Hoffmann Architects Quarterly

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Masonry . . . Care & Treatment

— by Karen L. Warseck

Masonry is a generic term which is loosely used to describe varied types of exterior building materials including brick, clay tile, stone, concrete block, glass block, adobe, precast concrete and terra cotta. While each of these materials differ from the other in form, color, composition, strength and utility, they share some basic similarities in construction . . . and destruction.

Contemporary masonry walls generally tend to be designed and constructed in one of two ways: either a facing built into a backup wall, or as a curtain wall tied to a structural frame of steel or concrete. The masonry units themselves *(specifically excluding glazed masonry and glass block which will not be addressed in this article)* tend to have porous surfaces which allow water to be absorbed into the wall. They share a common factor in that both water retention in the wall and various environmental stresses are the major causes of failure of masonry systems.

The ability of a masonry wall to withstand deterioration is a function of the interaction of the original design, the care in construction and the prompt and proper attention to water-entry problems.

Water in the wall system usually is first noticed when it enters the interior wall and causes the wallcovering to stain, or paint to peel. The first thought of the property manager or owner is to call a contractor to put a coating on the exterior of the building to inhibit water entry into the wall system. This may be exactly the wrong thing to do, and may, in fact, be the cause of worsening deterioration. It may be likened to scratching an itch. Scratching may alleviate the problem temporarily, but it sure doesn't cure the itch, and may aggravate the situation by introducing an infection or spreading a rash.

The *cause* of the problem must be found and remedied.

The natural tendency of the porous surface to absorb water is not, in itself, necessarily something to worry about. Normally during a rainstorm, the masonry will absorb some water, but very rarely will it penetrate through the masonry units them-

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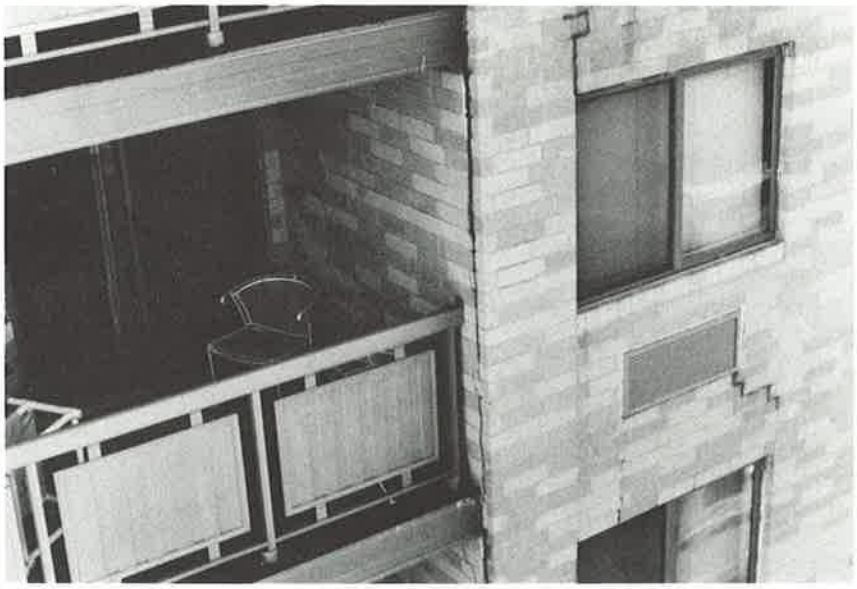


services

Representative Projects

The types of services we offer our clients tend to be unlike those of traditional 'design' firms. Because of this, one of our readers has suggested that we publish a list of recent commissions that are representative of the wide variety of projects we undertake within our narrow specialty of investigative and rehabilitative architecture. So, beginning with this issue, we are implementing the suggestion. We hope you find it interesting and would like to hear your comments. Our representative projects follow:

Typical real estate consulting services include a pre-purchase building condition survey of an apartment complex in Rocky River, Ohio for Connecticut Mutual Life Insurance Company's Urban Investments and a construction document review and building condition survey prior to closing the mortgage on an office building in Jericho, New York for the Travelers Insurance Companies' Real Estate Investment Department in White Plains, New York. We are performing a preacquisition survey of a 280-unit apartment complex for Century Partners in Atlanta, Georgia. The firm is monitoring the construction of a new 33-story concrete frame luxury apartment building in Manhattan for The Broadview Savings and Loan Company, Cleveland, Ohio.

