

ROOF MAINTENANCE GUIDE

SMC Group Inc.

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1. **OVERVIEW**

The most important reason for establishing a program of regular roof maintenance is to protect the owner's investment. A properly executed maintenance program will add years to the life of the roof by detecting minor problems before they become major, as well as providing better protection for, and avoiding interruption of, the internal functions of the building.

A roof system is exposed to all manner of chemical and physical stress. The long term effects of these forces are called "Normal Aging". In reality, small isolated problems caused through abuse, stress concentration, inadequate ventilation, error, or other factors result in a shortened lifespan of the roofing system.

Small problems or defects, if not detected and repaired, inevitably become major problems affecting the performance of the whole roof system.

Roofs represent approximately 5 to 7% of capital building costs - but roofs cover 100% of the building and its contents.

1.1 **ROOF TYPES (DEFINITIONS)**

MEMBRANE ROOFING

Conventional Uninsulated

Roof membrane is installed directly to the deck (usually wood or concrete), and is exposed to the weather. There is no insulation directly below the membrane. In a wood deck of this type the insulation, if used, is typically installed in the supporting joist space, which must be cross-vented.

Conventional Insulated

Roof membrane is installed directly over insulating materials, which are installed on the deck (wood, concrete or steel). The membrane is exposed to the weather.

Protected (or Inverted) Membrane

Roof membrane is installed directly to the deck (wood, concrete or overlaid steel). Extruded polystyrene is installed over the membrane covered by filter fabric and appropriate ballast. Ballast is required to counteract insulation flotation and wind uplift, and to provide ultraviolet resistance for the insulation. A modified protected membrane includes insulation both above and below the membrane. It is often used to provide slope to the membrane in order to improve drainage or to move the dew point away from the membrane.

STEEP ROOFING

In the context of this guide, steep roofing may be defined as roofs with asphalt shingles, cedar shakes or shingles or metal roofing on slopes that exceed 1:6 (2" in 12").

1.2 MEMBRANE TYPES (MOST COMMON)

Built-Up Roofing (also called "Tar & Gravel" or "BUR")

A continuous, relatively inflexible roof assembly consisting of plies (usually 3 or 4) of saturated felts or fabrics between which layers of bitumen (asphalt, pitch, or modified rubberized asphalt) is applied. The roof is usually surfaced with gravel to provide ultraviolet protection.

Flexible Membranes

Flexible membranes encompass a large number of unique membranes installed in single or multi-ply applications. The materials may be bituminous or non-bituminous and offer a wide choice of physical properties and performance.

The key point with these membranes — from a maintenance and repair standpoint — is that each type is unique. The building owner must be aware of the specific type and product in place in order to know what maintenance is required and what specialized repair materials and methods should be used.

Remember: "Your Roof May Be Different"

Common Types of Flexible Membranes are:

Modified Bitumen

A generic description for pre-manufactured sheet membranes consisting of asphalt, modified with a polymer, which improves the physical properties of the asphalt and coated on a reinforcing mat or carrier. Different polymers offer different physical properties. Sheets may be installed either in hot asphalt or by heating with a propane torch, and in some cases they may be self-adhesive. Applications normally consist of 2 plies but may be a single ply in certain well sloped applications. Modified Bitumen Membranes are used in all roof types.

EPDM (Ethylene Propylene Diene Monomer)

A generic description for synthetic rubber sheet membranes. Applied only in single-ply applications on all roof types. Seams are accomplished with proprietary adhesives.

PVC (Polyvinyl Chloride and TPO (Thermoplastic polyolefin)

Generic descriptions for a plastic sheet membrane. Applied in single-ply applications on all roof types. Seams are accomplished by fusion either with solvent or hot-air welding techniques.

Although these are the most commonly used generic flexible membranes, there are other types on the market (each of which, as mentioned, requires special knowledge and techniques). Make sure you know what you are dealing with.

2. **BASIC PREVENTIVE MAINTENANCE**

2.1 **MAINTENANCE PROGRAM**

A preventive maintenance program is simply a program of scheduled inspections and subsequent corrective action. The purpose is to maximize the life expectancy of the roofing system, thus providing maximum protection to building and contents and minimizing overall costs.

