NRCA/ARMA Manual of Roof Maintenance and Repair

Published by:
National Roofing Contractors Association
Asphalt Roofing Manufacturers Association

(Revised 1988.)

FOREWORD

The purpose of the *NRCA/ARMA Manual of Roof Maintenance and Repair* is to provide guidance to persons engaged in or responsible for the inspection, maintenance, repair, re-covering or replacement of built-up roofing materials. Contained in this manual is information about the causes of roof problems, inspection guidelines, maintenance procedures, repair techniques, and reroofing considerations.

This manual has been designed as a reference guide for the maintenance and repair of hot-asphalt and hot-coal-tar built-up roof membranes, using conventional hot-applied, cold-applied and modified bitumen materials. It is intended to be used by persons generally familiar with the materials used and the methods of handling and installing these materials. Other repair techniques and roofing systems are beyond the scope of this manual.

It is universally recognized that good workmanship is a key element in the successful installation and performance of roofing products. It is, therefore, recommended that consideration be given to the utilization of a professional roofing contractor in the conduct of the work. Upon request, NRCA will provide a list of criteria for identifying professional roofing contractors. The *NRCA Roofing & Waterproofing Manual* can be used to provide supplemental information on roofing materials and installation techniques complementing the information contained in this manual.

TABLE OF CONTENTS

I. INTRODUCTION

A. Manufacturers' Instructions

Information is presented in this publication in general terms. It is impossible to cover in detail the many types of roofing materials and component accessories produced by numerous manufacturers. The instructions, diagrams, drawings, and photographs that most manufacturers provide with their products should be consulted for detailed information.

B. Fire and Wind-Uplift Classification of Roof Coverings

For most constructions, local building codes and insurance agencies require that roof coverings have a Class A, B or C fire rating, when tested according to ASTM E108. Insurance agencies and local building codes may also require that roof coverings resist specific wind forces or be classified as I-60 or I-90 when tested by Factory Mutual. The products and systems used for roof repair, re-covering and replacement must satisfy the same ratings that would be required for new construction.

C. Use of Accepted Materials

The materials used for roof repair, re-covering and replacement should comply with the physical properties listed in the most current ASTM specifications.

D. Structural Problems

Roofing problems sometimes lead to or are the result of problems with the structural roof system. Structural problems must be addressed by qualified engineers before permanent roof repair or reroofing can begin. The building owner or his agent are responsible for verifying the adequacy of existing structural systems to support anticipated rooftop loads.

E. Determining Treatment for Built-Up Roofs

Roof membrane problems are often caused by deck, insulation, or perimeter edge problems hidden beneath the membrane surface. Unless these substrate problems are identified and corrected, the roof membrane problem is likely to recur. Analysis of a building's historical records and inspection data may assist in determining the kind of treatment the roof is to receive. "As-built" drawings and specifications can also provide essential information. Walls, parapets and the underside of the roof deck should be visually examined. If necessary, cutouts of roofing materials and insulation can be used to evaluate the condition of the roof assembly.

In addition to the above, consideration must be given to such factors as:

- The kind of structure in question
- Whether the structure is permanent or temporary
- The type of occupancy
- The type of roof installed
- The age of the roof
- The frequency of the leaks
- The type and extent of other problems.

The roof on a temporary structure may need to be given only minimum treatment. The roof on a permanent structure, however, should be given the best maintenance, repair, or reroofing available.

F. Roof Maintenance, Application and Repair

Roof maintenance, application and repair should only be performed by qualified workers. Minor maintenance and repair work may be performed by the building owner. Emergency work required to provide immediate protection against water damage may also be performed by the building owner. However, permanent repairs should be performed by a qualified contractor, and scheduled during dry weather.

Major repairs or complicated reroofing projects should be performed by qualified contractors. Most owners do not have the necessary knowledge, staffing or equipment to attempt large scale work.

G. Pre-Roofing Conference

Prior to beginning major work, a pre-roofing conference should take place involving the roofing contractor, material manufacturer, owner or his representative, and any other interested party. The purpose for this meeting is to ensure that everyone understands the specifications and to address other management details.

H. References

There are other publications that contain detailed information on the maintenance of built-up roof system components. The Reference List in the back of this manual identifies the material standards and other publications pertinent to the maintenance and repair of built-up roof systems.

II. CAUSES OF ROOF PROBLEMS

A. Lack of Maintenance

The failure to find and correct minor roof defects and deterioration in the earliest stages is probably the greatest cause of premature roof problems. This is particularly true of roofing materials applied on relatively low-sloped roofs.

B. Weathering

All roofing materials deteriorate from exposure to the weather at rates determined largely by the kind of material and the conditions of exposure. In general, inorganic roofing materials tend to deteriorate less rapidly from exposure than organic roofing materials. All types of roofing materials may be damaged by hail. Exposure to air pollutants and industrial or salt-laden atmospheres may accelerate the deterioration process of some roofing materials.

C. Wind Damage

Roofing materials are subject to damage from strong winds and flying debris. Generally, roofs are not designed to withstand winds of hurricane and tornado intensity. However, roofs may also be damaged by winds of moderate intensity, with gusts that may reach 50 to 75 miles per hour. The primary cause of wind damage is from the partial vacuum created by wind blowing over the edge of the roof. The constant pull from relatively mild winds loosens the fasteners or adhesion, permitting wind to enter beneath the membrane at the edges, and makes the built-up roof susceptible to damage from the next strong wind to which it is subjected. To counteract the effects of wind-uplift forces, the built-up roofing and insulation should be adequately fastened to the roof deck, and a securely fastened roof edge detail should be provided. (See the NRCA Construction Details for recommended roof edge details.)

Wind damage to roof

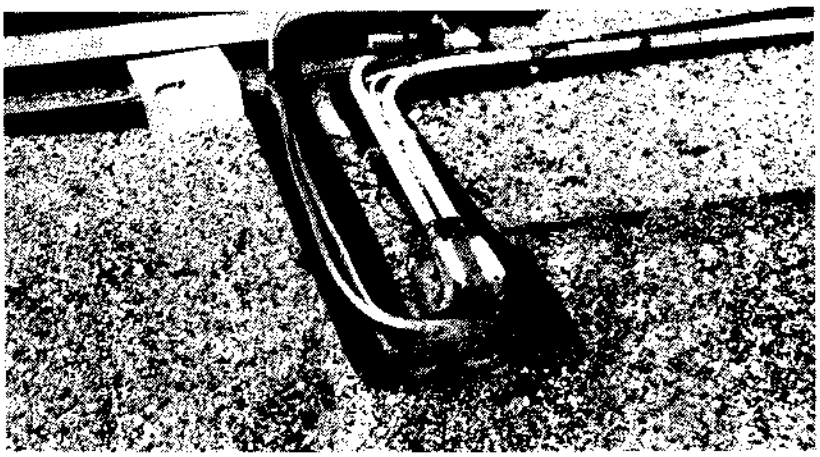
D. Improper Design

Troublesome and costly roofing problems are often the result of faulty initial design of the roof system. Design deficiencies are costly to correct, and usually can only be corrected during roof replacement. However, unless design deficiencies are discovered and corrected during roof repair or reroofing, the problems relating to them most likely will recur. Some examples of faulty design are:

- Weak roof structures that deflect excessively under load, causing splitting of the roof membrane
- Inadequate roof slope, sagging roof structure, or insufficient number or location of drains, resulting in ponding water
- Inadequate provision for expansion and contraction at changes in deck material or direction, causing membrane splits

- Incorrect specification, such as mopping directly to wood or plywood roof decks, resulting in membrane splits, blisters or other problems
- Omission of roof traffic walkways, resulting in membrane punctures
- Incorrect flashing detail design, resulting in flashing separation, sagging and splitting
- Incorrect penetration flashing design, resulting in flashing leaks.

NOTE: Both the Asphalt Roofing Manufacturers Association and the National Roofing Contractors Association advocate that roof-deck construction should provide for positive drainage of water from the roof membrane.



Incorrect penetration flashing design

E. Improper Material Storage

Finished built-up roof systems are intended for direct exposure to the weather. However, some materials used to construct them may be damaged if exposed to the weather prior to application. Felts and insulations that become wet during storage or application may promote blistering or reduce adhesion. Consequently, these materials should be protected and kept dry at all times. Roofing materials, particularly insulation and rolls of felt, should be stored off the ground. Manufacturers' stacking, storage and handling instructions should be followed.

Improper material storage

F. Improper Application

Workmanship in applying roofing materials is as important as the design of the roof and the selection of the proper materials. The best roofing materials, improperly applied, will render poor service. Some of the more common faults in the application of built-up roofing materials are:

- Failing to take precautions against bitumen drippage over decks with open joints
- Entrapping moisture within roof by not removing wet insulation or by installing wet materials. This may result in blisters, deterioration and other roof problems
- Applying asphalt or coal tar at improper temperatures, which may result in slipping, lack of adhesion or voids
- Failing to broom or squeegee felts smoothly. This may result in poor adhesion, fishmouths, wrinkles, voids or blisters
- Applying roofs in unsuitable weather
- Inadequately fastening or adhering the felts or roof insulation to the deck

- Applying an insufficient flood coat on aggregate-surfaced roofs, resulting in poor aggregate adhesion
- Applying an excessive flood coat on smooth-surfaced roofs, resulting in severe alligatoring
- Improperly preparing the substrate, particularly when patching slag or gravel-surfaced roofs, resulting in a lack of adhesion
- Improperly fitting and fastening base flashing and metal edges, making them susceptible to slippage and damage from winds and roof traffic.

Bitumen drippage at mechanical fasteners

G. Use of Improper Materials

Roofing materials are well-suited for certain types of service and may be ill-suited for other applications. Information about appropriate combinations of roofing materials, their specific slope limitations, and bitumen and felt compatibilities may be obtained from the roofing material manufacturer.

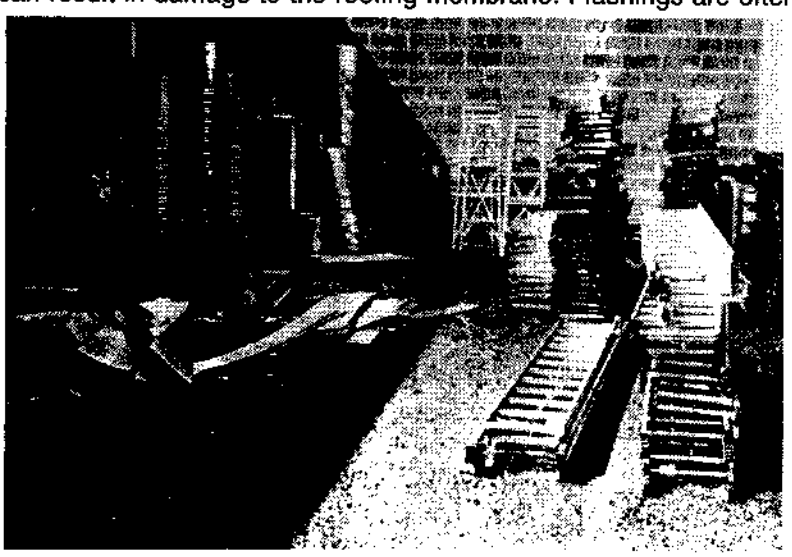
The repair or installation of structural decking materials is beyond the scope of this manual. However, decking materials should be installed according to the deck material manufacturer's recommendations, and in compliance with local building codes.

Unseasoned lumber used for roof framing and roof decks may shrink and warp, resulting in roof problems. Movement in the wood deck may cause buckles in built-up roofs. The roof membrane can be damaged by warping or deflection where decking end joints do not fall over supporting joists.

Only exterior-grade plywood should be used for roof-deck sheathing. Interior-grade plywood may delaminate when exposed to moisture. The use of plywood that is too thin can result in excessive deck deflection.

H. Damage and Vandalism

Traffic on roofs can result in damage to the roofing membrane. Flashings are often kicked and punctured by



Membrane damage can result when roof is used as staging area

individuals working on rooftop equipment or leaning over parapet edges. The area around rooftop equipment is easily punctured by a dropped tool or equipment access panel. Roofs are also often a target for vandalism. Roof traffic should, therefore, be kept to a minimum, and access to the roof should be limited. Where traffic on roofs cannot be avoided, walkways and protection pads should be provided. When the roof must be used as a staging area for maintenance, service or other construction, the roof membrane must be protected against tear and puncture from scaffolding and stacked or transported materials, and should be inspected for damage when work is completed.

I. Flashing Failures

The function of flashings is to provide a watertight junction between roofing materials and roof projections or other parts of the structure, and between roof sections. Flashings should be designed to furnish service for at least as long as the materials used in the roof system. NRCA and roofing material manufacturers have recommended flashing details that can help reduce flashing problems. Flashings are the most vulnerable part of any roof. Their importance and the importance of maintaining them properly cannot be overemphasized.

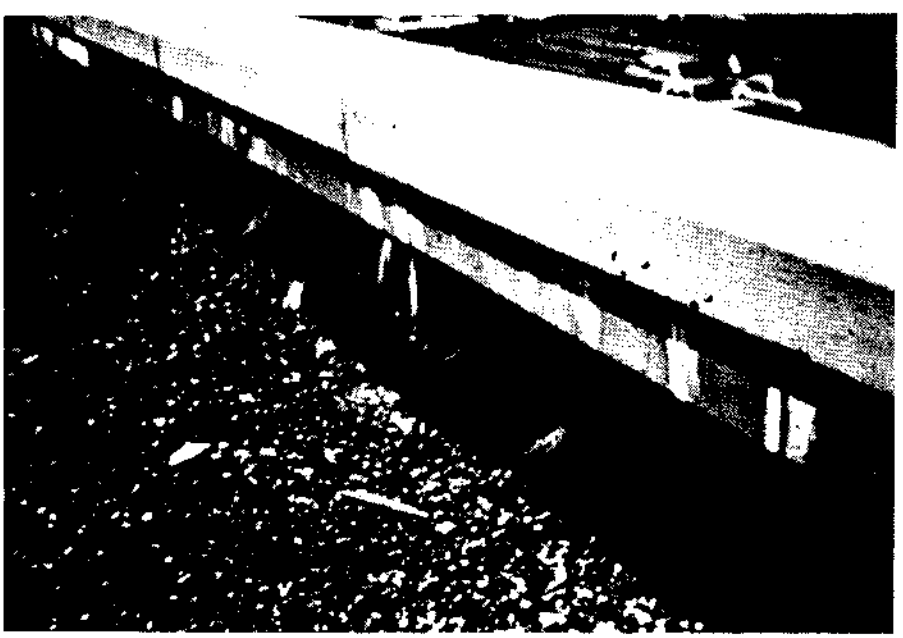
Many early roof problems are actually flashing problems. Often, repairing the flashings or providing new flashings is all that is needed to make the roof watertight again. Most flashing problems result from inadequate flashing design or faulty construction. Many flashing problems can be reduced or eliminated by careful examination by competent inspectors during roof installation, and by regularly scheduled inspection and maintenance. (See Section III-C, Locating Flashing Problems.)

