 per year)
Reroofing Specifications (Monograph 07M561, February 1986, $10.00)
By mail: Construction Specifications Institute, 601 Madison Street, Alexandria, VA 22314-1791 (enclose check to CSI)
Inquiries: (703) 684-0300

2. Edgell Communications
Handbook of Commercial Roofing Systems (annual publication, $15.00 per copy plus $3.00 handling per order)
My mail: Edgell Communications, Inc., 1 East First Street, Duluth, MN 55802

3. RIEI: Roofing Industry Educational Institute
The Roofing Industry Educational Information Letter (monthly newsletter)
For current publications price list, write to: RIEI, 7006 S. Alton Way, Unit B, Englewood, CO 80112-2003
Inquiries: (303) 770-0613
Note: This organization has many publications relating to roofing; write for their publications catalog. ■

Compiled by Alan Eddy, Technical Librarian

Criteria for Roof System Selection

New Roof vs. Reroofing

Building Structure

Ability to Support Load
Building Movement

Slope and Drainage

Regulatory/Insurance Requirements

Fire Ratings
Use of Flame and Flammables
Hazardous Materials Removal
Toxic Fumes

Interior Conditions

High Humidity
Insulation Requirements
Coolers and Freezers
Hot Deck or Deck Penetrations
Building Pressurization

Exterior Environment

Chemicals
Debris
Climate
Ultraviolet Radiation
Ozone
Temperature
Humidity
Wind / Hail

Abuse

Traffic
Vermin, Birds, Fungus
Vandalism

Construction Factors

Ease of Application
Cost
Application Temperatures
Logistics of Moving Materials

continued on page 8

REPRESENTATIVE PROJECTS

Roof Repair and Replacement

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

A major portion of the firm's practice involves roof rehabilitation, including repair and replacement of membranes, insulation, decks, flashings and parapets.

Its professional architects and engineers conduct surveys to investigate problem areas, determine causes of deterioration, analyze structural integrity, and evaluate roof life expectancy.

The firm prepares detailed plans and specifications for competitive bidding of reroofing projects. Contract administrators and on-site project representatives track the progress and quality of construction.

Hoffmann Architects has provided roof rehabilitation services for such prominent buildings as:

Lever House
New York, New York
(Unilever United States)

Hartford Insurance Tower
Hartford, Connecticut
(Hartford Fire Insurance Company)

Warner Communications Building
New York, New York
(Rockefeller Center Management Corporation)

Metropolitan Opera House
New York, New York
(Lincoln Center for the Performing Arts)

International Club Building
Washington, District of Columbia
(Prudential Insurance Company of America)

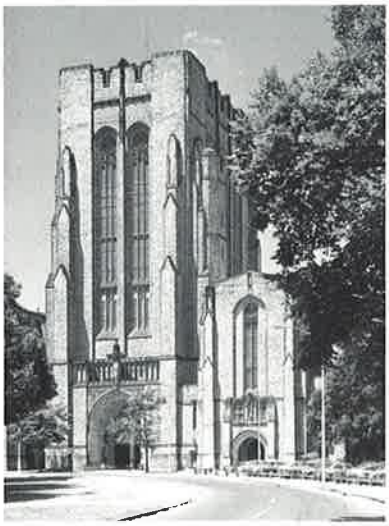
NYNEX Facility
Springfield Gardens, New York
(NYNEX Materiel Enterprise)

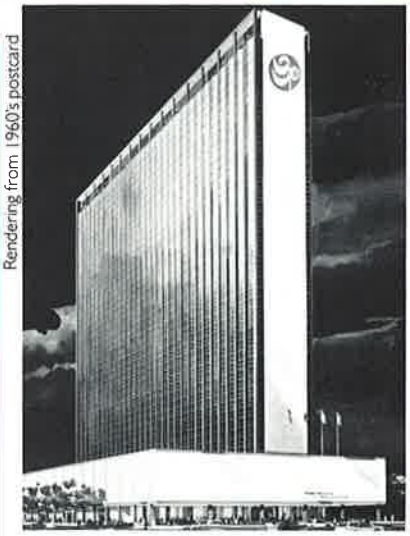
Grumman Glen Arm Plant
Glen Arm, Maryland
(Grumman Aerospace Corporation)

Mendenhall Center for the Performing Arts
Northampton, Massachusetts
(Smith College)

Vivian Beaumont Theater
New York, New York
(Lincoln Center for the Performing Arts)

Payne Whitney Gymnasium *(below)*
New Haven, Connecticut
(Yale University)





Rendering from 1960's postcard

New York Hilton Hotel
New York, New York
(Hilton Hotel Corporation)

Serin Physics Laboratory
New Brunswick, New Jersey
(Rutgers University)

Georgia Pacific Warehouse
Port Hudson, Louisiana
(Georgia Pacific Corporation)

GE Bridgeport Facility
Bridgeport, Connecticut
(General Electric Company)

IBM Office Building
Hamden, Connecticut
(IBM Corporation)

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

Mobil Research & Development Center
Edison, New Jersey
(Mobil Chemical) ■

Hoffmann Architects
432 Washington Avenue
North Haven, Connecticut 06473
(203) 239-6660

OFF THE WALL: Six Phases of a Project

1. Enthusiasm
2. Disillusionment
3. Panic
4. Search for the Guilty
5. Punishment of the Innocent
6. Praise and Honors for the Non-participants

JOURNAL is a publication of Hoffmann Architects, specialists in investigative and rehabilitative architectural/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.

Roof System Selection

continued from page 6

(Construction Factors)

Labor Intensity
Sequence of Trades
Effect on Building Operations

Maintenance

Inspection
Repair

Ease of Reroofing

Disposal of Materials
Recoverability ■

Editor: Ann M. Prokop *Design:* Grandesign *Editorial Services:* Editorial Resources, Inc.