The basic elements of a preventive maintenance program for roofs are:

- Regular visual inspections to determine the current condition of the roof membrane and flashings.
- Immediate repair of any defect before it allows moisture to enter the roof system or building interior.
- Non-destructive moisture detection to determine if moisture has infiltrated into the insulation of the roof system.

A vital part of the condition of the roof system is whether or not the insulation remains dry. A roof may appear to be in excellent condition from the surface, but may have areas of saturated insulation, which severely affect the thermal efficiency of the roof.

Non-destructive moisture detection of roof systems has developed into a sophisticated technique that can provide accurate analysis of roof insulation condition. Two commonly used systems are nuclear meter and infrared thermography. Both systems require trained skilled operators, specific weather conditions, specific roof types, and professional analysis. Visual inspection by a trained person is the key to a successful maintenance program.

2.2 **INSPECTION**

Roofs should be inspected at least twice a year — spring and fall — and also after any significant weather or construction event.

The inspection should be preceded by the preparation of a detailed roof plan on which all defects or notes can be marked. If the inspection indicates that more than minor work is required, an inspection checklist is necessary to ensure thoroughness. Call SMC GROUP at 416-731-7737 to perform the required inspection & maintenance work.

A typical roof plan and an inspection checklist are included in this guide for your convenience.

Begin the inspection by looking at the underside of the deck, if accessible, and also at the outside of the building. Look for cracks, stains, rusting, watermarks, efflorescence, wet spots, spalled mortar etc. or other signs of excessive moisture or deterioration. The observations may give clues to not only roofing problems but also other conditions affecting the performance of the building envelope.

The final and most important part is inspecting the roof itself. The keys to a competent roof inspection are thoroughness, experience and attention to detail — be prepared to get dirty!

2.3 DO'S AND DON'TS OF ROOF MAINTENANCE

DO's:

- *Do* be aware that wise maintenance will prolong the life of any roof — even the best of them.
- *Do* perform inspections at least twice a year, preferably at the end of winter and right after summer, when roofs have passed through the periods of severest stress.
- *Do* conduct additional inspections immediately after unusual occurrences such as extremely heavy rains, high winds, hail, nearby fires, explosions, etc.
- *Do* check the building exterior for settlement or movement. Cracks in the wall are a warning of possible cracks in the roofing and flashing. Are overhangs, cornices, fascias and edging in good condition? Are gutters and downspouts satisfactory? Breaks in roof edge elements can cause leaks and also let wind get under the roofing membrane and cause blow-offs. Damaged or clogged gutters, roof drains, and downspouts can cause water back up on the roof.
- *Do* be certain that equipment servicemen going on the roof are warned against penetrating or dropping tools on the roof. They should be accompanied by your trained maintenance man to ensure no damage to the roof assembly occurs.
- *Do* assure that your roof is kept clean and free from debris.
- *Do* recognize that exposure of roof felts (bare spots) on a gravel surfaced roof can lead to quick deterioration. This requires immediate attention by qualified personnel.
- *Do* be advised that flashings, gum pans, gravel stops and all other roof penetrations are the source of most leaks. Pay extreme and careful attention to these items.

DON'TS:

- *Don't* allow unqualified personnel to maintain your roofs.
- *Don't* allow traffic on your roof unless accompanied by your informed maintenance man.
- *Don't* allow equipment servicemen to penetrate your roof without being certain that qualified personnel flash the penetrations. If your roof is covered by a warranty, the membrane manufacturer should be notified prior to cutting the roof or altering it in any manner.

WHEN IT'S TIME TO REROOF:

DON'TS:

- *Don't* permit products of unproven quality to be used on your roof.
- *Don't* be taken in by "Cure-All" products, which can be applied by anyone.
- *Don't* take bids on projects without adequate, uniform specifications.
- *Don't* reroof over an existing roof unless a careful evaluation is made, and a qualified consultant or standards authority gives prior approval.
- *Don't* expect a guarantee to keep the water out of your buildings. Guarantees do not cover many of the problem areas of your roof.
- *Don't* think that the lowest price is always the best. Be certain you will not be faced with a number of change order requests for extras after a project is awarded.
- *Don't* deal with firms who cannot stand behind their work and will not be available when you need them. Remember that no product is better than the applicator.