In many instances, leaks occur at flashings where there are no flashing defects. These leaks may be the result of open joints in a masonry wall or coping cap, which permit water to enter behind the flashings and into the building. This problem may be eliminated by "through-wall" flashings.

J. Base-Flashing Problems

Some common causes of base-flashing problems are:

- Insufficient number of base-flashing plies
- Improper base-flashing height
- Insufficient protective coating, resulting in accelerated weathering and deterioration
- Omission of cant strips, making the base flashing more susceptible to damage
- Open vertical endlaps or seams caused by insufficient sealing
- Insufficient adhesion or movement between vertical surfaces and the roof deck, resulting in separation of base flashings from vertical surfaces
- Loose insulation, causing base flashing to separate from vertical surfaces
- Improper fastening of base flashings to walls or curbs, resulting in sagging or separation of the flashing from the vertical surface
- Deteriorating substrates, causing base flashings to separate from the surface, or permitting water to enter behind base flashings.



Wrinkled base flashing at parapet wall

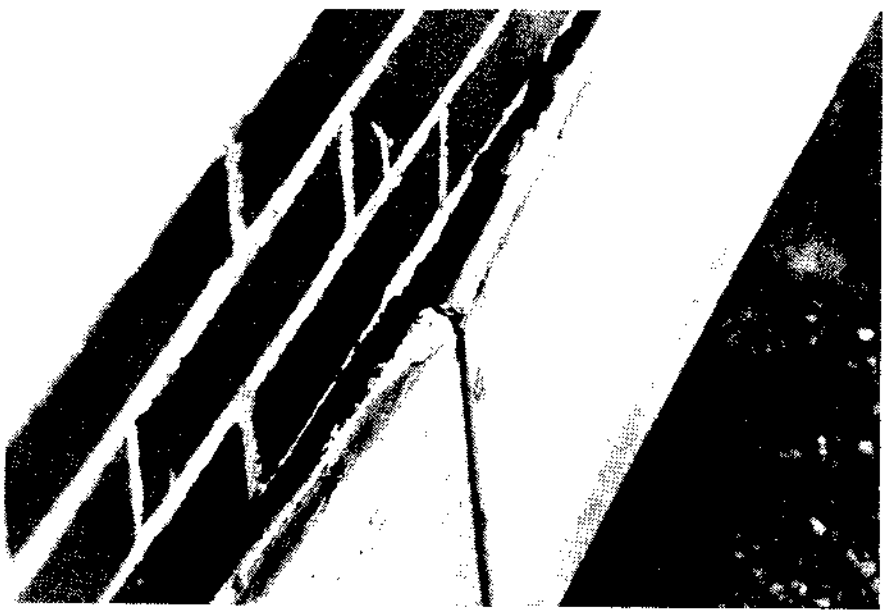
K. Metal Base Flashing and Bituminous Counterflashing Problems

The use of metal base flashings in the construction of built-up roofs is not recommended. Metal base flashings easily separate from bituminous materials and stripping felts crack at the edge of the metal because of the difference in expansion coefficients between the materials. Open joints between metal pieces and deterioration of the metal are also sources for water entry. Inside and outside corners are particularly vulnerable areas. For these reasons, metal base flashings should be replaced with bituminous base flashings whenever possible.

L. Metal Counterflashing Problems

Metal counterflashings protect the top of bituminous base flashings from water entry. The most common metal counterflashing problems are:

- Counterflashings located too high above the base flashing
- Metal deterioration caused by a lack or loss of protective coating
- Cracks and open joints between metal pieces
- The separation of counterflashings from vertical surfaces
- Reglets not being sealed
- Counterflashings not tightly fit to base flashings.



Metal counterflashing separated from parapet wall

M. Penetration Flashing Problems

Penetrations through the built-up roof membrane are usually flashed in one of two ways. Individual pipes and small vents usually use flat, metal flange flashings that are placed directly on the last ply of roofing material and are stripped in with felts and mastic. Larger penetrations and groups of smaller penetrations usually use curbs constructed of wood, metal or concrete, flashed with bituminous base flashing and metal counterflashings. The use of pitch pans and wood sleepers to flash penetrations and rooftop equipment is not recommended.

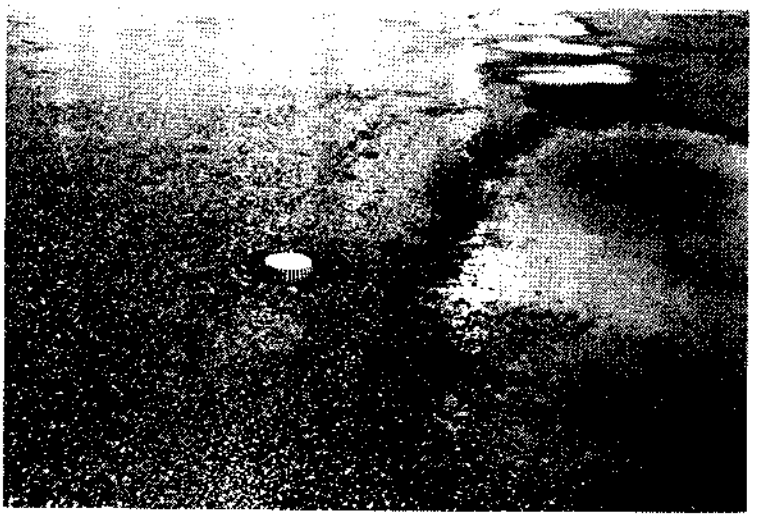
Common penetration flashing problems are:

- The failure to properly design the flashing for the penetration (i.e., using sleepers and pitch pans instead of curbs and hoods)
- Open or broken seams in metal curbs caused by expansion and contraction
- Standing water behind penetration curbs caused by the omission of crickets
- Sagging or separating base flashings caused by omission of top wood nailers
- Missing or deteriorated counterflashing
- Splitting or separation of the felt stripping over the edge of metal flanges
- Improper priming and stripping of metal surfaces
- Fastener backout and separation of the metal flashing flange from the roof around penetration flashings
- Movement between stack vents or pipes and the flashing.

N. Drain Flashing Problems

A roof's drainage system includes the gutters, leaders, drain openings and scuppers, as well as the slope provided by the structural deck, tapered insulation, crickets and sumps. The primary function of the drainage system is to prevent the retention of water on the roof by removing water from the roof as quickly as possible. Every roof, including so-called "dead-level" roofs, must have some provision for drainage. Further, it is important that the drainage system be kept free from debris that might interfere with the proper flow of surface water.

Many roof problems can be traced directly to inadequately designed or improperly installed drainage systems; for example, the use of only one drain; the failure to install overflow scuppers in parapet walls; the placement of drains next to support columns instead of at points of maximum deflection; loose or missing drain clamping rings. Ponded water is the principal indication of inadequate drainage, and may indicate the presence of structural defects.



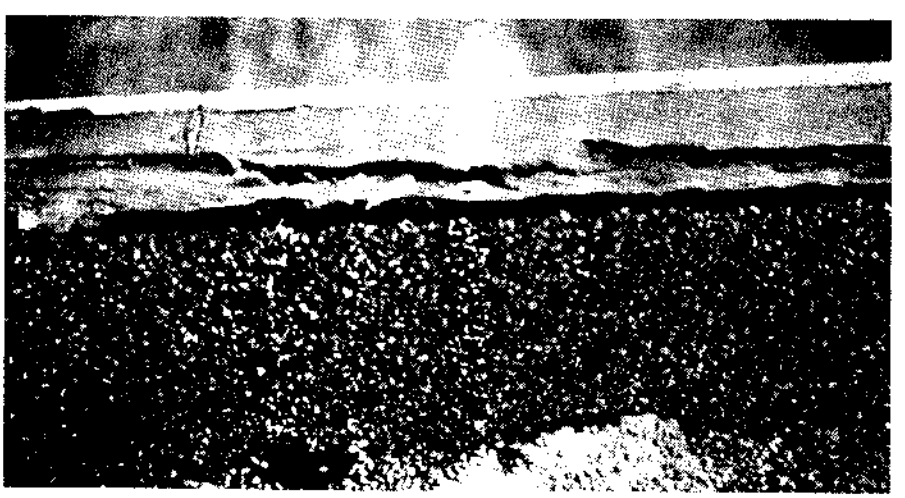
Drain not located at point of maximum roof deck deflection

O. Gravel Stop and Metal Edge Strip Problems

The primary function of gravel stops (for aggregate-surfaced roofs) and metal roof edge strips (for smooth-surface roofs) is to close off the edges of the roof to prevent wind damage or blow-offs. Another important function of gravel stops is to prevent the loss of aggregate surfacing near the edge of the roof.

The principal problems with gravel stops and metal edge strips are leakage through open or broken joints between metal pieces, and splitting of the stripping felts at metal edges. For these reasons, gravel stops and metal edge strips should be raised out of the water line whenever possible by using raised wood nailers and tapered edge strips. The use of interior drainage is preferred. However, where water must drain over the metal edge, scupper cutouts are preferable to continuous edge drainage.

Gravel stops or metal roof edge strips have sometimes been omitted from building structures. Instead, the roof membrane has been bent over the edge of the roof and fastened to the fascia board with wood battens. These types of edge flashings are subject to severe weathering and wind damage, and should be replaced with metal edge flashings.



Stripping felt failure at gravel stop

P. Problems with Rooftop Equipment, Signs, Braces and Supports

Often, the rooftop is used as a platform for all types of mechanical equipment, ladder struts, antennas, flag poles, signs, bracings, etc. These items should not be placed on the rooftop except when absolutely necessary. They should never be mounted or placed directly to the top of the roof membrane, as leaks beneath or adjacent to the supports for this equipment are impossible to repair. Rather, they should be mounted to a support structure or to raised curb-type supports. Flat flange or curb flashings can then be used to keep the roof watertight, and roof replacement and re-covering can be done without disturbing or removing the equipment. Pitch pans, however, should not be used to keep supports watertight, and should be avoided where possible. Refer to the *NRCA Construction Details, ARI/NRCA/SMACNA Guidelines for Roof-Mounted Outdoor Air-Conditioner Installations*, and the roof membrane manufacturer for recommendations concerning the proper mounting and flashing of these items.

III. ROOF INSPECTIONS

A. Periodic Inspections

The first step in establishing a proper roof maintenance and repair system is the adoption of a periodic inspection program. The early discovery and correction of minor defects forestalls major repairs and extends the date when reroofing will be necessary. Because many roof problems involve flashings, the regular inspection of flashings is of vital importance.

Roof inspections should be made by competent personnel, beginning when the roof is completed and continuing at least twice each year thereafter (in the spring and fall). The spring inspection should be made to detect and repair damage to the roof that occurred during the winter. The fall inspection should prepare the roof for the oncoming winter.

The first semi-annual inspection is important because it frequently discloses minor defects that were not apparent in the final inspection when the roof was first completed. Roof inspection records should be initiated during this inspection and made a part of the historical records for the structure. The records should contain the description, age and condition of all roof areas. Photographs are extremely helpful. These continuing records can be of considerable value later on when determining more extensive roof maintenance, repair or replacement. Suggested forms for maintaining historical records and for use when inspecting built-up roofing are shown in the Appendix.

The condition of the roof deck, flashings and insulation must be determined. The removal of roof assembly samples may be necessary when severe problems are evident. Routine removal of roof samples, however, is not recommended. Places where samples have been removed should be patched immediately.

Periodic inspections should include an examination of the roof deck from the underside for evidence of leaks, deteriorated decking, structural cracks, structural movement, and other defects. Walls and parapets should also be examined to detect evidence of cracking, deterioration, and water entry.

B. Special Inspections

In addition to scheduled semi-annual inspections, roof inspections should be made whenever the following occur:

- After exposure of the roof to unusually severe weather conditions, such as strong winds, hail, snow or long, continued rain
- Both before and after the maintenance, repair or installation of rooftop equipment, parapets, chimneys, etc., and at other times when the roof is altered or may have been damaged by tradesmen
- Immediately prior to beginning maintenance, repair, or reroofing projects.

Debris left on roof by tradesmen

C. Locating Flashing Problems

Many problems mistakenly attributed to roofing materials are actually problems related to flashings. Flashing areas should be the first areas suspected when leaks in a structure are reported.

Following are the general guidelines for conducting flashing inspections.

- Carefully inspect the roofing materials near flashings for signs of breaks or moisture. Blisters in these areas are an indication that moisture may have worked its way beneath the roof membrane through the flashings.
- Look for punctures, broken laps or seams, separation of flashings from vertical surfaces, and signs of weather deterioration. Flashings that face the sun deteriorate more rapidly than those not facing the sun.

- Check to see that roofing felts and base-flashing sheets are tightly adhered to the cant strip. Loose base flashing can be detected by gently tapping the flashing mid-way between the roof and the vertical surface.
- Check for discoloration and other evidence of water entry on the inside and outside of walls and parapets. Areas in question should be clearly marked for maintenance and repair.
- Check metal counterflashings for deterioration and to see that they are properly in place.

Puncture at bottom of base flashing

D. Drainage Inspection

Following is a suggested drainage checklist for inspectors.

- Check the roof deck incline. It should be unobstructed and permit free drainage. Look for sagging and depressed areas, standing water or water-stained areas. Any plant growth should be removed. Areas where roots have penetrated the roof membrane should be repaired.
- Check gutters, leaders, strainers, etc., to see that they are in place and in good condition. Check for obstructions which will hinder water drainage. Look for broken and clogged drains.
- Verify that the size, location and number of drains, gutters and leaders are adequate for proper drainage. Look for standing water around drains. Standing water may indicate that the drain is set too high or not in the correct location.

Drainage inspection—check for signs of incomplete drainage

- Look for defective drain flashings. Check to see that the roof membrane is securely clamped within the drain clamping ring.
- Verify that gutters slope downward to the leader a minimum of 1/16 inch per foot of length.