Hoffmann Architects has been commissioned for such roofing projects as the investigation and analysis of the built-up roof assembly of an urban shopping mall in Buffalo, New York; a survey for Perkin-Elmer of a ballasted EPDM roof on an office building in Pittsburgh, Pennsylvania; and preparation of plans and specifications for reroofing Payne-Whitney Gymnasium at Yale University. Through our Atlanta office, the firm has also done a roofing and masonry survey for Emery Worldwide in East Point, Georgia.

Following a previous survey for the Southern New England Telephone Company, Hoffman Architects is preparing construction documents and providing contract administration and on-site project representation for the rehabilitation and insulation retrofit of a 9-story aluminum curtain wall office building in New Haven, Connecticut. We are also involved in preparing plans and specifications for extensive remedial construction of the exterior masonry walls of a condominium building in Stamford, Connecticut. This project is the result of surveys performed earlier for the condominium association.

We were asked by Blakeslee-Arpaia-Chapman of New Haven, Connecticut to do the design for the alterations to an existing office building and maintenance facility in Branford, Connecticut, which will serve as their headquarters. We will be providing plans and specifications for electrical, mechanical and structural alterations as well as interior space planning and finish selection.

The above is not intended to be a complete or comprehensive list of our recent commissions; it is only to show representative projects with which we are currently involved. If you would like more information on the services provided by Hoffmann Architects, please let us know.

technical notes

Coating is peeling as a result of water trapped within the masonry wall.

Reply Card

To be sure your newsletter reaches you with a minimum of fuss and delay, we try to keep our mailing list as up to date and accurate as possible. We need your help. Enclosed with this issue is a postage paid business reply card with your name, title, company and address as it appears in our records. If (horrors!) we misspelled your name or you would like to add someone else to our list or if there are *any* other changes you might like to make, please let us know by filling out and returning our reply card. If the listing is fine as is, keep the card for possible changes in the future. Thanks for your help!

Masonry *(cont. from page 1)*

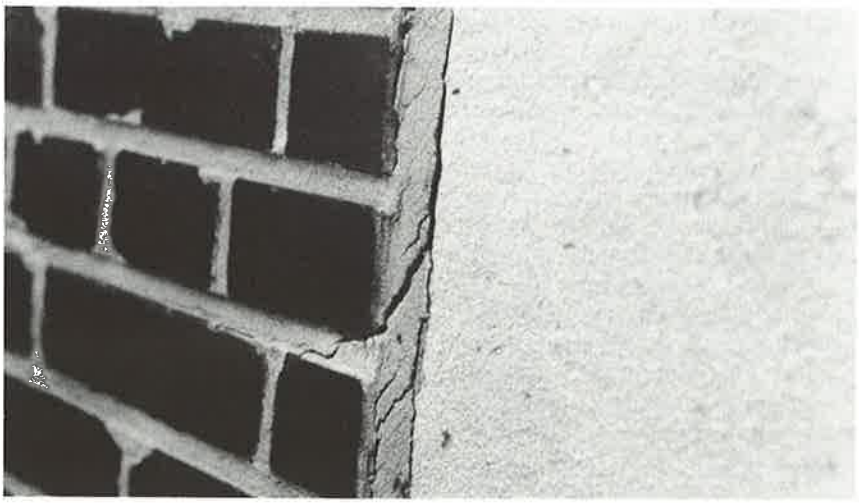
selves. Other factors are generally at work.

Oftentimes, the leakage does not originate within the walls. Leaking roof and flashing details can allow water to migrate into the wall assembly and cause problems. Covers or copings on tops of parapet walls which have open joints or are poorly constructed or missing can also be a common point of leakage into walls. Failed caulking around windows and doors can allow seepage around these penetrations which may be blamed on the wall itself.

