A CLOSER LOOK

UP ON THE ROOF

A Guide to Identifying Potential "Flat" Roofing Problems

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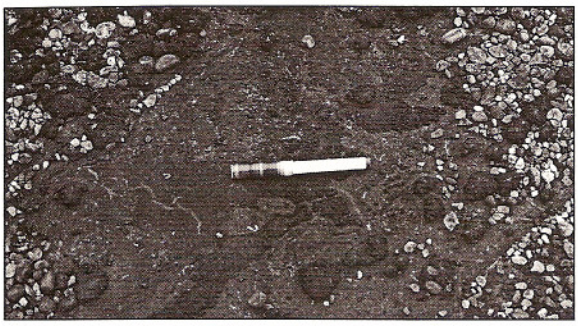
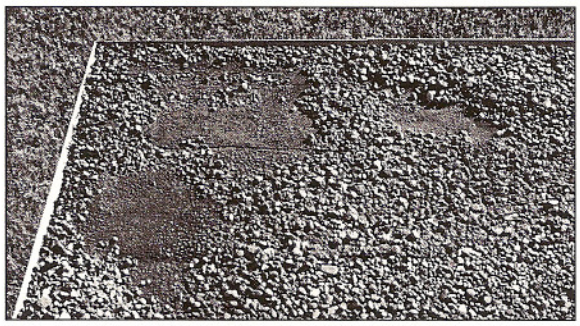


Large blueberry blisters (1.1) and general weather deterioration of (exposed) bitumen (1.10).



Typical wind scour of gravel at corner of roof (1.13), resulting in exposure of bitumen and felt to UV degradation.

The famous French architect Le Corbusier always referred to roofs as the "5th Elevation," but unlike walls, they are elevations which are not seen by many people. Roofs, and "flat" roofs in particular, are often out of sight and out of mind ... until they leak.

The roofs of most buildings represent a small fraction of the total cost of a building. Yet roofs protect not only the building, but also the contents which can represent many times the value of the building itself.

Roofs are designed to be either *water-shedding* (steep roofs) or *waterproof* (flat roofs). This guide deals with the so-called "flat roofs" which are roofed using membrane roofing systems. The system may be a low-tech "tar and gravel" roof or one of the more high-tech "torch-on" modified bitumen or single ply systems.

The Myth of Flat Roofs

"Flat roof" is a bit of an oxymoron. "Flat roofing" systems can be and are installed on buildings with roof slopes from dead flat up to 3 in 12, but the norm or building code requirement is usually in the 1/8" per foot to 1/4" per foot range. They might be more accurately described as "ultra low slope" roofs.

All roofs should slope to a drain, somewhere. The drains may be in the middle of the roof or they may be at the edges in the form of gutters or scuppers. Unfortunately, lack of drainage is one of the major problems associated with roofs, both flat and pitched.

A successful roof system depends on three factors:

- good roof design
- good choice of materials for the design and installation process, and
- good installation practices

Often one or more of these factors is left out or modified along the way, resulting in a less than adequate roof.

Identifying Potential Roof Problems or Defects

The charts that follow identify many of the roofing system problems or defects which you may find during your inspections. Detecting small problems will enable you to help your clients prevent them from becoming large and even more expensive to repair.

These defect charts were originally developed by John Wells, J.W. Wells Consultants, Inc., Victoria, BC, formerly Technical Manager for the Roofing Contractors Association of BC (RCABC) and are reprinted with his permission. ■