DO's:

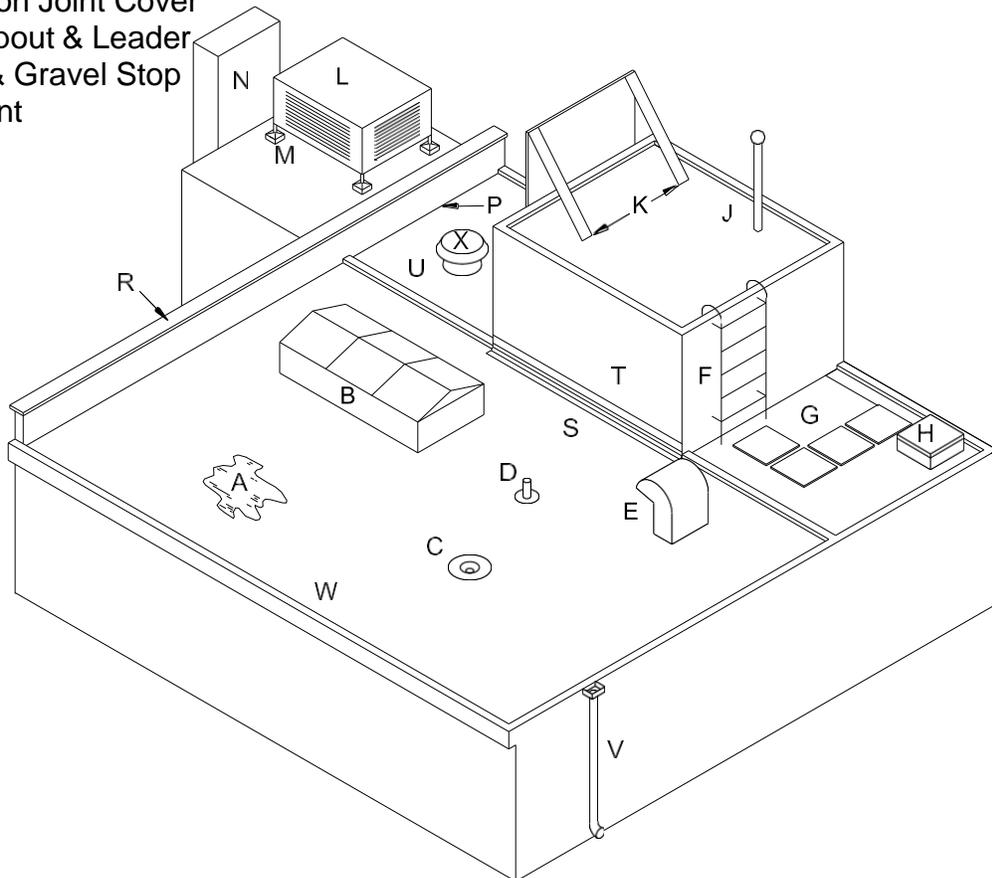
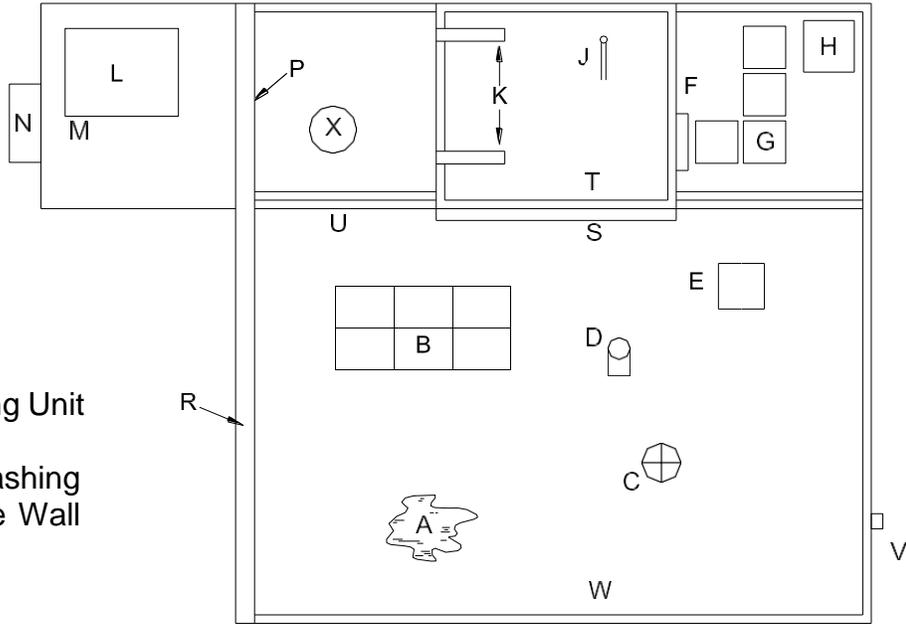
- ✓ *Do* hire a professional roof consultant to design, specify, manage, tender and supervise the project.
- ✓ *Do* call a Registered Roof Consultant (RCI).
- ✓ *Do* use a competent and experienced consultant as it is cost-effective and time-saving for you in several ways. You save your valuable time and energy by permitting the consultant to allocate the significant amount of time required to inspect, evaluate, and handle contract documents as well as secure the appropriate contractor for the job and spend the necessary time with the roofer in review of their work.
- ✓ *Do* save money by letting the consultant develop proper designs and specifications from the start, thereby dramatically reducing the potential for long-term problems. In general, a consultant will substantially reduce the life-cycle cost of your asset as well as problems and issues associated with roofing projects.