E. Gravel Stop and Metal Edge Inspection

Gravel stops and metal roof-edge strips are particularly subject to leakage. Roof-edge details should be inspected for:

- Damaged, unattached or deteriorated overhanging material and fascia boards
- Flashing flanges that have separated from the roof
- Movement of edging in relation to the roof deck or wall
- Bitumen drippage under gravel stops and down fascia boards
- Missing or loose gravel stops and metal roof-edge strips
- Split and cracked stripping felts
- Open or broken joints between metal pieces.

Metal edge strip separating from roof edge

IV. ROOF MAINTENANCE

A. Maintenance

Roof maintenance is defined as the treatment given a roof prior to the occurrence of roof problems or the need to replace materials. Maintenance involves the recurring work required to keep the roof in a useful condition. It may also involve correcting minor defects in small areas.

The importance of proper roof maintenance cannot be over-emphasized. With good maintenance, the useful life of the roof can be extended and the cost per year for roofing is reduced.

Except for emergency situations, owner-performed roof repairs are not recommended. Puncturing a blister or spreading a coating or mastic may cover up evidence a professional roofing contractor could use to discover the cause or extent of a roof problem.

B. General Information

The materials used for maintaining built-up roofs should be compatible with existing materials. Asphalt products should always be used for the maintenance of asphalt built-up roofs, and coal-tar (or compatible) products should be used for the maintenance of coal-tar built-up roofs.

NOTE: While asphalt and coal tar should not be mixed in heated form, asphalt-coated base sheets and base flashings are routinely adhered in hot steep asphalt in conjunction with coal-tar built-up membranes. Additionally, asphalt-impregnated glass felts are sometimes used as ply sheets for coal-tar built-up roofs. Contact the roofing material manufacturer for specific recommendations regarding the combination of these products.

The following sections address maintenance techniques for both aggregate and smooth-surfaced built-up roofs. More detailed application descriptions can be found in Section VIII, Application of Roofing Materials.

C. Exposed Bituminous Coating on Aggregate-Surfaced Roofs

When aggregate-surfaced built-up roofs have been wind scoured, exposing the bituminous coating, or when the bituminous coating of a smooth-surfaced roof has weathered to the extent that the top ply of felt is exposed but still in good condition, remove the remaining loose aggregate surfacing from the bare area, and sweep the area clean. Apply a thin coat of asphalt primer to existing asphalt roof surfaces, and allow the primer to dry. (Coal tar roofs generally do not require priming.) The primer helps the bond between the new asphalt and the old roof. Coat the bare areas with either hot asphalt or hot coal tar as appropriate. Re-embed the aggregate surfacing into the hot coating as required. Do not apply hot bitumen directly over loose aggregate surfacing as the bitumen will not adhere the loose aggregate.

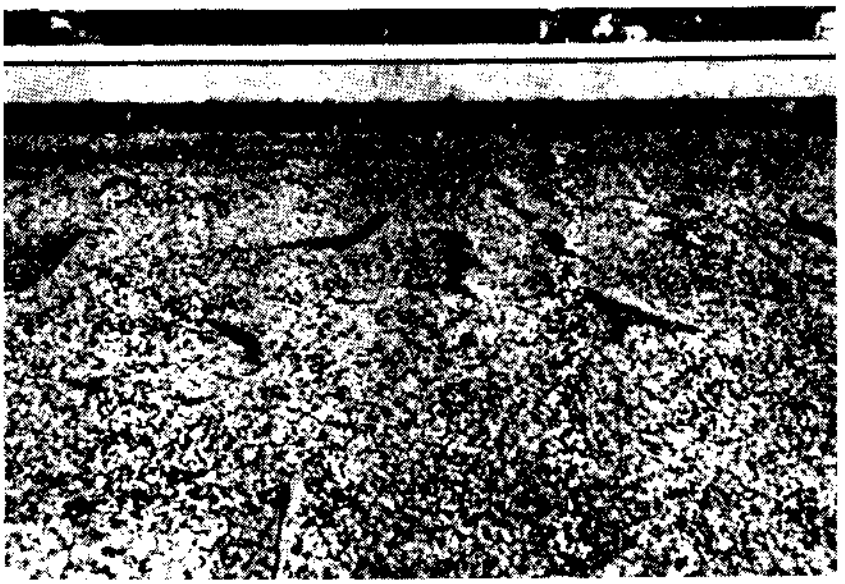
Exposed bituminous coating

D. Small Blisters or Buckles

When small blisters or buckles are exposed, but the surface of the blister has not deteriorated or ruptured, sweep dust, dirt and aggregate from the exposed surface areas. Take care not to rupture the blister. Apply a thin coat of asphalt primer to existing asphalt roof surfaces, and allow the primer to dry. (Coal-tar roofs gener-

ally do not require priming.) The primer helps the bond between the new asphalt and the old roof. Coat the bare areas with either hot asphalt or hot coal tar as appropriate. Re-embed the aggregate surfacing into the hot coating as required. Do not apply hot bitumen directly over loose aggregate surfacing as the bitumen will not adhere the loose aggregate. Mark the area for future reference.

When small blisters or buckles are NOT exposed, they should be marked for future reference, but should not be repaired.



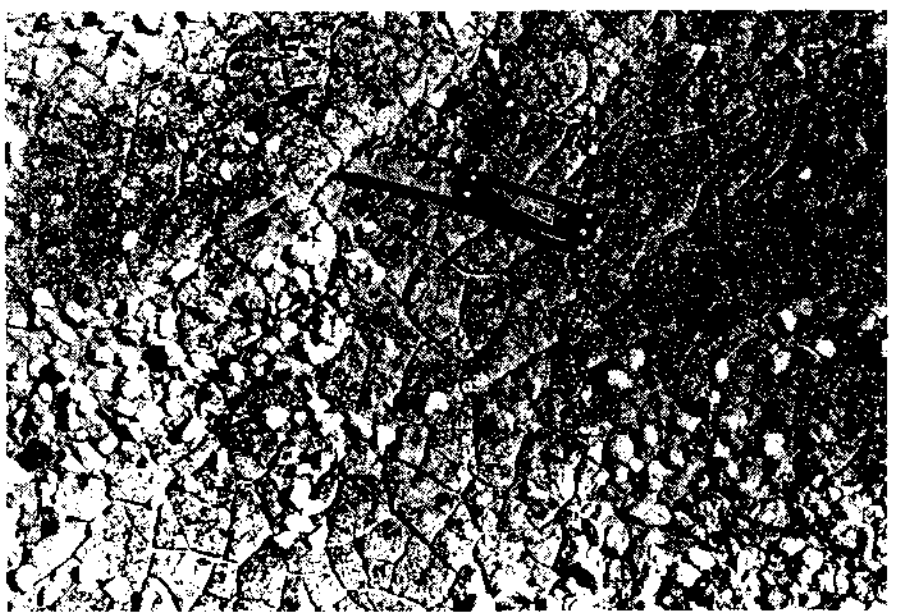
Small buckles in roof membrane

E. Alligatored Coating

The top surface of a smooth-surface asphalt built-up roof may show signs of alligatoring (small surface cracks in a pattern resembling an alligators skin) within three to five years. Alligatoring is most severe where the coating is thickest. If alligatoring is allowed to proceed, deep cracks penetrating to the felts may develop. When this occurs, water enters the roof membrane and roofing materials deteriorate at a rapid rate. Consequently, maintenance is best performed before cracks become severe.

Coatings applied over alligatored and cracked surfaces also tend to alligator and crack. This tendency increases as the coating thickness is built-up. Therefore, when re-coating procedures are employed, coating thicknesses should be properly controlled.

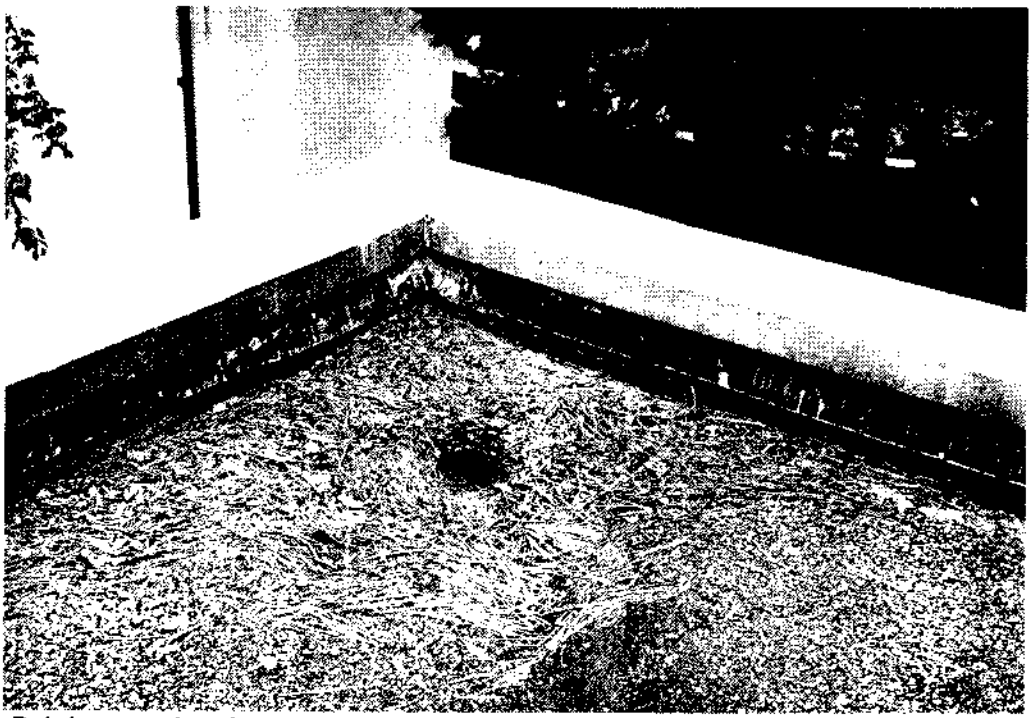
When the asphalt coating is severely alligatored, remove dust and dirt by sweeping or vacuuming. Apply one thin coat of asphalt primer, preferably by brushing. Avoid excessive amounts of primer. After the primer is allowed to dry, apply a coating of clay-based emulsion or asphalt roof coating.



Alligatored flood coat

F. Gutters, Leaders and Drains

Gutters, leaders, drains and scuppers must be kept clean and free from obstruction to function properly. During roof maintenance, remove aggregate, dirt, leaves and other debris from sump areas and drains. Make sure that strainers and gratings are provided to prevent debris from clogging drains and downspouts.



Debris around roof drain interferes with drainage

G. Gravel Stops, Edge Strips and Metal Counterflashing

When gravel stops, edge strips or metal counterflashing show signs of mild deterioration, remove surface rust, moisture, loose scale, grease and dirt. Apply a fresh coat of paint to the metal.

V. ROOF REPAIR

A. Repairs

Roof repair, as distinguished from roof maintenance, is defined as the treatment given a roof to correct existing problems or leaks, short of re-covering or partial replacement of the roof. Roof repair involves the restoration of a roof system to a useful condition, beyond what can be accomplished through maintenance, usually by replacing some of its constituent parts or by patching deteriorated areas.

Repair may be minor, involving small roof areas, or it may be major, involving the whole roof, such as the application of additional layers of felt over a built-up roof.

The materials used for maintaining built-up roofs should be compatible with existing materials. Asphalt products should be used for the maintenance of asphalt built-up roofs, and coal-tar (or compatible) products should be used for the maintenance of coal-tar built-up roofs.

NOTE: While asphalt and coal tar should not be mixed in heated form, asphalt-coated base sheets and base flashings are routinely adhered in hot steep asphalt in conjunction with coal-tar built-up membranes.

B. When to Repair vs. Reroof

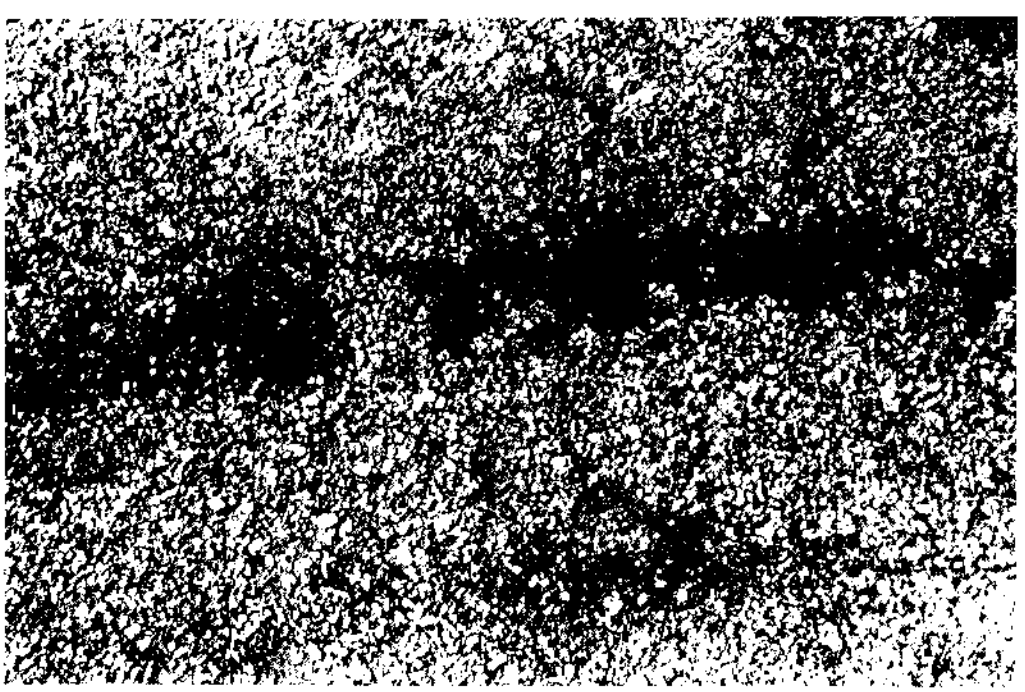
Roof repair, as opposed to reroofing, is generally appropriate when all of the following conditions are met:

- The roof has not yet reached its expected service life
- Leaks that have developed are few in number and are not serious
- The roofing felts are in sound condition, are not water-logged nor deteriorated, and are well-adhered or attached to the substrate
- The insulation is sound, dry and adequately attached to the roof deck, and
- The roof deck is sound.

C. Exposed Felts and Small Deteriorated Areas

When the roof surface shows exposed felts and small deteriorated areas, remove deteriorated plies, loose felt and surfacing materials at least 2½ feet beyond the area of the deteriorated felts. Clean the area to be repaired by sweeping or vacuuming. On asphalt roofs, apply a thin coat of asphalt primer; coal-tar roofs generally do not require priming. After the primer has dried, install the same type and number of plies as were removed from the original roof. Install the new felts in hot asphalt, hot coal tar or cold-applied mastic as appropriate.