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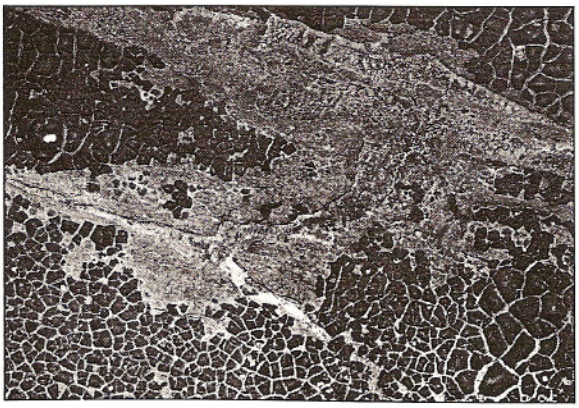
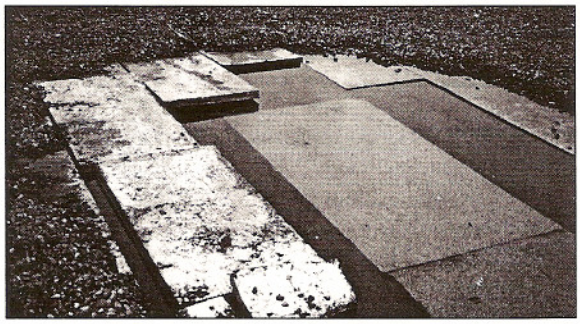


Extreme alligator cracking (1.14), lack of bitumen and exposure of felts. Note crack in felt.



Long term flooding on a protected membrane roof resulting in some (type 1 polystyrene) insulation floating (thereby allowing some of the gravel to become trapped under the insulation, on top of the membrane) while other insulation panels absorb water and sink.

Membrane Roofing System Defects

1. Defects in Built-Up Bituminous Roofing

DEFECT OBSERVED	POSSIBLE CAUSE	REQUIRED MAINTENANCE
1. Blueberry blisters in surface bitumen	Expansion of volatile fractions of bitumen, or of air or water, in sunny weather. More common with low melting point bitumens, particularly with heavy coatings and poor gravel cover.	Initially, apply additional opaque gravel. If many blisters occur and are broken to expose felts, recoat with bitumen and apply heavy layer of opaque gravel.
2. Blisters between layers of felt	Sunny weather expansion 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-occurence.
3. Blisters between felt membrane and substrate	Sunny weather expansion of entrapped air or water, usually over concrete fills or with wet insulation.	Where possible, cut blister, trim excess material, re-adhere and patch. Venting (if possible) may help. Heavy layer of opaque gravel may help.
4. Ridging or buckling	Movement of either the felts, deck, or substrate caused by moisture or thermal effects. Long ripple ridges may appear, especially where felt is not well bonded, often over insulation or deck joints.	Usually little can be done. If small in size and elevation, a heavy application of gravel will make less conspicuous and give some protection. If wide and high, cutting and relaying is necessary. May re-occur if movement persists.
5. Lifting at laps (fishmouths)	Twisting of the roll during application.	Re-adhere if not wrinkled. Where there are wrinkles or fishmouths, cut, remove excess material, re-adhere and patch.
6. Cracking or breaking	Poor adhesion initially due to wrinkled felt or workmanship, or pulling as a result of blister or ridging formation.	Cut out, provide support and patch. Cut blister, re-adhere felts and patch. Round off and patch.
7. Felt penetrating top pour & gravel at laps (flags)	Breaks in unsupported felt. Cracking of blisters or ridges by traffic. Breaks at sharp bends in felt.	Re-adhere if possible, or cut away. Cover with bitumen & gravel. Felt edge must not be exposed.
8. Deterioration due to ponding	Poor workmanship initially resulting in poor adhesion. Curling of felt edges when left exposed too long during construction.	Clear drains. Use additional bitumen and gravel in the low areas which may help limit damage.
9. Bare spots from loss of gravel	Improper design with no or inadequate slopes to drains. Drains blocked or at high points on roof.	Re-coat with adequate bitumen and apply a heavy dressing of properly sized gravel.
10. General weather deterioration of bitumen	Gravel applied in adverse weather. Too thin a layer or too-fine gravel. Inadequate adhesion of gravel at edges and corners. Inadequate gravel or other surface protection. Inadequate bitumen, lack of maintenance.	If advanced, may be necessary to re-lay. If felt strength affected, cannot be rejuvenated with coatings. If felts not affected, apply bitumen & gravel protection.
11. Flashing failures	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 & expansion joints. Loss of, or damage to, mastic in joints.	Repair to allow movement and shed water. Repair, add fresh mastic, counter-flash.
12. Ponding	Insufficient slope to drains. Building settlement. Structural movement.	Where ponding cannot be eliminated by adding drains or creating slope, pumping is sometimes used to remove water from roof after rain.
13. Wind scour	Inadequate adhesion of gravel. Ballast too small for application or location.	Where bare spots due to wind scour at corners, it may be necessary to use concrete slabs as protective cover in affected areas.
14. Alligator Cracking	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 re-occur.	Remove alligatored material and recoat. If possible use a felt-reinforced recoating. Protect the recoating with gravel or paint coating.
15. Slippage	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, or lack of mechanical fastening where required.	If not too severe, may correct itself by change in bitumen properties on exposure to atmosphere or with aging. Mechanically fasten if possible, or remove and re-roof with stiffer bitumen, and adequate fastening of components.