Even when it *is* the wall that is leaking, the porosity of the masonry material is usually not the cause. Water will find its way through the path of least resistance, open joints or cracks. Cracks may be caused by myriad reasons involving stress, movement and a failure to provide for them. However, the major cause of throughwall leakage is not as obvious – voids in the mortar and/or hairline cracks due to limited bonding between the mortar and the masonry unit itself.

Once the water is in the wall assembly, it becomes imperative to get it back *out*. If it has been absorbed into porous masonry, it will tend to evaporate naturally. If an impervious waterproofing coating has been applied to a surface, any water which has found its way into the wall assembly will remain trapped. If the water has condensed and accumu-

Cracks in the masonry mortar



lated inside the cavity between a veneer and back-up or curtain and interior wall, it will tend to trickle down the inside of the cavity and out weep holes. If these holes, designed to allow water to drain, are clogged or missing, any accumulated water will remain in the wall or make its way into the interior of the building. In either case, it can mean trouble.

When water is caught within the wall, it can cause steel structural members and masonry ties to rust. Rusting of the structure can lead to weakening of the entire building. Since masonry walls tend to be thinner over structural members, the expanding nature of the rust can cause the masonry to move out of the wall plane. Rusting of the masonry ties can cause them to fail. This will allow the exterior face of a cavity or curtain wall system to delaminate.

If there is enough movement, the exterior wall may come loose from the structure and collapse.

Even if a water-resistant coating is used instead of a waterproof one, the trapped moisture may still cause problems. With a waterproof coating, the water cannot escape at all and can freeze within the wall causing chunks of masonry to fall off the surface. This is called "spalling." Even if moisture can escape through a "breathable" coating by evaporation, the salts acquired by the passage of the water through the construction materials *(such as concrete or mortar)* can be trapped and then crystallize just below the outer surface of the masonry after the water has evaporated. This condition, if left untreated, will allow the salts to build up and cause exfoliation or spalling.

Not only is spalled material extremely hazardous to anyone underneath it when it falls, but it can also contribute to spiralling deterioration.

Masonry moving out of the wall plane

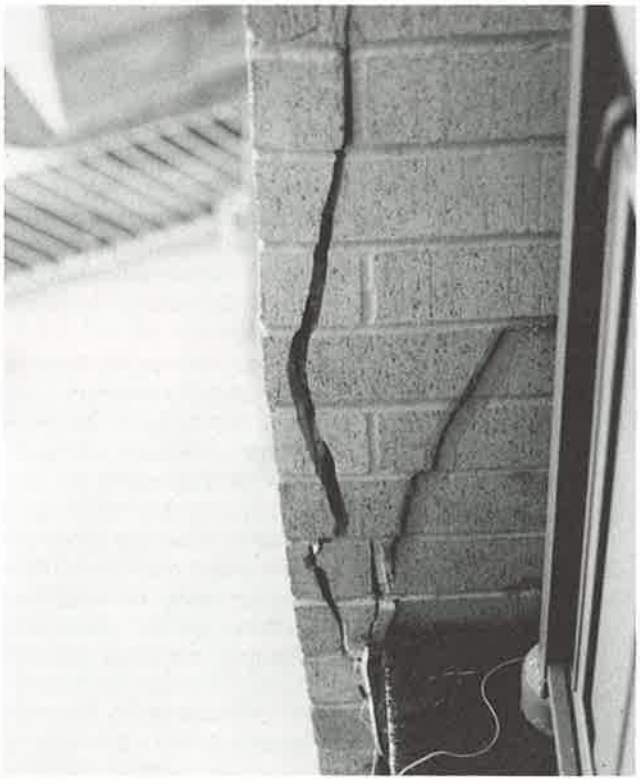
In brick masonry, for example, because of the way it is made, the surface is harder and less porous than the interior. When this protective surface is removed by spalling, the soft porous interior is exposed. Since it is more porous than the outer surface, more water can be absorbed and trapped in the wall. This water can freeze, causing further spalling and greater damage.