Apply two additional plies of felt over the replaced area. Extend the first ply of felt at least 6 inches beyond the area replaced, and the second ply of felt at least 6 inches beyond the first ply. Install the additional plies of felt in hot asphalt, hot coal tar or cold-applied mastic as appropriate. A single layer of modified bitumen sheet may be used instead of this two-ply patch. Embed aggregate surfacing or apply surface coating as required.



Exposed felts and small deteriorated areas.

D. Roof Membrane Splits

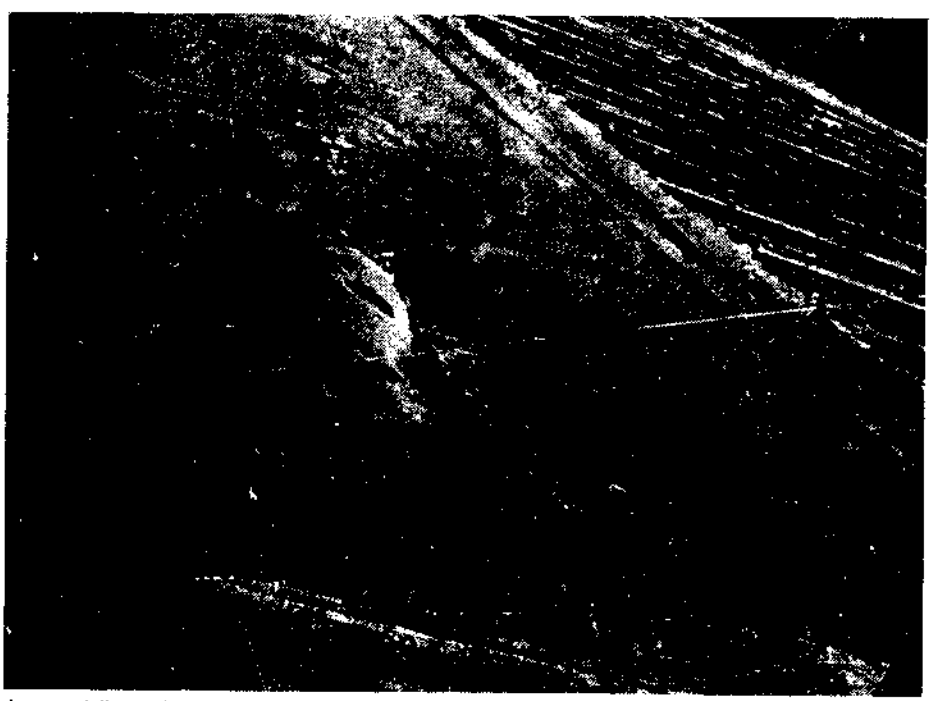
When splitting is extensive, occurs frequently or occurs in a pattern, the cause for the splitting should be determined and corrective action taken to prevent recurrence. Unless this is done, the splitting is likely to recur.

To repair roof membrane splits, remove loose felt and surfacing materials at least 2½ feet beyond the split. Clean the area to be repaired by sweeping or vacuuming. At each end of the split, cut through the roof membrane extending the split approximately 12 inches, then make a second cut perpendicular to the split approximately 2 inches long. On asphalt roofs, apply a thin coat of asphalt primer; coal-tar roofs generally do not require priming. After the primer has dried cut a piece of granular surface sheet, base sheet or other suitable material approximately 9 inches wide, and lay it over the split to serve as a slip sheet. Install the same type and number of plies as were used in the original roof in hot asphalt, hot coal tar or cold-applied mastic as appropriate. Extend the bottom ply of felt at least 6 inches beyond the area being repaired, and each succeeding ply at least 3 inches beyond the previous ply. A modified bitumen membrane may be used instead of the multiply patch described above. Embed aggregate surfacing or apply surface coating as required.

Roof membrane split

E. Large Blisters or Buckles

Large blisters or buckles should be repaired only if they allow water to penetrate the roof system. Large blisters or buckles that are not in danger of leaking should be marked for future reference but left intact.



Large blister in roof membrane

When large blisters or buckles have deteriorated or cracked, remove deteriorated felts and surfacing material to a dry felt surface at least 2½ feet beyond the edge of the blister or buckle. Clean the area to be repaired by sweeping or vacuuming. Cut the blistered plies off so that no loose felt remains. Ensure that the area within the blister is dry. Install the same type and number of plies that were removed from the original roof in hot asphalt, hot coal tar or cold-applied mastic as appropriate. Extend the bottom ply at least 6 inches beyond the area to be repaired, and each succeeding ply at least 3 inches beyond the previous ply. A modified bitumen membrane may be used instead of the multi-ply patch described above. Embed aggregate surfacing or apply surface coating as required.

F. Fishmouths

When fishmouths need to be repaired, remove surfacing materials at least 12 inches beyond the fishmouth in all directions. Cut the fishmouth, and adhere the loose felts down with hot asphalt, hot coal tar or cold-applied mastic as appropriate.

Apply two additional plies of felt over the repaired fishmouth. Extend the first ply of felt at least 6 inches beyond the end of the cut felt, and the second ply of felt at least 6 inches beyond the first ply. Install the additional plies of felt in hot asphalt, hot coal tar or cold-applied mastic as appropriate. A single layer of modified bitumen sheet may be used instead of this two-ply patch. Embed aggregate surfacing or apply surface coating as required.

Membrane fishmouth

G. Exposed and Badly Deteriorated Felts

It is difficult to determine whether a deteriorated roof membrane surface can be repaired by adding plies of felt, or whether reroofing is instead required. The condition of the existing roof, the extent of entrapped moisture, and historical records on the performance of the roof must all be reviewed when making this decision. Factors such as cost and the future use of the structure must also be considered.

Badly deteriorated exposed felts

If plies are to be added, remove deteriorated plies, loose felt and surfacing materials at least 2½ feet beyond the area of the deteriorated felts. Clean the roof area by sweeping or vacuuming. On asphalt roofs, apply a thin coat of asphalt primer; coal-tar roofs generally do not require priming. After the primer has dried, apply at least two additional plies of felt over the deteriorated area in hot asphalt, hot coal tar or cold-applied mastic as appropriate. A modified bitumen membrane may be used instead. Embed aggregate surfacing or apply surface coating as required.

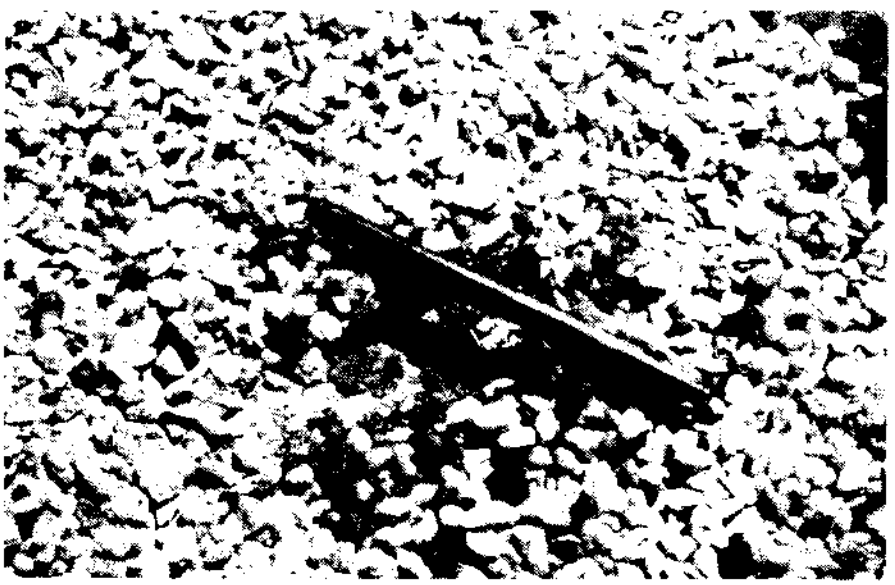
H. Punctures in the Membrane or Base Flashing

Punctures in the built-up roof membrane or base flashings are usually caused by roof traffic or by falling objects, and often occur at base flashings where the cant strip has been omitted.

For temporary repairs, coat the area around the puncture with flashing cement. Embed felt or reinforcing fabric into the cement. Coat the felt or fabric with a second application of flashing cement. Mark the area for permanent repair at a later time.

For permanent repair of a punctured membrane, remove deteriorated plies, loose felt and surfacing materials at least 2½ feet beyond the puncture. Clean the roof area by sweeping or vacuuming. On asphalt roofs, apply a thin coat of asphalt primer; coal-tar roofs generally do not require priming. After the primer has dried, apply at least two additional plies of felt over the punctured area in hot asphalt, hot coal tar or cold-applied mastic as appropriate. A modified bitumen sheet may be used instead of the two-ply patch described above. Embed aggregate surfacing or apply surface coating as required.

For permanent flashing repairs, remove the punctured flashing and reinstall a new flashing according to specifications for new roof construction.



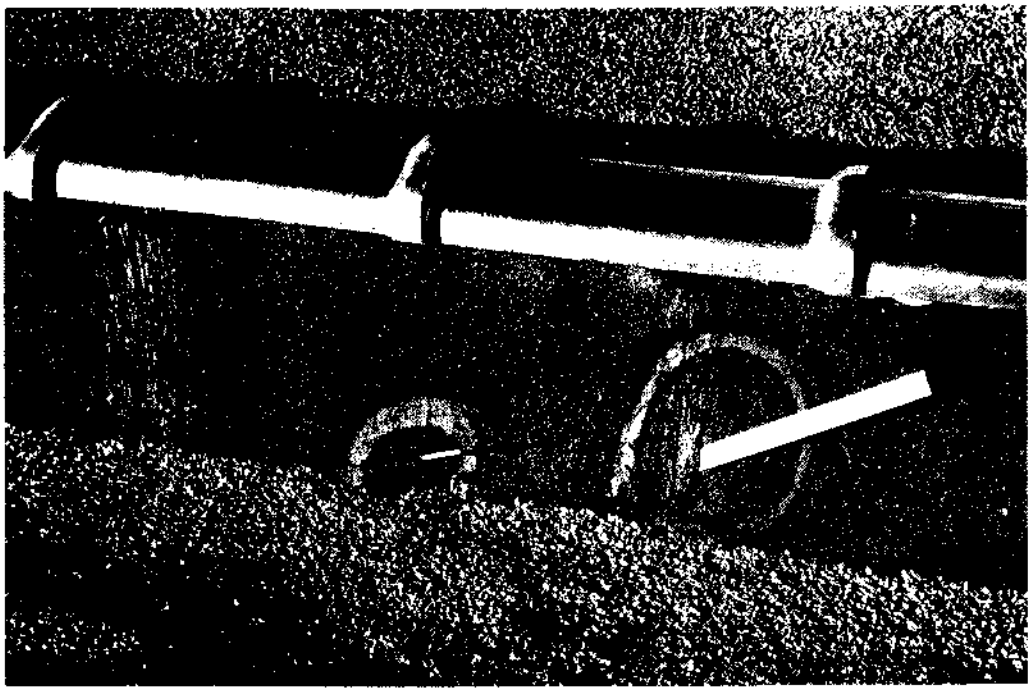
Puncture in roof membrane from dropped tool

I. Open Vertical Laps in Bituminous Base Flashings

When vertical laps in bituminous base flashings are open, apply flashing cement under the open lap and smooth the felt back in place. Coat the area around the lap with flashing cement. Embed felt or reinforcing fabric into the cement. Coat the felt or fabric with a second application of flashing cement.

When the lap edge is badly deteriorated, or when water damage is suspected beneath the flashing, remove the deteriorated flashing and reinstall a new flashing according to specifications for new roof construction.

Remove the deteriorated flashing and aggregate surfacing adjacent to the flashing. Clean the roof area adjacent to the flashing by sweeping or vacuuming. On asphalt roofs, apply a thin coat of asphalt primer to the roof; coal-tar roofs generally do not require priming. After the primer has dried, replace the flashing according to specifications for new construction. Install the new flashing in hot asphalt or cold-applied mastic as appropriate. Flashing sheets should extend out onto the roof surface at least 6 inches. A modified bitumen flashing may also be used. Embed aggregate surfacing or apply surface coating as required.



Open vertical lap in base flashing

J. Bituminous Base Flashing Separation from Wall or Curb

When bituminous base flashings have separated from a wall or curb, remove or bend the counterflashing out of the way. Apply flashing cement to the wall or curb and re-embed the base flashing. Re-nail the top of the base flashing to the wall or curb. Recoat the base flashing with flashing cement, if necessary, and replace the counterflashing.

When the flashing is badly deteriorated, or when water damage is suspected beneath the flashing, remove the deteriorated flashing and reinstall a new flashing according to specifications for new roof construction.

Remove the deteriorated flashing and aggregate surfacing adjacent to the flashing. Clean the roof area adjacent to the flashing by sweeping or vacuuming. On asphalt roofs, apply a thin coat of asphalt primer to the roof; coal-tar roofs generally do not require priming. After the primer has dried, replace the flashing according to specifications for new construction. Install the new flashing in hot asphalt or cold-applied mastic as appropriate. Flashing sheets should extend out onto the roof surface at least 6 inches. A modified bitumen flashing may also be used. Embed aggregate surfacing or apply surface coating as required.

Base flashing separated from parapet wall

K. Deteriorated Bituminous Base Flashing Surface Coating

When the surface coating of a bituminous base flashing has deteriorated, brush off all loose coating and recoat the base flashing with flashing cement.

L. Metal Base Flashing

When the protective paint coating on a metal base flashing has deteriorated but the metal itself is not severely damaged, remove surface rust, loose scale, grease, dirt, etc., and reapply a fresh coating of paint.

When holes or punctures exist in the metal base flashing, the base flashing should be removed and replaced with bituminous base flashing in lieu of the metal base flashing.

M. Metal Counterflashings

When the protective paint coating on a metal counterflashing has deteriorated but the metal itself is not severely damaged, remove surface rust, loose scale, grease, dirt, etc., and reapply a fresh coating of paint.

When holes or punctures exist in the metal counterflashing, remove the metal counterflashing and replace it with new metal.

Counterflashings should overlap base flashings at least 2 inches, and should cover the fasteners. Base flashings should extend 8 to 14 inches above the roof surface.