2.4 ROOF PLAN

Each roof inspected by SMC comes with a complete "Roof System Record", which includes a roof plan and a copy of this maintenance guide. If you set up your own roof maintenance file, you should prepare a roof plan using the following as a guide.

Key to Potential Roof Top Problems

- A - Ponded Water
- B - Skylight
- C - Roof Drain
- D - Vent Pipe
- E - Vent or Fan
- F - Ladder
- G - Walkway
- H - Hatch
- J - Flag Pole
- K - Sign Support
- L - Air Conditioning Unit
- M - Pitch Pan
- N - Chimney & Flashing
- P - Parapet or Fire Wall
- R - Coping
- S - Base Flashing
- T - Cap Flashing
- U - Expansion Joint Cover
- V - Down Spout & Leader
- W - Fascia & Gravel Stop
- X - Roof Vent



2.5 ROOFING MAINTENANCE CHECKLIST (page 1)

BUILDING _____	DATE _____				
LOCATION _____	INSPECTOR _____				
	Problem			Observation	Date of Repair
	O.K.	Major	Minor		
I. ROOF CONDITION					
A. General Appearance					
Debris					
Drainage					
Physical Damage					
General Condition					
New Equipment /					
Other					
B. Surface Condition					
Bare Spots in Gravel					
Alligatoring / Cracking					
Slippage					
Other					
C. Membrane Condition					
Blistering / Splitting /					
Physical Damage					
Other					
II. FLASHING CONDITION					
A. Membrane Flashing					
Physical Damage					
Deterioration /					
Blistering / Open					
Attachment					
Other					
B. Metal Flashings					
Physical Damage					
Attachment / Fasteners					
Corrosion					
Drainage					
Other					

2.5 ROOFING MAINTENANCE CHECKLIST (page 2)

	Problem			Observation	Date Repair
	O.K.	Major	Minor		
I. ROOF PENETRATIONS					
A. Equipment					
1.					
2.					
Open Laps					
Punctures					
Attachment					
Other					
B. Equipment Housing					