Thus, coatings, if used at all, should be applied as a *preventive* measure, rather than a *rehabilitative* one. The best method of making a watertight masonry wall is to first inspect the joints for hairline cracks. If these are present, cutting out the old mortar to a depth of ¾" and then repointing the masonry with a high lime content mortar will usually make the masonry walls watertight – that is, providing the rest of the building is, too!

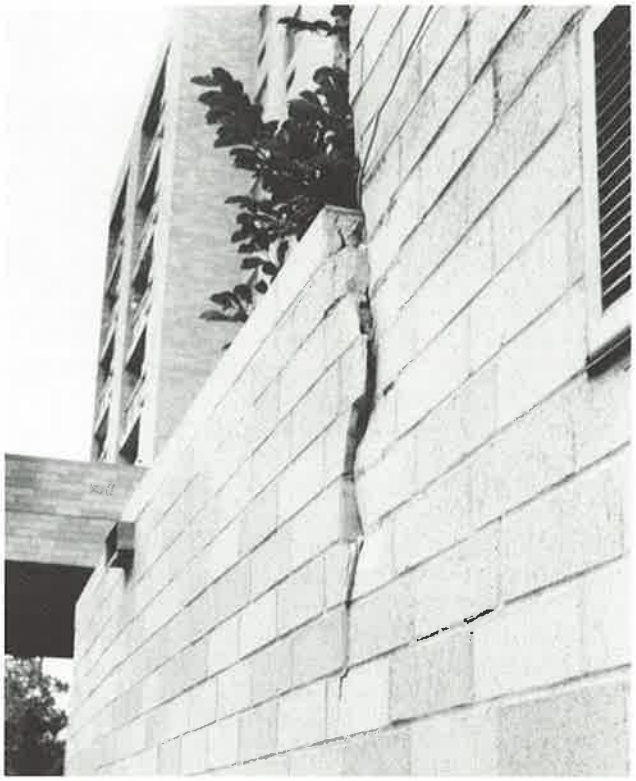
Details of design and care in construction play an integral part in the weather-tightness of a masonry wall. The proper mortar mix is essential and can significantly affect the flexibility of the joint. But even a proper mortar mix will not help if the mason is unskilled and leaves voids, or places masonry units in partially set mortar. The voids and hairline cracks caused by this will show up while the building is still new.

Other serious damage due to design or construction flaws will not appear as quickly. These problems may take decades to manifest themselves, but the owner/manager should be aware of their possibility and watch carefully for their symptoms – cracking and movement of the masonry units out of the wall plane.

Masonry, in general, is a stiff material not prone to flexing. When used in conjunction with a material that is more flexible, the masonry will tend to crack long before its counterpart when subjected to movement or stress. So, for example, if a masonry curtain wall is tied to a flexible steel structure, (unless adequate precautions are designed in and constructed properly) when the frame moves, the



Vertical displacement of brick veneer



Masonry moving out of the wall plane

wall will crack.

These precautions are in the form of "soft" joints. Soft joints are vertical cuts in the masonry wall, or horizontal joints below a bearing shelf angle, that are sealed with a material that will stretch or compress, depending on building movement. They will relieve the strain on the masonry due to building movement or environmental stress.

Other less obvious reasons for including soft joints have to do with the interaction of dissimilar materials and/or thermal expansion. Concrete, for example, shrinks upon aging, but bricks absorb moisture and grow. The different properties of the materials will cause stresses in the brick which, if soft joints are not included in the building, will cause it to crack.

Shrinkage of a concrete structural frame can cause floor-to-floor heights of a building to decrease. Steel will expand and contract much more readily and in greater amounts than masonry. The side of a parapet wall facing the sun will expand more than the side away from the sun, causing the wall to bow.

All these subtleties must be accounted for in the design, or else cracking or movement out of the wall plane will occur.

Other items which the owner/manager should be aware of are the presence of efflorescence and staining, both of which can make a building look unattractive to tenants. Efflorescence is the result of salts having been dissolved in water and drawn to the exterior surface and deposited as a white, dusty substance. Unless the wall has been coated and the salts prohibited from reaching the exterior, efflorescence is not, in itself, harmful. It is, however, a sign that water has penetrated the wall. When the source of water penetration is discovered and rectified, the efflorescence should disappear.