N. Loose Flashing Flanges and Deteriorated Stripping Felts

When drain or vent flange flashings are loose or separated from the roof membrane, remove aggregate surfacing and stripping felts, and clean the vent flange. Clean the roof area around the flashing by sweeping or vacuuming. Apply flashing cement beneath the flange and fasten the flange to the roof deck or nailer. On asphalt roofs, apply a thin coat of asphalt primer to both the roof and the flange; coal-tar roofs generally do not require priming. After the primer has dried, apply two plies of stripping felt over the flange and adjacent roof area. Install the additional plies of felt in hot asphalt, hot coal tar or cold-applied mastic as appropriate. The first ply of felt should extend not less than 3 inches beyond the flange. The second ply of felt should extend not less than 3 inches beyond the first ply. A modified bitumen sheet may be used instead of this two-ply stripping. Embed aggregate surfacing or apply surface coating as required.

O. Low Areas

Low areas that permit ponding water are usually the result of deck deflection, settling, inadequate slope to drainage, structural problems, or improper placement of drains. Filling in these low areas with felt and hot bitumen or with cementitious fill material only adds weight. Removing the low area may require repair of the structural roof deck. Where raising joists or purlins is impractical, placing additional drains in the low area will serve to remove the weight of ponded water from the roof and will lessen the deterioration of the roof membrane. Slope to drainage can be provided by installing factory-tapered or field-tapered roof insulation, covered with a new built-up roof membrane. In some instances, this can be done without removing the existing membrane. (See Section VI-C, Re-covering.)

Low roof areas retain water

P. Standing Water Around Drains

If it is not blocked or clogged, standing water around a drain indicates that the drain is either not located at the low point on the roof or that it is set too high. Lower the drain or add new drains to the low point of the pond according to specifications for new roof construction.

Q. Gutters, Leaders and Other Metal Pieces

When the protective paint coating on metal gutters, leaders and other metal pieces has deteriorated but the metal itself is not severely damaged, remove surface rust, loose scale, grease, dirt, etc., and reapply a fresh coating of paint. Coat the inside of gutters with asphalt-based paint.

When holes or punctures exist in metal pieces, they should be removed and replaced.

R. Damaged Fascia Boards and Overhanging Material

Deteriorated fascia boards and overhanging material should be removed. The fascia board should be replaced, and new gravel stops or metal edge strips installed in accordance with specifications for new roof construction.

S. Bitumen Flow Beneath Gravel Stops or Metal Roof-Edge Strips

Sometimes bitumen will flow beneath the gravel stop or metal roof-edge strip and down the fascia board. This problem is more common on coal-tar bitumen roofs than on asphalt roofs. It is usually caused by the original design or construction, and very little can be done to correct the problem aside from removing and replacing the edge detail according to proper design and specifications for new roof construction.

VI. ROOF RE-COVERING AND REPLACEMENT

A. Reroofing

Every roof ultimately requires re-covering or replacement. While the main purpose of this manual is to serve as a guide for extending the useful life of roofs by proper maintenance and repair, of equal importance is the development of guidelines for determining the point at which maintenance and repair treatments become economically unsound and reroofing is required. Many factors enter into this determination. The more important of these are:

- The age of the roofing materials
- The condition of the roof
- Damage from weather (such as hail or strong winds)
- How well the roof has been maintained or previously repaired
- The current and future use of the structure
- The economics of further repair versus re-cover or replacement.

Other factors that should be considered include:

- The advantages of correcting roof deck, insulation, insulation attachment, and flashing deficiencies when a roof membrane is replaced
- The desirability of keeping roof loads to a minimum
- The problem of maintaining a watertight roof while reroofing is being accomplished
- Drainage restrictions, ponding and flashing height problems created by increasing the thickness of the insulation or adding plies of felt.

B. Correcting Deficiencies

Roof re-covering or replacement specifications must include measures to eliminate design deficiencies and trouble areas that exist. Specifications can take advantage of improved application techniques and materials where appropriate. Examples of some measures used to eliminate design deficiencies and trouble areas include:

- Adding expansion joints to reduce splitting problems
- Installing factory-tapered or field-tapered insulating fill material to provide roof slope for better drainage
- Installing additional drains in ponds and low areas
- Reworking flashings to raise metal out of the water line and to account for structural movement
- Installing permanent walkways to reduce traffic damage
- Removing unneeded projections or rooftop equipment.

C. Re-covering

While the application of a new roof covering over the existing membrane is sometimes practical and advantageous, there is the danger of entrapping moisture within the old roofing materials and insulation. If moisture is entrapped, blisters and other problems are likely, and may result in early failure of the new membrane. The existing roof membrane and insulation must be dry if an additional roof membrane is to be installed over them.

D. Choosing Between Re-covering and Replacement

It is difficult to decide whether an existing roof membrane can be repaired by adding plies of felt, whether a new roof should be installed over the existing roof, or whether the old roof should be removed entirely and a new membrane applied. The condition of the existing roof, the extent of entrapped moisture, and historical records on the performance of the roof will aid in making this decision. In some instances, compliance with building code or insurance agency requirements may dictate the need for roof replacement instead of re-covering.

A thorough analysis of the roof assembly should be made to determine the most feasible method of reroofing. The causes of roof problems should be determined and eliminated. Generally, roof replacement, as opposed to re-covering, is recommended when any of the following conditions are met:

- The roof has exceeded its expected service life and shows evidence of advanced deterioration
- Felts have deteriorated, are loose, or the entire roof membrane is in poor condition
- Insulation is wet, deteriorated or poorly attached
- Numerous leaks of a serious nature have developed in the roof membrane

- The existing roof membrane is not an acceptable substrate for the addition of a new roof covering, or
- Two or more roof coverings already exist on the structure.

E. Reroofing Specifications

Roof membrane specifications published by trade associations and roof material manufacturers are written to cover a wide range of reroofing situations or are written for new construction. They must be carefully adapted for each reroofing project to suit the conditions to be encountered. Whenever practical, contract drawings and specifications should be provided, outlining what is to be left in place, what is to be removed, what may be reused, and what is to be provided new. Each flashing installation should be addressed, as well as each problem area.

F. Preparing the Existing Roof Membrane for Re-covering

Remove loose aggregate surfacing, bituminous coating and loose and deteriorated felts from the old roof. Repair blisters, buckles, cracks and fishmouths, omitting the final pouring of bitumen and aggregate surfacing. Remove and replace areas of wet and deteriorated insulation and areas where the membrane or insulation are not well-attached to the roof deck, and cover these areas with at least two plies of felt. Remove deteriorated flashings, and provide cant strips and expansion joints where needed. Repair any deficiencies in the existing construction that are likely to compromise the performance of the new installation.

G. Applying the Re-cover Roof Membrane

The new roof membrane should never be adhered directly to the existing roof membrane. Instead, install a layer of re-cover board, standard roof insulation, or a venting-type base ply to the surface of the old roof membrane. Consider using additional insulation to increase the thermal efficiency of the roof system, or using tapered insulation to improve drainage. Over nailable decks, this layer may be mechanically fastened through the old membrane to the roof deck below. Over non-nailable decks and in other situations where mechanical fastening is impractical, this layer should be adhered to the old roof membrane with hot asphalt.

Over the insulation layer, install the roof membrane in accordance with the roofing material manufacturers' recommendations.

H. Preparing the Roof Deck During Roof Replacement

During partial or complete roof replacement, the old roof membrane must be removed entirely in the area affected. The roof deck should be restored to a condition as close to new as practical. Deteriorated decking should be removed and replaced with sound decking or covered with an overlayment to provide a smooth surface for the application of new materials. Loose decking should be re-fastened.

NOTE: It is the owner's responsibility to verify that the existing structural deck is capable of sustaining the loads and forces that it will encounter both in service and during the application of the new roof covering. The system may also need to be restored or modified to comply with present building code and insurance underwriting requirements for load-carrying capacity, fire resistance, and wind-uplift resistance.

Base flashings and deteriorated counterflashings should be removed. Metal counterflashings that are in good condition can be bent up out of the way for installation of new base flashing and bent down after the base flashing is installed. Metal base flashings should be replaced with bituminous base flashings.

Roof tear-off in progress

I. Repair of Metal Vents During Reroofing

During roof replacement, metal vents and flashing flanges should be examined for signs of deterioration and re-installed in accordance with standard specifications for new roof construction. Small vents should be replaced or removed and reset on top of the new roof membrane. Large hoods and vents should be raised, new flashing installed on the curb, and the hood or vent replaced. Curb-type flashings should be provided around projections to the extent that it is feasible.

Penetration flashings such as these can be properly installed during reroofing

VII. PRECAUTIONS

A. Weather Conditions

Except in emergencies, roofing work should be performed only during dry weather. Ice, frost and standing water should not be present on the surfaces to which the roofing materials will be applied. During cold weather, roofing felts should be stored inside prior to use.

B. Asphalt Emulsions

Asphalt-based emulsions contain water and must be stored at temperatures above 32 degrees Fahrenheit. Asphalt-based emulsions should be used only when the temperature is expected to remain above freezing and rain is not expected within 24 hours of application.

C. Insulation

Insulation should be stored under cover and kept dry at all times. No more insulation should be installed in a single day than can be covered with roofing materials on that day. At the end of each day's work, the exposed edges of insulation boards or underlayment should be covered with temporary cutoffs. The cutoffs must be removed when work is resumed.

D. Felts

Felts stored on the jobsite must be protected from the weather. Roofing felts will absorb considerable amounts of moisture if exposed to it. Felts that contain excessive moisture will blister. Felt rolls should be stored on end above ground on raised skids or platforms and covered with protective tarps.

E. Bitumen Heating Temperature

Asphalt should never be heated to the Flash Point (FP) and should not be heated and held above the Finished Blowing Temperature (FBT) for more than 4 hours. Coal tar should not be heated above 425 degrees Fahrenheit.

F. Equiviscous Temperature (EVT)

The Roofing Systems Technical Committee, a joint committee of the National Roofing Contractors Association and the Asphalt Roofing Manufacturers Association, recommends that the Equiviscous Temperature (EVT) concept be used for controlling the heating of asphalt during roof construction. Equiviscous Temperature is the temperature at which asphalt attains a target viscosity of 125 centistokes. The temperature of asphalt at the point of application (i.e., in the mop bucket or mechanical spreader) should be the EVT temperature plus or minus 25 degrees Fahrenheit. Asphalt labeled with the EVT temperature is available from asphalt suppliers. In the event EVT information is not furnished, consult the manufacturer for recommended application temperatures.

G. Aggregate Surfacing

Surfacing aggregate for built-up roofs should be reasonably dry and free from dust. If aggregate surfacing is going to be re-used, it must be screened to remove all fines, dirt and other foreign material.

VIII. APPLICATION OF ROOFING MATERIALS

A. General

A built-up roof, as its name implies, is a roof membrane that is "built-up" from alternate layers of bitumen and bituminous-saturated and/or coated felts or fabrics. Because each built-up roof is custom-made, the importance of quality application cannot be overemphasized. This section discusses application techniques for surface preparation and membrane repair.

B. Roof Decks

Replacement of the roof deck must be in accordance with the deck material manufacturer's requirements. All decks must be attached securely to protect against uplift and lateral movements.

Lightweight insulating concrete decks, which are placed as a slurry, contain more moisture than other roofing substrates. Retained moisture may contribute to problems with the roofing system installed over such decks if proper precautions are not taken. When these decks are used as a substrate for built-up roofing:

- The lightweight insulating concrete deck should be installed using form boards or galvanized slotted deck to provide underside venting. Topside pressure relief is also suggested.
- The base ply of the roofing system should be attached using appropriate mechanical fasteners.
- The deck applicator and deck manufacturer should certify in writing that the deck was installed in accordance with the deck manufacturer's recommendations and is satisfactory to receive the roofing system.
- The roofing contractor should install the roof in accordance with the roofing manufacturer's recommendations for application over lightweight insulating concrete decks.

For wood plank and plywood decks, large knot holes and wide cracks between plywood panels or planks should be covered with sheet metal. A separator sheet of rosin-sized sheathing paper should be applied between the deck and the roof membrane.

If a poured concrete deck is uneven, high spots must be removed, and low spots must be filled with portland cement or gypsum mortar. A fibrous cementitious grout should be used to level uneven precast concrete units and to fill in cracks in the deck. However, only gypsum mortar should be used to level uneven precast gypsum concrete units and to fill in cracks in the deck.

C. Parapet Walls

Spalling or deteriorated parapet walls and other vertical flashing areas need to be repaired or replaced prior to roofing application, so that roofing repair can be completed in a continuous operation and thus remain watertight. Deteriorated and loose materials should be repaired or replaced according to manufacturers recommendations for new construction.

D. Application of Vapor Retarders

The need for, use of and location of vapor retarders must be determined by qualified individuals. Vapor retarders must be continuous and unbroken, and must not be turned over the edges of insulation boards adjoining vented gravel stops or other vented edges. Refer to manufacturers literature for detailed instructions.

E. Application of Insulation

For detailed instructions, refer to the design manuals and to instructions furnished by the manufacturers.

Insulation boards should be laid in parallel courses, with staggered joints and in moderate contact with adjoining units (without forcing the units). The boards should be cut to fit neatly against adjoining surfaces. Where insulation thickness permits, insulation should be installed in two layers, with the joints of the top layer of insulation offset from the joints of the layer of insulation below.

F. Distinguishing Between Asphalt and Coal Tar

Asphalt can be distinguished from coal tar by placing a small specimen of bitumen in a glass jar filled with mineral spirits. When the jar is shaken, the mineral spirits solution will turn black if the bitumen specimen is asphalt, since asphalt is a petroleum byproduct. Coal tar is only partially soluble in mineral spirits, and the mineral spirit solution will turn only yellow. If a positive identification cannot be made by these methods, a sample specimen should be sent to a qualified laboratory for examination.

G. Asphalt

Asphalt used in built-up roofing should conform to ASTM Standard D 312, Types I, II, III, or IV. The particular type of asphalt chosen should be appropriate for the roof slope on which the asphalt will be applied and the climatic (temperature) conditions to be encountered.

H. Coal Tar

Because of its self-healing properties and chemical structure, coal tar is particularly suited for flat built-up roofs on which water may occasionally collect. Coal tar is more susceptible than asphalt to changes in temperature; that is, coal tar is more fluid at high temperatures. Consequently, asphalt is better suited than coal tar for slopes exceeding ¼ inch per foot. Coal tar should conform to ASTM Standard D450, Types I or III. Type II is for use in below-grade waterproofing. Coal-tar roofs should always be surfaced with slag, gravel, crushed stone or other suitable surfacing.