C. Equipment Operation					

D. Roof Jacks / Vents					

E. Roof Drains					
Type					
Condition					
Quantity					
Overflows					
IV. EXPANSION JOINT COVERS					

V. GUM PANS					
Fill Material Shrinkage					
Other					
VI. OTHER OBSERVATIONS					
1.					
2.					
3.					

3 IDENTIFYING POTENTIAL ROOFING PROBLEMS OR DEFECTS

3.1 DEFECTS IN BUILT-UP BITUMINOUS ROOFING

<u>Defect Observed</u>	<u>Possible Cause</u>	<u>Required Maintenance</u>
<i>Blueberry blisters in surface of bitumen</i>	Expansion of volatile fractions of bitumen or of air or water, in sunny weather. More common with low meltpoint bitumens particularly with heavy coatings and poor gravel cover.	Initially apply additional opaque gravel. If many blisters occur and are broken to expose felts, re-coat with bitumen and apply heavy layer of opaque gravel.
<i>Blisters between layers of felt</i>	Expansion in sunny weather of entrapped air or water in areas of poor adhesion.	Cut blister, trim excess material, re-adhere and patch. Heavy layer of opaque gravel may help to prevent re-occurrence.
<i>Blisters between felt membrane and substrate</i>	Expansion in sunny weather of entrapped air or water, usually over decks with concrete fills, or with wetted insulation.	Where possible, cut blister, trim excess material, re-adhere and patch. Venting (if possible) may help. Heavy layer of opaque gravel may help.
<i>Ridging or buckling</i>	Movement of either the felts or the deck or substrate under moisture or thermal effects, causing long ripple ridges especially where felt not well bonded, often over insulation or deck joints.	Usually little can be done. If of small size and elevation, a heavy application of gravel will make it less conspicuous and give some protection. If wide and high, cutting and relaying is necessary. May re-occur if movement persists.
<i>Lifting at laps (fishmouths)</i>	Poor adhesion initially due to wrinkled felt or workmanship, or pulling as a result of blister or ridging formation.	Re-adhere if not wrinkled. Where wrinkles or fishmouths, cut, remove excess material, re-adhere and patch.
<i>Cracking or breaking</i>	Breaks in unsupported felt. Cracking of blisters or ridges by traffic. Breaks at sharp bends in felt.	Cut out, provide support and patch. Cut blister, re-adhere felts and patch. Round off and patch.
<i>Felt penetrating top pour and gravel at laps</i>	Poor workmanship initially resulting in poor adhesion. Curling of felt edges when left exposed too long during construction.	Re-adhere if possible, or cut away. Cover with bitumen and gravel. Felt edge must not be exposed.
<i>Deterioration due to ponding</i>	Improper design with no, or inadequate, slopes to drains. Drains at high points on roof or obstructed.	Clear drains. Use additional bitumen and gravel in the low areas, which may help to limit damage. Add additional drains if possible.

<u>Defect Observed</u>	<u>Possible Cause</u>	<u>Required Maintenance</u>
<i>Bare spots from loss of gravel</i>	Gravel applied in adverse weather. Too thin a layer of too-fine gravel. Inadequate adhesion of gravel at edges and corners.	Recoat with adequate bitumen and apply a heavy dressing of properly sized gravel.
<i>General weather deterioration of bitumen</i>	Inadequate gravel or other surface protection, inadequate bitumen, lack of maintenance.	If felt strength affected, cannot be rejuvenated with coatings. If felts not affected, apply new bitumen and gravel protection.
<i>Flashing failures</i>	Inadequate allowance for movement. Inadequate fixing into reglets. Poor adhesion or inadequate protection of stripping felts. Movement at roof drains or vent pipes. Damage to capping at parapets and expansion joints. Loss of mastic or damage to mastic pans.	Repair with allowance. Re-fix and caulk. Apply new felts and protect. Allow movement and repair. Repair to allow movement and shed water. Repair, add fresh mastic, counter-flash.
<i>Ponding</i>	Insufficient slope to drains. Building settlement. Structural movement.	Where ponding cannot be eliminated, pumping is sometimes used to remove water from roof after rain. Add new drains if possible.
<i>Windsour</i>	Inadequate adhesion of gravel. Ballast too small for application.	Where bare spots are due to wind scour at corners, it may be necessary to use concrete slabs as the protective cover in the area affected.
<i>Alligator Cracking</i>	When alligator cracking of surface bitumen occurs on bare spots or on smooth-surface roofs without protective covering, adding more bitumen is only a short-term remedy; cracks will recur.	Remove alligatored material and recoat if possible. Use a felt-reinforced recoating. Protect the recoating with gravel or a paint coating.
<i>Slippage</i>	Slippage of gravel, felts or complete membrane on sloping roofs is due to improper choice of bitumen, thick layers of bitumen, phased construction, excessively heavy protective covering, lack of mechanical fastening where required.	If not too severe, may correct itself by change in bitumen properties on exposure. Mechanically fasten if possible, or remove and reroof with stiffer bitumen and adequate fastening of components.
<i>Sealing</i>	Deterioration due to U.V. degradation, ozone or other atmospheric contaminants, physical abuse, normal wear and tear etc.	For skylights and similar roof construction, new gasketing or sealants may be required.