Washing the building without determining the cause of water penetration will be futile, since the water already in the wall system will continue to leach out the salt, and the efflorescence will reappear. We have already noted that dissolved salts deposited under the surface of coated masonry can cause spalling.

Staining has many causes, including simple dirt, soot, metal oxidation, organic matter and improper clean-

jargon

BACKUP: Masonry material or masonry construction used in a wall behind stone or brick facing.

CAVITY WALL: A hollow wall built of masonry units so arranged as to provide a continuous air space within the wall (with or without insulating material), and in which the inner and outer wythes of the wall are tied together with metal ties.

COPING: The material or units used to form a cap or finish on top of a wall, pier, pilaster or chimney.

CURTAIN WALL: An exterior nonloadbearing wall not wholly supported at each story. Such walls may be anchored to columns, spandrel beams, floors, or bearing walls, but not necessarily built between structural members.

EFFLORESCENCE: The formation of a white saline powder on the surface of masonry walls.

JOINT: The space between stone units -- usually filled with mortar.

LIME: Specifically, calcium oxide (CaO); also, loosely, a general term for the various chemical and physical forms of quick-lime, hydrated lime, and hydraulic hydrated lime.

MORTAR: A plastic mixture of cement, lime, sand and water used to bond masonry units.

PARAPET WALL: The part of a wall that extends above the intersection of the wall with the roof.

POROSITY: The ratio, usually expressed as a percentage, of the volume of voids in a material to the total volume of the material, including the voids.

PRESSURE-RELIEVING JOINT: An open horizontal joint below the supporting angle or hanger to prevent the weight from being transmitted to the masonry below. These joints are to be caulked with a resilient material to prevent moisture penetration.

SPALL: A small fragment removed from the face of a masonry unit by a blow or by action of the elements.

SPANDREL: On buildings supported by skeleton structure, the facing of the area between the sill of one window and the top (or lintel) of the window next below.

TIE: Any unit of material which connects masonry to masonry or other materials.

WEEP HOLE: Opening placed in mortar joints of facing material at the level of flashing to permit the escape of moisture.

WYTHE: Each continuous vertical section of a wall one masonry unit in thickness.

ing methods. Sometimes the discoloration is actually a part of the masonry itself. Dirt and soot are carried atmospherically, deposited on any flat surface and then washed over the edges, appearing in a flume pattern on the wall. Oxidation of metals will cause rusty, green or brownish stains in the mortar joints and sometimes over the face of the brick. Organic matter will be left after ivy is removed.

There are three different systems of cleaning a masonry wall that are in general use – water, chemical and abrasive. Water methods include low-pressure washes over an extended period of time, high-pressure washes and steam cleaning. Chemical methods include muriatic acid and other acid and/or detergent based proprietary formula cleaners that are used in conjunction with a water rinse or chemical neutralizer. Abrasive methods include sandblasting and grinding.

Inappropriate cleaning methods or products may actually do more harm than good. Each type of cleaning system – water, chemical, and abrasive – must be thoroughly investigated and tested on the building, if possible, to determine any detrimental effects the system may have. These tests should be done on a surface area large enough to adequately show the results, and, since different masonry materials will react in different ways to different cleaning methods and products, on each type of masonry existing on the building. Ideally, the composition of the masonry and mortar should be analyzed to determine if any chemical reactions will occur during cleaning.

In all cases, the masonry joints should be tight before proceeding with *any* cleaning method. If acids are allowed to enter the wall system, corrosion problems can occur in the masonry ties. If joints are loose, they can be destroyed by sandblasting. Water in the system can cause any of the problems noted earlier.

Many things should be considered before choosing the right cleaning methods and products, including whether or not cleaning is a good idea. If the discoloration is due to weathering, cleaning the "dirty" area will mean removal of a portion of the masonry itself. Repaired areas

are often stained to match the existing masonry, and cleaning can make these differences apparent. Acid cleaners, even in a dilute form, seriously deteriorate limestone and marble and should never be used. Harsh chemicals can etch glass, corrode aluminum and destroy plants surrounding the building.