I. Felts

The layers of felt in a built-up roof reinforce the membrane and hold the layers of waterproofing bitumen in place. Built-up roofs are always designated by the number of plies of felt they contain; for example, three-ply and four-ply roofs contain three and four plies of felt respectively.

The various kinds of felts used in built-up roofs are:

- Asphalt-saturated organic felts
- Coal-tar-saturated organic felts
- Asphalt-coated glass fiber felts
- Coal-tar-coated glass fiber felts
- Asphalt-coated organic felts.

Asphalt felts are also used for the construction of bituminous vapor retarders. Coated felts surfaced with mineral granules are sometimes used for the wearing surface (as cap sheets) on built-up roofs.

J. Fastening

Sufficient anchorage of the roof membrane and roof insulation must be provided to prevent ply slippage, blow-off, thermal contraction and to accommodate lateral movement of the roof membrane and its components. Components may be adhered or mechanically fastened, depending on their location and the type of roof deck. Adhesion and fastening requirements are provided in various construction guide specifications and design manuals.

Uplift (suction) forces due to wind are generally greatest at the edge of the roof. That is why roof material blow-off usually begins at the roof edge, with the roof membrane, and sometimes the insulation, being peeled back toward the center of the roof. This demonstrates the need for adequate fastening of all flashings, as well as fastening the roof membrane and insulation near the edges of the roof.

For barrel or arch-type roofs and other steep slopes, the use of the up-and-over "vertical" application technique can help prevent ply slippage. This technique is also called "strapping".

Backnailing is not generally required for built-up roofs installed with inclines of less than 1 inch per foot.

K. Bitumen Pourcoat Application

The final coating (flood coat) of asphalt or coal tar on aggregate-surfaced built-up roofs should be poured rather than mopped to ensure sufficient quantities of bitumen for embedding the aggregate surfacing.

L. Modified Bitumen Membrane Materials

Modified bitumen sheets consist of polymer-modified asphalt that has been coupled with various reinforcing fabrics to form a roof membrane sheet. Modified bitumen sheets may be self-adhered, installed with hot asphalt or installed by heating the underside of the sheet with a propane torch or other suitable device. Some modified bitumen sheets have factory-applied surfacings to provide weathering resistance or to improve the appearance of the roof membrane.

Modified bitumen sheets may be used in lieu of reinforced base-flashing sheets, stripping felts and two-ply, hot-applied built-up roof patches. Metal surfaces and existing asphalt built-up roof membranes may require priming before the modified bitumen membrane is installed. Substrate preparation requirements are generally the same as they are for hot-applied repairs. The modified bitumen membrane manufacturer's literature should be consulted for specific application recommendations and requirements.

M. Cold-Applied Roof Membranes and Coatings

There are a wide variety of coatings and mastics that are applied to the roof without heating. Some of these products include fabric reinforcement, and are suitable for use in lieu of hot-applied built-up roof patches. Others may be used to coat smooth-surfaced built-up and modified bitumen roof membranes. The individual manufacturer's literature should be consulted for specific application recommendations and requirements.

GLOSSARY

Aggregate: (1) crushed stone, crushed slag or water-worn gravel used for surfacing a built-up roof; (2) any granular mineral material.

Alligatoring: the cracking of the surfacing bitumen on a built-up roof, producing a pattern of cracks similar to an alligator's hide; the cracks may or may not extend through the surfacing bitumen.

Application Rate: the quantity (mass, volume or thickness) of material applied per unit area.

Area Divider: a raised, double wood member attached to a properly flashed wood base plate that is anchored to the roof deck. It is used to relieve thermal stresses in a roof system where no expansion joints have been provided. (*See NRCA Construction Details.*)

Asbestos: a group of natural, fibrous, impure silicate materials.

Asphalt: a dark brown to black cementitious material in which the predominating constituents are bitumens, which occur in nature or are obtained in petroleum processing.

Dead-Level Asphalt: a roofing asphalt conforming to the requirements of ASTM Specification D312, Type I.

Flat Asphalt: a roofing asphalt conforming to the requirements of ASTM Specification D312, Type II.

Steep Asphalt: a roofing asphalt conforming to the requirements of ASTM Specification D312, Type III.

Special Steep Asphalt: a roofing asphalt conforming to the requirements of ASTM Specification D312, Type IV.

Asphalt, Air Blown: an asphalt produced by blowing air through molten asphalt at an elevated temperature to raise its softening point and modify other properties.

Asphalt Felt: an asphalt-saturated felt or an asphalt-coated felt.

Asphalt Mastic: a mixture of asphaltic material and graded mineral aggregate that can be poured when heated but requires mechanical manipulation to apply when cool.

Asphalt, Steam Blown: an asphalt produced by blowing steam through molten asphalt to modify its properties.

Asphaltene: a high molecular weight hydrocarbon fraction precipitated from asphalt by a designated paraffinic naphtha solvent at a specified temperature and solvent-asphalt ratio.

NOTE—The asphaltene fraction should be identified by the temperature and solvent-asphalt ratio used.

Backnailing: the practice of blind-nailing roofing felts to a substrate in addition to hot-mopping to prevent slippage. (See BLIND NAILING.)

Base Flashing: (See FLASHING.)

Base Ply: the lowermost ply of roofing material in a roof membrane assembly.

Base Sheet: a saturated or coated felt placed as the first ply in some multi-ply built-up roof membranes.

Bitumen: (1) a class of amorphous, black or dark colored, (solid, semi-solid or viscous) cementitious substances, natural or manufactured, composed principally of high molecular weight hydrocarbons, soluble in carbon disulfide, and found in asphalts, tars, pitches and asphaltites; (2) a generic term used to denote any material composed principally of bitumen.

Bituminous: containing or treated with bitumen. Examples: bituminous concrete, bituminous felts and fabrics, bituminous pavement.

Bituminous Emulsion: (1) a suspension of minute globules of bituminous material in water or in an aqueous solution; (2) a suspension of minute globules of water or an aqueous solution in a liquid bituminous material (invert emulsion).

Bituminous Grout: a mixture of bituminous material and fine sand that will flow into place without mechanical manipulation when heated.

Blackberry: a small bubble or blister in the flood coating of a gravel-surfaced roof membrane.

Blind Nailing: the practice of nailing the back portion of a roofing ply in a manner that the fasteners are not exposed to the weather in the finished product.

Blister: an enclosed pocket of air mixed with water or solvent vapor, trapped between impermeable layers of felt, or between the felt and substrate.

Blocking: wood built into a roofing system above the deck and below the membrane and flashing to stiffen the deck around an opening, act as a stop for insulation, or to serve as a nailer for attachment of the membrane or flashing.

Bond: the adhesive and cohesive forces holding two roofing components in intimate contact.

Brooming: embedding a ply of roofing material by using a broom to smooth out the ply and ensure contact with the adhesive under the ply.

British Thermal Unit (Btu) the heat energy required to raise the temperature of 1 pound of water 1 degree Fahrenheit.

Built-Up Roof Membrane: a continuous, semi-flexible roof membrane assembly, consisting of plies of saturated felts, coated felts, fabrics or mats between which alternate layers of bitumen are applied, generally surfaced with mineral aggregate, bituminous materials, or a granule-surfaced roofing sheet. (Abbreviation: BUR.)

Cant Strip: a beveled strip used under flashings to modify the angle at the point where the roofing or waterproofing membrane meets any vertical element.

Cap Flashing: (See FLASHING.)

Capillarity: the action by which the surface of a liquid (where it is in contact with a solid) is elevated or depressed, depending upon the relative attraction of the molecules of the liquid for each other and for those of the solid.

Cap Sheet: a granule-surfaced coated sheet used as the top ply of a built-up roof membrane or flashing.

Caulking: a composition of vehicle and pigment, used at ambient temperatures for filling joints, that remains plastic for an extended time after application.

Coal Tar: a dark brown to black, semi-solid hydrocarbon obtained as residue from the partial evaporation or distillation of coal tar.

Coal-Tar Pitch: a coal tar used as the waterproofing agent in dead-level or low-slope built-up roof membrane, conforming to ASTM Specification D450, Type I.

Coal-Tar Waterproofing Pitch: a coal tar used as the dampproofing or waterproofing agent in below-grade structures, conforming to ASTM Specification D450, Type II.

Coal-Tar Bitumen: a coal tar used as the waterproofing agent in dead-level or low-slope built-up roof membrane, conforming to ASTM Specification D450, Type III.

Coal-Tar Felt: a felt that has been saturated with refined coal tar.

Coated Sheet (or Felt): (1) an asphalt felt that has been coated both sides with harder, more viscous asphalt; (2) a glass fiber felt that has been simultaneously impregnated and coated with asphalt on both sides.

Cold-Process Roofing: a continuous, semi-flexible roof membrane, consisting of plies of felts, mats, or fabrics that are laminated on a roof with alternate layers of cold-applied roof cement and surfaced with a cold-applied coating.

Condensation: the conversion of water vapor or other gas to liquid as the temperature drops or the atmospheric pressure rises. (See DEW-POINT.)

Coping: the covering piece on top of a wall exposed to the weather, usually sloped to shed water.

Counterflashing: formed metal or elastomeric sheeting secured on or into a wall, curb, pipe, rooftop unit or other surface, to cover and protect the upper edge of a base flashing and its associated fasteners.

Course: (1) the term used for each application of material that forms the waterproofing system or the flashing; (2) one layer of a series of materials applied to a surface (i.e., a five-course wall flashing is composed of three applications of mastic with one ply of felt sandwiched between each layer of mastic.)

Coverage: the surface area continuously covered by a specific quantity of a particular roofing material.

Crack: a separation or fracture occurring in a roof membrane or roof deck, generally caused by thermally induced stress or substrate movement.

Creep: the permanent deformation of a roofing material or roof system caused by the movement of the roof membrane that results from continuous thermal stress or loading.

Cricket: a relatively small, elevated area of a roof constructed to divert water around a chimney, curb or other projection.

Cutback: solvent-thinned bitumen used in cold process roofing adhesives, flashing cements and roof coatings.

Cutoff: a detail designed to prevent lateral water movement into the insulation where the membrane terminates at the end of a day's work, or used to isolate sections of the roofing system. It is usually removed before the continuation of the work.

Dampproofing: treatment of a surface or structure to resist the passage of water in the absence of hydrostatic pressure.

Dead Level: absolutely horizontal, or zero slope. (See SLOPE.)

Dead-Level Asphalt: (See ASPHALT.)

Dead Loads: non-moving rooftop loads, such as mechanical equipment, air conditioning units, and the roof deck itself.

Deck: the structural surface to which the roofing or waterproofing system (including insulation) is applied.

Delamination: separation of the plies in a roof membrane system or separation of laminated layers of insulation.

Dew Point: the temperature at which water vapor starts to condense in cooling air at the existing atmospheric pressure and vapor content.

Double-Pour: the process of applying two layers of aggregate and bitumen to a built-up roof.

Drain: a device that allows for the flow of water from a roof area. (See NRCA Construction Details.)

Dropback: a reduction in the softening point of bitumen that occurs when bitumen is heated in the absence of air. (See SOFTENING POINT DRIFT.)

Edge Sheets: felt strips that are cut to widths narrower than the standard width of the full felt roll, used to start the felt shingling pattern at a roof edge.

Edge Stripping: application of felt strips cut to narrower widths than the normal felt roll width to cover a joint between flashing and built-up roofing.

Edge Venting: the practice of providing regularly spaced protected openings along a roof perimeter to relieve moisture vapor pressure.

Elastomer: a macromolecular material that returns rapidly to its approximate initial dimensions and shape after substantial deformation by a weak stress and the subsequent release of that stress.

Elastomeric: the elastic, rubber-like properties of a material.

Embedment: (1) the process of pressing a felt, aggregate, fabric, mat, or panel uniformly and completely into hot bitumen or adhesive; (2) the process of pressing granules into coating in the manufacture of factory-prepared roofing.

Emulsion: the intimate dispersion of an organic material and water achieved by using a chemical or clay emulsifying agent.

Envelope: a continuous membrane edge seal formed at the perimeter and at penetrations by folding the base sheet or ply over the plies above and securing it to the top of the membrane. The envelope prevents bitumen seepage from the edge of the membrane.

Equilibrium Moisture Content: (1) the moisture content of a material stabilized at a given temperature and relative humidity, expressed as percent moisture by weight; (2) the typical moisture content of a material in any given geographical area.

Equiviscous Temperature (EVT): the temperature at which the viscosity of an asphalt is 125 centistokes; the recommended asphalt temperature plus or minus 25F at the time of application.

Expansion Joint: a structural separation between two building elements that allows free movement between the elements without damage to the roofing or waterproofing system.

Exposure: (1) the transverse dimension of a roofing element not overlapped by an adjacent element in any roof system. The exposure of any ply in a membrane may be computed by dividing the felt width minus 2 inches by the number of shingled plies; thus, the exposure of a 36-inch-wide felt in a shingled, four-ply membrane should be 8-1/2 inches; (2) the time during which a portion of a roofing element is exposed to the weather.

Fabric: a woven cloth of organic or inorganic filaments, threads or yarns.

Factory Mutual (FM): an organization that classifies roof assemblies for their fire characteristics and wind-uplift resistance for insurance companies in the United States.

Factory Square: 108 square feet of roofing material.

Fallback: (See DROPBACK.)

Felt: a flexible sheet manufactured by the interlocking of fibers through a combination of mechanical work, moisture and heat. Felts are manufactured principally from vegetable fibers (organic felts), asbestos fibers (asbestos felts) or glass fibers (glass fiber felts); other fibers may be present in each type.

Felt Layer: a machine used for applying bitumen and built-up roofing felts.

Felt Mill Ream: the mass in pounds of 480 square feet of dry, unsaturated felt; also termed "point weight.'

Fine Mineral Surfacing: water-insoluble, inorganic material, more than 50 percent of which passes the No. 35 sieve, used on the surface of roofing.

Fishmouth: (1) a half-cylindrical or half-conical opening formed by an edge wrinkle; (2) in shingles, a half-conical opening formed at a cut edge.

Flashing: the system used to seal membrane edges at walls, expansion joints, drains, gravel stops, and other places where the membrane is interrupted or terminated. Base flashing covers the edges of the membrane. Cap flashing or counterflashing shields the upper edges of the base flashing.

Flashing Cement: a trowelable mixture of cutback bitumen and mineral stabilizers, including asbestos or other inorganic fibers.

Flat Asphalt: (See ASPHALT.)

Flood Coat: the top layer of bitumen into which the aggregate is embedded on an aggregate-surfaced built-up roof.