3.2 DEFECTS IN FLEXIBLE MEMBRANES

The most important thing to remember when dealing with maintenance or repair to any flexible membrane (be it TPO, PVC, EPDM or modified bitumen) is that you must understand and know the specific system, its components and required repair materials and techniques. Do not mix and match materials without specific instructions from the membrane manufacturer.

3.2.1 Modified Bitumen Membranes

Modified bitumens are in many ways similar to built-up roofing for inspections, maintenance and repairs. Similar defects may appear such as blisters, ridging, buckling and fishmouths. Follow the manufacturer's published repair methods.

- Particular attention should be given to seam inspection especially at end-laps and "T" joints where moisture may penetrate and migrate.
- Severe granule loss may result in ultraviolet degradation of the sheet membrane. Recoat the bare spots with new granules in adhesive.
- Watch for chemical contamination near roof top units and vents.
- Watch for deterioration or slipping of base flashings.
- Wrinkles are not uncommon to the systems; provided they are small and isolated and do not cause an opening across a lap seam, they may not affect performance.

3.2.2 EPDM, TPO and PVC Single Ply Membranes

- Referring to the checklist, report the general appearance of the roof and the surface conditions of the membrane.
- General appearance is primarily a function of housekeeping. Debris, poor drainage, or ponding may be evidence of physical damage.
- Any discolouration, cracking or splitting, as well as punctures, should be noted and repaired.
- Seams should be observed for open joints, fishmouthing or ridging.
- On fully-adhered systems, it is important to note any unadhered areas. On mechanically-fastened systems, a check should be made to be sure that there is no evidence of fasteners backing out or popping. On ballasted systems, the weight and depth of stone ballast should be checked against the design specifications.
- Any signs of scouring should be noted and all gravel redistributed evenly.
- If increased foot traffic becomes necessary, be sure to provide walkways.

The following troubleshooting guide for TPO, PVC and EPDM membranes identifies some defects and the possible causes.

Defect Observed

Possible Cause

Discolouration of Membrane

Chemical or atmospheric contamination

Cracking, crazing, or splitting of membrane

Possible defective membrane. Call manufacturer immediately.

Fishmouthing or open joints

Improper seam welding or adhesive.

Loss of adhesion in fully-adhered system

Interlaminar separation between insulation and facing indicating failure of insulation. Separation between membrane and insulation indicating improper application of adhesive. Call manufacturer immediately.

Loose fastening in mechanically-fastened system

Fasteners not properly installed. Fasteners too short. Buckling, warping, shifting or corrosive deterioration of deck or structure. Heavy foot traffic.

Movement of ballast in loosely laid system

Ballast too small for wind uplift conditions. Foot traffic or vandalism.

Ridging or buckling of membrane at insulation joints

Movement of substrate due to moisture or thermal effects.