Using high-pressure equipment to spray acid based cleaners may drive them too far into the masonry. This makes complete rinsing impossible, which can cause a white scum to form on the masonry surface. Sandblasting and other abrasive methods can severely damage brick masonry, mortar and stone. Scarred surfaces caused by blasting will accumulate dirt faster than smooth surfaces. Iron or copper in the water supply may stain, or in some cases, disfigure a surface cleaned by water washing. Any cleaning method which requires the use of water should never be undertaken when the possibility of freezing exists.

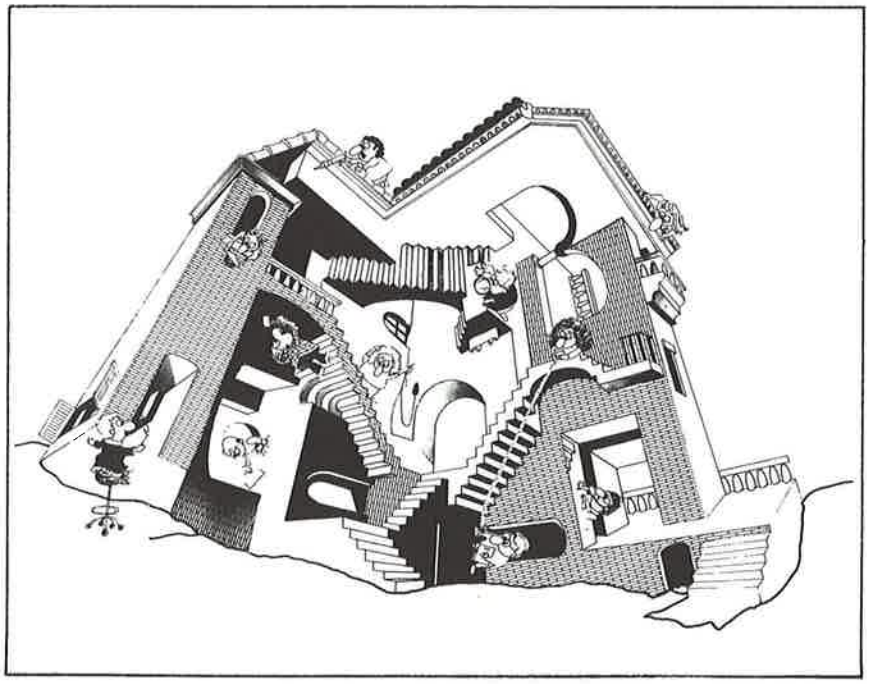
Periodic examinations of the building are the best way to ascertain if the building needs attention. The property manager or owner should be sure that each wall and parapet of the structure is inspected for cracks, movement out of plane, spalling, staining and efflorescence. This inspection may be made by the maintenance staff. If any or all of these symptoms are present, a professional scrutiny is warranted.

Keep in mind, however, that a contractor – though quite knowledgeable in the application techniques of coatings and cleaners and the results they can have – may be unaware of the underlying causes of the problems, and inadvertently make them worse. He also may have a possible conflict of interest, in that he may be more inclined to recommend a service which he performs, whether or not there may be something more appropriate.

Representatives of manufacturers of coating and cleaning products may suffer from a similar potential conflict of interest. The best solution is to commission a specialist in rehabilitative architecture/engineering to survey the problems and recommend solutions that suit *that particular project*.

There is no one way to fix or clean every building. The objectivity of the consultant can help assure that the money spent to repair masonry damage will not be spent again five or ten years later when the price has escalated, and/or the damage compounded. The consultant can also provide alternatives and prioritize work to help fit an existing budget. In addition, the professional architect and engineer can prepare construction documents for repairs, or specifications for cleaning, that will allow meaningful competitive bidding by contractors. Apples to apples – so that the property manager/owner knows *what* he is getting for the price. And also, that he *is* getting the best price for a particular type of service.