Membrane Roofing System Defects

2. Defects in Flexible Membranes

The most import thing to remember when dealing with maintenance or repair to any flexible membrane (be it PVC, EPDM or modified bitumen) is that you 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.

2.1 Modified Bituminous 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. Recommend following the manufacturer's published repair methods.

1. Particular attention should be given to seam inspection especially at end-laps and "T" joints where moisture may penetrate and migrate. Check these joints with a roofer's trowel.
2. Severe granule loss may result in ultraviolet degradation of the sheet membrane. Recoat the bare spots with new granules in adhesive.
3. Watch for chemical contamination near roof top units and vents.
4. Wrinkles are not uncommon to these systems. They may not affect performance provided they are small and isolated and do not cause opening across a lap seam.

2.2 EPDM and PVC Single Ply Membranes

1. Referring to the checklist, report the general appearance of the roof and the surface condition of the membrane.
2. General appearance is primarily a function of housekeeping. Debris, poor drainage, or ponding may be evidence of physical damage.
3. Any discoloration, cracking, or splitting, and especially punctures should be noted.
4. Seams should be observed for open joints, fishmouths or ridging.
5. 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 noted and all gravel redistributed evenly.
6. Any signs of scouring should be noted and all gravel redistributed.
7. If increased foot traffic becomes necessary, be sure to recommend providing walkways.

2.3 Troubleshooting Flexible Membranes

The following troubleshooting guide for PVC and EPDM membranes identiifies some defects and possible causes.

DEFECT OBSERVED	POSSIBLE CAUSE
1. Discoloration of membrane	Chemical or atmospheric contamination.
2. Cracking, crazing, or splitting of membrane	Possible defective membrane. Call manufacturer immediately.
3. Fishmouths or open joints	Improper seam welding or adhesive.
4. 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.
5. Loose fastening of mechanically fastened systems	Fasteners not properly installed. Fasteners too short. Buckling, warping, shifting or corrosive deterioration of deck or structure. Heavy foot traffic.
6. Movement of ballast on loosely laid systems	Ballast too small for wind uplift conditions. Foot traffic or vandalism.
7. Ridging, buckling of membrane at insulation joints	Movement of substrate due to moisture or thermal effects.

SUGGESTED READING

Robinson, Roger C., *A Guide to The Standards of Practice of American Society of Home Inspectors,* 1993

ASHI, *Standards of Practice of American Society of Home Inspectors,* effective June 1, 1992

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Baker, Maxwell C., *Roofs: Design Application and Maintenance,* Multiscience Publications, Ltd., 1980

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Doyle, Carter: Dillner, Wayne & Rosenfield, Myer J., *Handbook for Repairing Nonconventional Roofing Systems,* US Army Corp of Engineers, USA-CERL Technical Report M-89/04, December 1988.

Shahin, Mohamed Y., Bailey, David M. & Brotherson, Donald E., *Membrane and Flashing Condition Indexes for Built-Up Roofs Volume II: Inspect and Distress Manual,* US Army Corps of Engineers, USA-CERL Technical Report M-87/13, Vol II, September 1987

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