4 GLOSSARY OF COMMON ROOFING TERMS

- Alligatoring:** Shrinkage cracking of the bituminous surface of built-up roofing or the exposed surface of smooth-surface roofing, producing a pattern of deep cracks with the scaly look of an alligator's hide.
- Asphalt:** A highly viscous hydrocarbon produced from the residuum left after the distillation of petroleum used as the waterproofing agent of a built-up roof.
- Ballast:** An anchoring material (such as rounded river rock, gravel, or pre-cast concrete pavers), which is used to resist wind, uplift forces and hold roof membranes in place.
- Bitumen:** A generic term for either the asphalt or coal tar pitch used in the roofing industry.
- Blister:** A spongy, raised portion of roofing membrane, ranging in size from 25 mm (1") in diameter and barely detectable to as much as 4.6 m² (50 ft²) in area and 300 mm (12") high. Blisters result from the pressure of entrapped air or water vapour.
- Built-up Roofing: (BUR)** A continuous, semi-flexible roof covering, consisting of laminations or plies of saturated or coated felts alternated with layers of bitumen. Surfaced with bitumen, and in some cases covered with aggregate.
- Cant Strip:** A continuous strip of triangular cross-section, fitted into the angle formed by a structural deck and a wall or other vertical surface. Used to provide a gradual transition for base flashing and horizontal roof membrane.
- EPDM (Ethylene Propylene Diene Monomer):** A synthetic rubber sheet used in single-play roof membranes.
- Felt:** A fabric made by the interlocking of fibres. Roofing felts are manufactured from cellulosic fibres (organic felts), asbestos fibres (asbestos felts), or glass fibres (glass-fibre felts). Felts are either saturated, or saturated and coated with bitumen.
- Fishmouth:** An opening formed by an edge wrinkle in a felt where it overlaps another felt in a built-up roofing membrane.
- Flashing:** Connecting devices that seal membrane joints, drains, gravel stops and other places where the membrane is interrupted. Baseflashing forms the upturned edges of the watertight membrane. Cap or counterflashing shields the exposed edges and joints of the base flashing.

Flood Coat:	The top layer of bitumen in an aggregate-surfaced built-up roofing membrane.
Gravel:	Coarse granular aggregate, having rounded edges, resulting from the natural erosion of rock.
Gravel Stop:	Flanged device, normally metallic, designed to prevent loose aggregate from washing off the roof; it also provides a finished edge detail for the built-up roofing assembly.
Gum Pan (or Pitch pocket): pitch pocket):	A flanged, metal container placed around a column or other roof penetrating element and filled with bitumen or flashing cement to seal the joint.
Loosely Laid Membrane:	Membranes, which are not attached to the substrate except at the perimeter of the roof. They are held in place with appropriate and adequate ballast.
Modified Bitumen:	Asphalt enhanced by the addition of polymer modifiers to increase cold temperature flexibility and warm temperature flow resistance and stability. The most common modifiers are SBS (styrene butadiene styrene) and APP (atactic polypropylene).
Parapet:	The part of any wall entirely above the roof.
Ply:	A layer of roofing membrane. A four-ply membrane has at least four plies of felt at any vertical cross section cut through the membrane.
Primer:	A liquid bituminous material applied to a surface to improve the adhesion of heavier application of subsequently applied bituminous materials.
PVC (Poly Vinyl Chloride):	A thermoplastic sheet material used for single ply roofing membranes.
Reglet:	A groove in a wall or other vertical surface adjoining a roof surface for the embedment of counterflashing.
Single Ply Membrane:	Roofing membranes that are field-applied using a pre-manufactured sheet of single-layer membrane materials (either homogenous or composite) rather than multiple layers.
Slope:	The ratio between the measure of the rise and the horizontal span.

Smooth-Surfaced Roof: A built-up roofing membrane surfaced with a coating of hot asphalt, asphalt emulsion or asphalt cutback.

Square: A roof area of one hundred square feet.

Substrate: The surface upon which the roofing membrane is placed — structural deck or insulation.

Vapour Retarder: A material designed to restrict the passage of water vapour through a wall or roof assembly.

Disclaimer

The SMC GROUP ROOF MAINTENANCE GUIDE is intended to be a general overview only. While every attempt to ensure completeness and accuracy has been made, this guide should be used as a reference only. The author of this guide accepts no responsibility for any errors or omissions with respect to the subject matter contained herein and expressly disclaim any such responsibility. The guide is not intended to provide legal advice and if legal advice or other expert assistance is required, the services of the appropriate professional should be sought.

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