The preceding article is reprinted from the January, 1984 issue of Building Operating Management. *The author, Karen L. Warseck, heads the Atlanta, GA office of Hoffmann Architects and has published three other articles – "Architectural Inspection", "Building a Strong Roof" and "The Office of Today" (with Harwood W. Loomis, AIA). If you would like copies of any of these articles, please let us know.*



"The best solution is to commission specialists in rehabilitative architecture/ engineering to survey the problems..."

staff and technical notes

Plywood Alert

If your plans call for 1/2 inch plywood in your roof assembly, be forewarned. The plywood manufacturers have adopted the lumber industry practice of using nominal rather than actual thicknesses in sizing their sheets. As a result, a nominal 1/2 inch plywood sheet is, in reality, only 15/32 inch. While the difference may seem like an insignificant amount, it can lead to some serious problems if care is not taken. Nominal 1/2 inch and actual 1/2 inch thick plywood sheets are not necessarily interchangeable.

First of all, substituting a nominal sheet for an actual 1/2 inch thickness may violate the building code. Suppose your building is being built with roof trusses at 24 inches on center, a standard construction practice. Table 1705.6A of the SBCCI Standard Building Code gives the allowable spans for plywood roof and floor sheathing. To span a distance of 24 inches, according to this table a *minimum* thickness of 1/2 inch is required. A nominal 1/2 inch sheet is not 1/2 inch thick and does not fit code requirements.

Second, your warranty may be invalid. Several manufacturers of built-up roofing systems (including Owens-Corning and Manville Corporation) specifically state in their recommended installation procedures that a plywood roof deck should be a minimum 1/2 inch thick. They do not mention that this means a nominal 1/2 inch. The warranties of these same companies specifically state also that a roof installed not in accordance with their recommended installation procedures is not covered by their warranties. Thus, a roof installed over a nominal 1/2 inch plywood deck may not be covered by the manufacturer's warranty.

Third, your roof may not be insurable. If your insurance carrier requires that your roof assembly be listed by Underwriter's Laboratories (UL), you should be aware that substitution of nominal sized plywood for actual thicknesses will result in an unlisted roof. UL uses specific materials in their testing procedures and only lists those assemblies containing the exact materials tested. Any deviations from those specifics results in an unlisted roof.

Until building officials, roofing manufacturers and testing laboratories accept and approve the nominal sized plywood, care should be taken. To obtain the required 1/2 inch thickness, nominal 5/8 or 3/4 inch plywood should be specified and the materials checked on site to be certain the proper size is installed. If the nominal 1/2 inch plywood must be used, documentation from the appropriate source approving or accepting it should be obtained prior to start of construction to avoid problems in the future.

We welcome contributions to Hoffmann Architects/Quarterly from our clients and friends. Please send news and technical information to either Karen L. Warseck, Hoffmann Architects, 1925 Century Boulevard, Suite 4, Atlanta, GA 30345 or Nancy H. Bostwick, Hoffmann Architects, 3074 Whitney Avenue, Hamden, CT 06518 or call (404) 633-7817. We'd like to hear from you.

Staff News

Hoffmann Architects is pleased to introduce the newest member of our staff, **Nancy H. Bostwick.** A native of Cleveland, Ohio, Nancy will be involved in coordination of marketing and business development activities including proposal preparation and public relations. Prior to joining Hoffmann Architects, she worked as a marketer for a New Haven engineering firm and before that a large architectural firm in New York City.

Karen L. Warseck has completed the four day seminar on roof design and technology offered by the Roofing Industry Educational Institute (RIEI). The seminar covered most aspects of roofing from the deck through built-up and non-conventional systems as well as roofing design, specification, application, investigation and problem solving.

John S. Van Jeune was an instructor on masonry and concrete construction details and their effect on buildings. The class was at the Hartford State Technical College.

Russell M. Sanders and **John J. Hoffmann** attended the 1984 Urethane Foam Contractors Association UFEX 9 convention in San Antonio, TX.

Karen L. Warseck has been elected to the board of directors of the Atlanta Chapter of the Construction Specifications Institute.