Fluid-Applied Elastomer: an elastomeric material, fluid at ambient temperature, that dries or cures after application to form a continuous membrane. Such systems normally do not incorporate reinforcement.

Glass Felt: glass fibers bonded into a sheet with resin and suitable for impregnation in the manufacture of bituminous waterproofing materials, roof membranes, and shingles.

Glass Mat: a thin mat composed of glass fibers with or without a binder.

Glaze Coat: (1) the top layer of asphalt in a smooth-surfaced built-up roof assembly; (2) a thin protective coating of bitumen applied to the lower plies or top ply of a built-up roof membrane when application of additional felts or the flood coat and aggregate surfacing are delayed.

Gravel: course, granular aggregate, with pieces larger than sand grains, resulting from the natural erosion of rock.

Gravel Stop: a flanged device, frequently metallic, designed to provide a continuous finished edge for roofing materials and to prevent loose aggregate from washing off of the roof.

Headlap: the minimum distance, measured at 90 degrees to the eaves along the face of a shingle or felt, from the upper edge of the shingle or felt to the nearest exposed surface.

Holiday: an area where a liquid-applied material is missing.

"Hot Stuff" or "Hot": the roofer's term for hot bitumen.

Hygroscopic: attracting, absorbing and retaining atmospheric moisture.

Ice Dam: a mass of ice formed at the transition from a warm to a cold roof surface, frequently formed by refreezing meltwater at the overhang of a steep roof, causing ice and water to back up under roofing materials.

Incline: the slope of a roof expressed either in percent or in the number of vertical units of rise per horizontal unit of run.

Inorganic: being or composed of matter other than hydrocarbons and their derivatives, or matter that is not of plant or animal origin.

Insulation: (See THERMAL INSULATION.)

Job-Average Basis: a technique for determining the average dimensions or quantities of materials, by analysis of roof test cuts. The technique requires a minimum of three test cuts per roof area, plus one cut for each additional 10,000 square feet of roof area. Job-average basis is computed by dividing the sum of all measurements taken by the number of measurements taken. The results would describe the job-average for the quantity or dimension.

Knot: an imperfection or non-homogeneity in materials used in fabric construction, the presence of which causes surface irregularities.

Live Loads: moving roof installation equipment, wind, snow, ice or rain.

Mastic: (See FLASHING CEMENT or ASPHALT MASTIC.)

Membrane: a flexible or semi-flexible roof covering or waterproofing layer, whose primary function is the exclusion of water.

Mesh: the square opening of a sieve.

Metal Flashing: (See FLASHING.) Metal flashing is frequently used as through-wall flashing, cap flashing, counterflashing or gravel stops.

Mineral Fiber Felt: a felt with mineral wool as its principal component.

Mineral Granules: opaque, natural, or synthetically colored aggregate commonly used to surface cap sheets, granule-surfaced sheets, and roofing shingles.

Mineral Stabilizer: a fine, water-insoluble inorganic material, used in admixture with solid or semi-solid bituminous materials.

Mineral-Surfaced Roofing: built-up roofing materials whose top ply consists of a granule-surfaced sheet.

Mineral-Surfaced Sheet: a felt that is coated on one or both sides with asphalt and surfaced with mineral granules.

Mole Run: a meandering ridge in a roof membrane not associated with insulation or deck joints.

Mop-and-Flop: an application procedure in which roofing elements (insulation boards, felt plies, cap sheets, etc.) are initially placed upside down adjacent to their ultimate locations, are coated with adhesive, and are then turned over and applied to the substrate.

Mopping: the application of hot bitumen with a mop or mechanical applicator to the substrate or to the felts of a built-up roof membrane.

Solid Mopping: a continuous mopping of a surface, leaving no unmopped areas.

Spot Mopping: a mopping pattern in which hot bitumen is applied in roughly circular areas, leaving a grid of unmopped, perpendicular bands on the roof.

Sprinkle Mopping: a random mopping pattern in which heated bitumen beads are strewn onto the substrate with a brush or mop.

Strip Mopping: a mopping pattern in which hot bitumen is applied in parallel bands.

Neoprene: a synthetic rubber (polychloroprene) used in liquid-applied and sheet-applied elastomeric roof membranes or flashings.

Nineteen-Inch Selvage: a prepared roofing sheet with a 17-inch granule-surfaced exposure and a nongranule-surfaced 19-inch selvage edge. This material is sometimes referred to as SIS or as Wide-Selvage Asphalt Roll Roofing Material Surfaced with Mineral Granules.

Ninety-Pound: a prepared organic felt roll roofing with a granule surfaced exposure that has a mass of approximately 90 pounds per 100 square feet.

Organic: being or composed of hydrocarbons or their derivatives, or matter of plant or animal origin.

Parapet Wall: that part of any wall entirely above the roof.

Perlite: an aggregate used in lightweight insulating concrete and in preformed perlitic insulation boards, formed by heating and expanding siliceous volcanic glass.

Perm: a unit of water vapor transmission defined as 1 grain of water vapor per square foot per hour per inch of mercury pressure difference (1 inch of mercury = 0.49 psi). The formula for perm is:

$$P = \text{GRAINS OF WATER VAPOR/SQUARE FOOT} \cdot \text{HOUR} \cdot \text{INCH MERCURY}$$

Permeance: an index of a material's resistance to water vapor transmission. (See PERM.)

Phased Application: the installation of a roof system or waterproofing system during two or more separate time intervals.

Picture Framing: a rectangular pattern of ridges in a roof membrane over insulation or deck joints.

Pitch: (See COAL TAR and INCLINE.)

Pitch Pocket: a flanged, open-bottomed, metal container placed around columns or other roof penetrations that is filled with hot bitumen or flashing cement to seal the joint. The use of pitch pockets is not recommended by NRCA.

Plastic Cement: (See FLASHING CEMENT.)

Ply: a layer of felt in a built-up roof membrane system. A four-ply membrane system has four plies of felt.

Point Weight: (See FELT MILL REAM.)

Pond: a roof surface that is incompletely drained.

Positive Drainage: the drainage condition in which consideration has been made for all loading deflections of the deck, and additional roof slope has been provided to ensure drainage of the roof area within 48 hours of rainfall.

Primer: a thin, liquid bitumen applied to a surface to improve the adhesion of subsequent applications of bitumen.

Rake: the sloped edge of a roof at the first or last rafter.

Re-covering: the process of covering an existing roofing system with a new roofing system.

Re-entrant Corner: an inside corner of a surface, producing stress concentrations in the roofing or waterproofing membrane.

Reglet: a groove in a wall or other surface adjoining a roof surface for use in the attachment of counterflashing.

Reinforced Membrane: a roofing or waterproofing membrane reinforced with felts, mats, fabrics or chopped fibers.

Relative Humidity: the ratio of the weight of moisture in a given volume of air-vapor mixture to the saturated (maximum) weight of water vapor at the same temperature, expressed as a percentage. For example, if the weight of the moist air is 1 pound and if the air could hold 2 pounds of water vapor at a given temperature, the relative humidity (RH) is 50 percent.

Replacement: the practice of removing an existing roof system and replacing it with a new roofing system.

Re-roofing: the process of re-covering or replacing an existing roofing system. (See RE-COVERING and REPLACEMENT.)

Ridging: an upward, tenting displacement of a roof membrane, frequently occurring over insulation joints, deck joints and base sheet edges.

Roll Roofing: smooth-surfaced or mineral-surfaced coated felts.

Roof Assembly: an assembly of interacting roof components (including the roof deck) designed to weatherproof and, normally, to insulate a building's top surface.

Roof Cement: (See FLASHING CEMENT.)

Roofer: the trade name for the workman who applies roofing materials.

Roof System: a system of interacting roof components (not including the roof deck) designed to weatherproof and, normally, to insulate a building's top surface.

Saddle: a small structure that helps channel surface water to drains, frequently located in a valley, and often constructed like a small hip roof or like a pyramid with a diamond-shaped base. (See CRICKET.)

Saturated Felt: a felt that has been partially saturated with low softening point bitumen.

Screen: an apparatus with circular apertures for separating sizes of materials.

Scuttle: a hatch that provides access to the roof from the interior of the building.

Seal: (1) a narrow closure strip made of bituminous materials; (2) to secure a roof from the entry of moisture.

Sealant: a mixture of polymers, fillers, and pigments used to fill and seal joints where moderate movement is expected; it cures to a resilient solid.

Selvage: an edge or edging that differs from the main part of (1) a fabric, or (2) granule-surfaced roll roofing material.

Selvage Joint: a lapped joint designed for mineral-surfaced cap sheets. The mineral surfacing is omitted over a small portion of the longitudinal edge of the sheet below in order to obtain better adhesion of the lapped cap sheet surface with the bituminous adhesive.

Shark Fin: an upward-curled felt side lap or end lap.

Shingle: (1) a small unit of prepared roofing material designed for installation with similar units in overlapping rows on inclines normally exceeding 25 percent; (2) to cover with shingles; (3) to apply any sheet material in overlapping rows like shingles.

Shingling: (1) the procedure of laying parallel felts so that one longitudinal edge of each felt overlaps and the other longitudinal edge underlaps, and adjacent felt. (See PLY.) Normally, felts are shingled on a slope so that the water flows over rather than against each lap; (2) the application of shingles to a sloped roof.

Sieve: an apparatus with apertures for separating sizes of material.

Slag: a hard, air-cooled aggregate that is left as a residue from blast furnaces, used as a surfacing aggregate.

Slippage: relative lateral movement of adjacent components of a built-up membrane. It occurs mainly in roofing membranes on a slope, sometimes exposing the lower plies or even the base sheet to the weather.

Slope: (See INCLINE.)

Smooth-Surfaced Roof: a built-up roof membrane surfaced with a layer of hot-mopped asphalt, cold-applied asphalt-clay emulsion, cold-applied asphalt cutback, or sometimes with an unmopped inorganic felt.

Softening Point: the temperature at which bitumen becomes soft enough to flow, as determined by an arbitrary, closely defined method.

Softening Point Drift: a change in the softening point of bitumen during storage or application. (See DROPBACK.)

Solid Mopping: (See MOPPING.)

Special Steep Asphalt: (See ASPHALT.)

Split: a membrane tear resulting from tensile stress.

Split Sheet: (See NINETEEN-INCH SELVAGE.)

Spot Mopping: (See MOPPING.)

Sprinkle Mopping: (See MOPPING.)

Spudding: the process of removing the roofing aggregate and most of the bituminous top coating by scraping and chipping.

Square: the term used to describe 100 square feet of roof area.

Stack Vent: a vertical outlet in a built-up roof system designed to relieve the pressure exerted by moisture vapor between the roof membrane and the vapor retarder or deck.

Steep Asphalt: (See ASPHALT.)

Strip Mopping: (See MOPPING.)

Stripping or Strip-Flashing: (1) the technique of sealing a joint between metal and the built-up roof membrane with one or two plies of felt or fabric and hot-applied or cold-applied bitumen; (2) the technique of taping joints between insulation boards or deck panels.

Substrate: the surface upon which the roofing or waterproofing membrane is applied (i.e., the structural deck or insulation).

Sump: an intentional depression around a drain.

Superimposed Loads: loads that are added to existing loads. For example, a large stack of insulation boards placed on top of a structural steel deck.

Tapered Edge Strip: a tapered insulation strip used to (1) elevate the roof at the perimeter and at curbs that extend through a roof; (2) provide a gradual transition from one layer of insulation to another.

Taping: (See STRIPPING.)

Tar: a brown or black bituminous material, liquid or semi-solid in consistency, in which the predominating constituents are bitumens obtained as condensates in the processing of coal, petroleum, oil-shale, wood, or other organic materials.

Tarred Felt: (See COAL-TAR FELT.)

Test Cut: a sample of the roof membrane that is cut from a roof membrane to: (a) determine the weight of the average interply bitumen moppings; (b) diagnose the condition of the existing membrane (e.g., to detect leaks or blisters).

Thermal Conductance (C): a unit of heat flow that is used for specific thicknesses of material or for materials of combination construction, such as laminated insulation. The formula for thermal conductance is:

$$C = \frac{k}{\text{thickness in inches}}$$

Thermal Conductivity: the heat energy that will be transmitted by conduction through 1 square foot of 1-inch thick homogeneous material in one hour when there is a difference of 1 degree Fahrenheit perpendicularly across the two surfaces of the material. The formula for thermal conductivity is:

$$k = \text{Btu/square foot•inch•hour•degree Fahrenheit}$$

Thermal Insulation: a material applied to reduce the flow of heat.

Thermal Resistance (R): an index of a material's resistance to heat flow; it is the reciprocal of thermal conductivity (k) or thermal conductance (C). The formula for thermal resistance is:

$$R = \frac{1}{C}, \text{ or } R = \frac{1}{k}, \text{ or } R = \frac{\text{Thickness in inches}}{k}$$

Thermal Shock: the stress-producing phenomenon resulting from sudden temperature changes in a roof membrane when, for example, a rain shower follows brilliant sunshine.

Through-Wall Flashing: a water-resistant membrane or material assembly extending through a wall and its cavities, positioned to direct water entering the top of the wall to the exterior.

Tuckpointing: (1) troweling mortar into a joint after masonry units are laid; (2) final treatment of joints in cut stonework. Mortar or a putty-like filler is forced into the joint after the stone is set.

Underwriters Laboratories (UL): an organization that classifies roof assemblies for their fire characteristics and wind-uplift resistance.

Vapor Migration: the movement of water vapor from a region of high vapor pressure to a region of lower vapor pressure.

Vapor Retarder: a material designed to restrict the passage of water vapor through a wall or roof.

Vent: an opening designed to convey water vapor or other gas from inside a building or a building component to the atmosphere, thereby relieving vapor pressure.

Vermiculite: an aggregate used in lightweight insulating concrete, formed by the heating and consequent expansion of a micaceous mineral.

Water Cutoff: (See CUTOFF.)

Waterproofing: treatment of a surface or structure to prevent the passage of water under hydrostatic pressure.

Wythe: a masonry wall, one masonry unit, a minimum of two inches thick.

ASTM STANDARD	TITLE
C 208	Insulating Board (Cellulosic Fiber), Structural and Decorative
C 552	Cellular Glass Block and Pipe Thermal Insulation
C 578	Preformed, Cellular Polystyrene Thermal Insulation
C 726	Mineral Fiber and Mineral Fiber, Rigid Cellular Polyurethane Composite Roof Insulation Board
C 728	Perlite Thermal Insulation Board
C 984	Perlite Board, Rigid Cellular Polyurethane Composite Roof Insulation
C 1050	Rigid Cellular Polystyrene, Cellulosic Fiber Composite Roof Insulation
D 41	Asphalt Primer Used in Roofing, Dampproofing and Waterproofing
D 43	Creosote Primer Used in Roofing, Dampproofing and Waterproofing
D 224	Smooth-Surfaced Asphalt Roll Roofing (Organic Felt)
D 226	Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
D 227	Coal-Tar-Saturated Organic Felt Used in Roofing and Waterproofing
D 249	Asphalt Roll Roofing (Organic Felt) Surfaced with Mineral Granules
D 312	Asphalt Used in Roofing
D 450	Coal-Tar Pitch Used in Roofing, Dampproofing and Waterproofing
D 1079	Definition of Terms Relating to Roofing, Waterproofing and Bituminous Materials
D 1227	Emulsified Asphalt Used as a Protective Coating for Built-Up Roofing
D 1327	Bitumen-Saturated Woven Burlap Fabrics Used in Roofing and Waterproofing
D 1668	Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
D 1863	Mineral Aggregate Used on Built-Up Roofs
D 2178	Asphalt Glass Felt Used in Roofing and Waterproofing
D 2626	Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing
D 2822	Asphalt Roof Cement
D 2823	Asphalt Roof Coatings
D 2824	Aluminum-Pigmented Asphalt Roof Coatings
D 2829	Recommended Practice for Sampling and Analysis of Built-Up Roofs
D 3617	Practice for Sampling and Analysis of New Built-Up Roof Membranes
D 3672	Venting Asphalt-Saturated and Coated Inorganic Felt Base Sheet Used in Roofing
D 3909	Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules
D 4022	Coal-Tar Roof Cement
D 4479	Asphalt Roof Coatings — Asbestos Free
D 4586	Asphalt Roof Cement — Asbestos Free
D 4601	Asphalt-Coated Glass Fiber Base Sheet Used in Roofing

FEDERAL SPECIFICATION	TITLE
HH-I-524C	Insulation Board, Thermal (Polystyrene)
HH-I-526C	Insulation Board, Thermal (Mineral Fiber)
HH-I-529B	Insulation Board, Thermal (Mineral Aggregate)
HH-I-551E	Insulation Block, Pipe Covering and Boards, Thermal (Cellular Glass)
HH-I-1972	Insulation Board, Thermal, Faced, Polyurethane or Polyisocyanurate
HH-R-595B	Roofing Felt, Coal-Tar and Asphalt-Saturated Organic Felts, Rolls
LLL-I-535	Insulation Board, Thermal (Cellulosic Fiber) Blocks
SS-A-666D	Asphalt, Petroleum (Built-Up Roofing, Waterproofing and Dampproofing)
SS-A-694D	Asphalt, Petroleum (Primer, Roofing and Waterproofing)
SS-C-450A	Cloth, Impregnated (Woven Cotton Cloth, Asphalt Impregnated, Coal-Tar Impregnated)
SS-R-501D	Roofing Felt, Asphalt-Prepared, Smooth Surfaced
SS-R-630D	Roofing Felt (Roll, Asphalt-Prepared, Mineral-Surfaced)

PG. 40 - BLANK

INDUSTRY PUBLICATIONS

PUBLICATION	PUBLISHER
The NRCA Roofing & Waterproofing Manual	National Roofing Contractors Association 6250 River Road Rosemont, IL 60018
Annual Book of ASTM Standards, Volumes 04.04 and 04.06	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103
Index of Federal Specifications, Standards and Commercial Item Descriptions	General Services Administration Office of Federal Supply and Services 7th & D Streets, S.W. Washington, DC 20202
UL Building Materials Directory	Underwriters Laboratories, Inc. 333 Pfingsten Road Northbrook, IL 60062
FM Approval Guide and FM Loss Prevention Data Sheets	Factory Mutual Research 1151 Boston-Providence Turnpike Norwood, MA 02062

PG. 42 BLANK

HISTORICAL RECORD—BUILT-UP ROOF No._____

BUILDING ID: _____ USED FOR: _____

Permanent_____ Temporary_____ Year roof was applied_____

Owner:

_____

_____

_____

Roofing Contractor:

_____

_____

_____

General Contractor:

_____

_____

_____

Architect:

_____

_____

_____

Building Address:

_____

_____

_____

Is the roof guaranteed? Yes_____ No_____
(attach copy of guarantee to Historical Record)

ROOF DECK TYPE:

Wood Plank _____	Plywood _____	
Concrete Slab _____	Gypsum Slab _____	Steel _____
Concrete Plank _____	Gypsum Plank _____	Other _____

ROOF SLOPE: Inches per foot_____

ROOF AREA: Number of squares (one square = 100 sq. ft.) _____

BUILT-UP ROOF TYPE: Asphalt_____ Coal-Tar_____ Cold-Process_____

SURFACING:

Crushed Stone _____	Gravel _____	Slag _____
Mineral-Surfaced Cap Sheet _____	Promenade Tile _____	Slate _____
Smooth-Surfaced Cap Sheet _____	Smooth-Asphalt _____	Other _____

TOTAL NUMBER OF PLIES:_____

FELT TYPE: Glass Fiber_____ Organic_____ Asbestos_____ Other_____

BASE PLY TYPE: _____

PG 43/44 BLANK

INSULATION TYPE/THICKNESS: None _____ Cellular Glass _____
Glass Fiber _____ Perlite _____ Isosyanurate _____
Polystyrene _____ Urethane _____ Wood Fiberboard _____
Phenolic Foam _____ Other _____

INSULATION FASTENED TO DECK WITH: Mechanical Fasteners_____ Hot Asphalt_____
Cold Adhesive_____ Other_____

VAPOR RETARDER: None_____ Bituminous_____ Kraft Paper_____ Vinyl Film_____ Other_____

DESCRIPTION OF VENTING: _____

FLASHING:

Metal Base Flashing: (Type of metal) _____

Composition Base Flashing: (Felt type) _____

Describe how top of flashing is fastened: _____

Cant Strips: None_____ Wood_____ Fiberboard Other_____

Counterflashing: Yes_____ No_____

Through-Wall Flashing: (Type of material) _____

Other Flashing: _____

DRAINAGE SYSTEM: (Briefly describe the roof drainage system, including drains, scuppers, gutters, downspouts and sumps, if any.) _____

PREVIOUS MAINTENANCE AND REPAIR WORK: (Briefly describe membrane and flashing work done, including dates and who did the work.) _____

NOTE: Copies of all documents concerning the roof, including design drawings, as-installed drawings and contracts covering the original installation of the roof should be kept on file with this historical record.

Form filled out by: _____ Date: _____

INSPECTION RECORD: (Keep inspection forms with this historical record.)

DATE	FORM NUMBER	INSPECTOR

INSPECTION FORM—BUILT-UP ROOF

No._____

BUILDING ID: _____ INSPECTION DATE: _____

HISTORICAL RECORD NUMBER:_____

ROOF DECK UNDERSIDE:
Record locations of signs of water leakage/damage: _____

_____

_____

Record locations and extent of deck deterioration: _____

_____

_____

Record locations of bitumen drippage: _____

PARAPET/WALL EXTERIOR:

Deteriorated Mortar Joints _____ Settlement Cracks _____

Open Coping Joints _____ Cracked/Broken Coping Cap _____

Efflousescence _____ Damaged Facia/Overhang _____

Deteriorated Gutters, etc. _____ Other _____

Record locations of signs of water infiltration: _____

_____

_____

FIELD OF ROOF:

General Condition: Good_____ Fair_____ Poor_____

Watertightness:

No leaks _____ Leaks during continued rain _____

Leaks every rain _____ Leaks during high wind _____

Leaks continuously _____

Check for evidence of: (indicate level of damage as L=light, M=moderate, S=severe. Record location on roof plan.)

Wind Damage _____	Hail Damage _____	Heavy Roof Traffic _____
Vandalism _____	Debris _____	Mechanical Damage _____
Cracks _____	Punctures _____	Deteriorated Felts _____
Fishmouths _____	Blisters _____	Alligatored Coating _____
Splits _____	Buckles _____	Standing Water _____
Exposed Felt _____	Low Spots _____	Other _____

FLASHINGS:

General Condition: Good_____ Fair_____ Poor_____

Watertightness: No leaks_____ Leaks during continued rain _____

Leaks every rain _____ Leaks during high wind_____

Leaks continuously _____

Check for evidence of: (indicate level of damage as L=light, M=moderate, S=severe. Record location on roof plan.)

Base Flashings:

Deteriorated Base Flashing _____ Open Vertical Joints _____

Flashing Separated from Wall _____ Sagging Base Flashing_____

Deteriorated Surface Coating _____ Missing Counterflashing _____

Punctured Base Flashing _____ Cracked Felts _____

Insufficient Flashing Height_____ Movement_____

Gravel Stop:

Deteriorated Stripping Felts_____ Deteriorated Metal_____

Flashing Separated from Wall _____ Loose Flashing Flange _____

Drains:

Standing Water around Drain _____ Clogged Drain_____

Deteriorated Stripping Felts_____ Deteriorated Metal_____

PHOTOGRAPHIC RECORD:

Prints_____ Slides_____ Video_____ Other_____ None_____

Attached_____ Other Location _____

(NOTE: Each photo/tape should be identified with Building ID, inspection date, inspection form number and a description of what is being shown.)

ROOF PLAN: Draw a roof plan on the next page showing the location of all problem areas found. Also note any changes or additions to the roof since the roof was first completed.

Form filled out by: _____ Date: _____

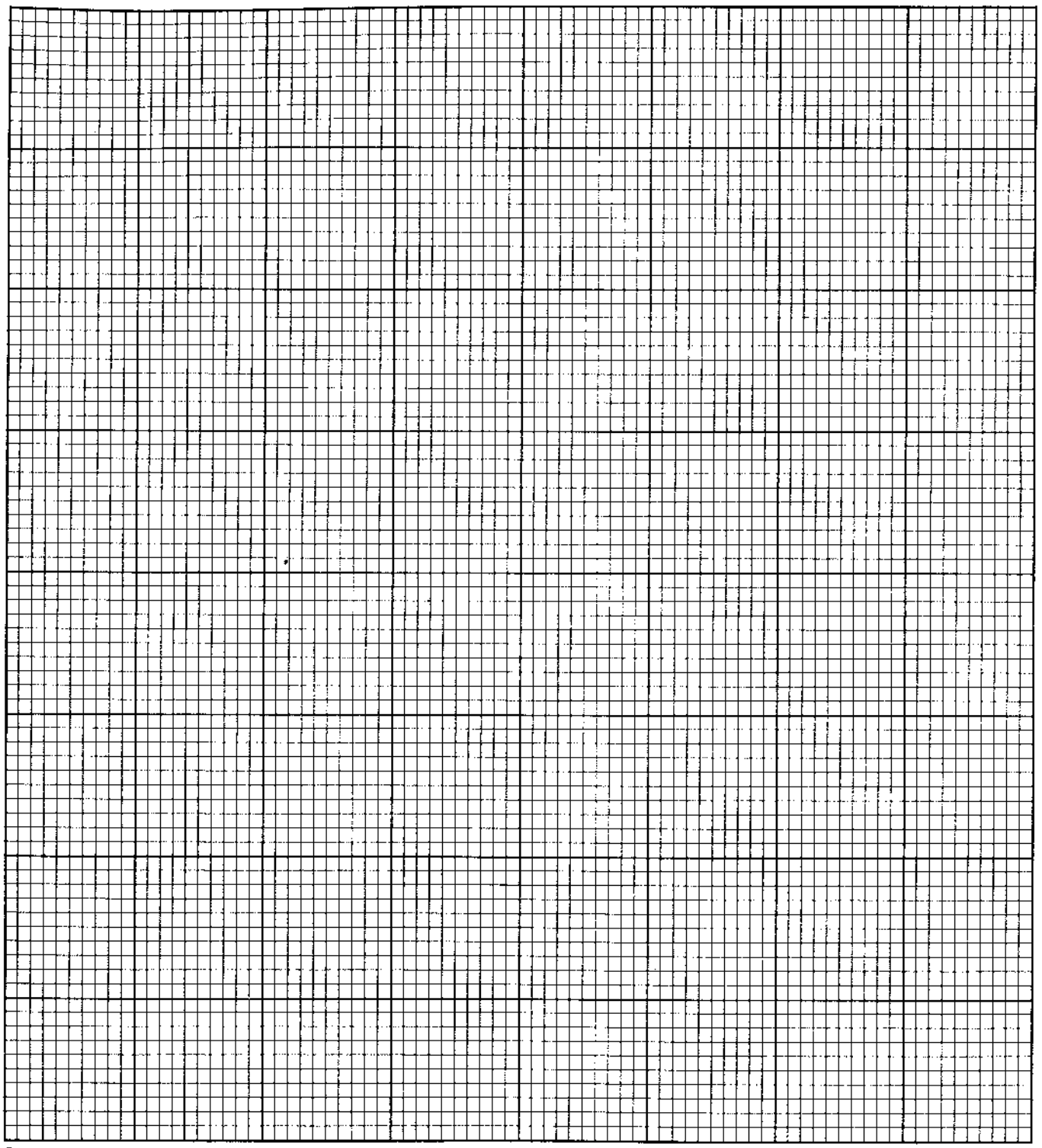
INSPECTION RECORD: (File this inspection form with the historical record.)

ROOF PLAN

Show inside wall dimensions—all sections.
Indicate cardinal compass points (N, S, E, or W).
Indicate street intersections or adjoining buildings for future identification of job.

INDICATE DIRECTIONS HERE

Scale_____



Sketch on the plan the location of monitors, fire walls, and large skylights or openings. Indicate with a cross (X) the location of chimneys, ventilators, etc. Mark each with the proper key number as follows:

1. Hips
2. Vent Pipes
3. Sign Supports
4. Saddles
5. Skylights
6. Monitors
7. Tanks
8. Fire Walls
9. Penthouses
10. Chimneys
11. Ventilators
12. Courts
13. Outlets
14. Gravel Guard
15. Pitch Pans
16. Scuttle Hole
17. _____
18. _____
19. _____
20. _____

(USE INK OR TYPEWRITER)

NATIONAL
ROOFING
CONTRACTORS
ASSOCIATION

10255 W. Higgins Road
Suite 600
Rosemont, IL 60018-5607
(708) 299-9070

ASPHALT ROOFING MANUFACTURERS ASSOCIATION

6288 Montrose Road, Rockville, MD 20852
(301) 231-9050