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Built-Up Roofing

Inspection and Repair

— By Martin A. Benassi, AIA

As a building owner or manager, you are well aware of the reasons for maintaining a watertight roof on your structure. In addition to protecting the initial investment made, the costs of replacing a defective roof and the damage and inconvenience caused by water leakage are reasons enough to perform periodic inspections and repairs. With a regularly executed inspection and maintenance program, one can expect a well-designed and properly installed roof to last its anticipated lifespan with few problems.

Inspection Procedures

An inspection and maintenance program should be done a minimum of twice a year, spring and fall, and after every major storm. The inspection should not be limited to just the exterior roof surface. First, examine the exterior elevations for cracking. This signals possible settlement or structural problems which can be transmitted to the roof, causing ruptured flashings and tears in the membrane. Check overhangs, eaves and soffits for damage and waterstaining. Be sure downspouts, gutters and suppers are not clogged with debris.

The interior spaces should also be observed for signs of leakage. Closely examine ceilings and walls for waterstaining, especially in areas near roof penetrations such as air conditioning units and vent stacks. If possible, inspect the underside of steel decks for rusted areas and wood decks for dry rot. Document all areas which show such evidence of water entry by noting them on a roof plan. This will aid in locating leaks while on the roof surface.

Finally, check the roof itself. This should be done under semi-dry conditions – one or two days after a rain. Observe and note the general condition of the roof. On your roof plan, show location and extent of any problem areas observed, including alligatoring, bare spots, blisters, fishmouths, ponding, ridges or splitting. Inspect all areas where vertical and horizontal surfaces intersect and check the flashings for holes, tears, or wrinkling. Be sure pitch pockets are full.

Does your roof look like this?

BUR *(cont. from page 1)*
Once you have completed the inspection, the condition of the roof should be evaluated for repair or replacement. Some criteria in the evaluation are: whether or not the roof is nearing or has exceeded its expected lifespan, or if it has been leaking a long time, the insulation is wet or disintegrated, the felts have disintegrated or are disbonded, blistered, split and if the entire membrane is in general in very poor condition. Should help be needed, an independent architectural/engineering firm which is experienced in the analysis and solution of roofing problems should be consulted. There should be licensed professionals on staff who are familiar with all aspects and components of buildings and knowledgeable about the interfacing and interaction among all their separate parts. If they are, they can advise you on problems that result from things other than just the roof membrane. As independent consultants, they are not limited to one product, method or approach, but treat each situation as unique. Thus, they are able to design remedial work individualized to suit the needs of each particular building or budget. A professional architectural/engineering firm can assist you with your total roofing program from the initial survey to preparation of bid/construction documents, assistance in choosing a contractor to perform repairs, and observation of the actual construction. This allows the owner or manager to carry on his or her daily activities without interruption or concern.

Repair Procedures

Once the decision has been made that repairs are all that are presently needed, using the following procedures can have results that will last the remaining life of the roof. These repairs cover the most common leak sources in asphalt built-up roofing.

ALLIGATORING (Smooth Surface) – Prepare surface by thoroughly cleaning and applying a thin coating of asphaltic primer. Finish with a coating of asphalt emulsion.

BARE SPOTS – Prepare surface by thoroughly cleaning and applying a thin coating of asphaltic primer. Finish by trowelling a layer of roofing cement and re-embedding the gravel.

BASE FLASHING – Base flashing with holes or tears can be repaired by cleaning the area of all dust, dirt, loose granules or other debris, and preparing the surface with a coat of asphaltic primer. Then trowel on a layer of roofing cement extending at least three (3) inches beyond the damaged area in all directions. Embed a layer of fabric firmly into the roofing cement. A final coat of roofing cement should be applied completely covering the fabric. If the base flashing has pulled away from the vertical surface, resecure using the appropriate fastener for the substrate at intervals of six (6) to eight (8) inches. Finish by stripping in with a four-inch wide piece of fabric embedded in and coated with roofing cement.

alligatoring

BLISTERS – Start by removing any gravel and cleaning the area of dirt or debris. Using a utility knife, cut an "X" through the plies across the blister. Fold back the cut felts and remove any

moisture by mopping, wiping or allowing it to evaporate. Apply a coating of roofing cement under each delamination and embed the plies tightly, creating a good bond. Next, apply two plies of fabric embedded in roofing cement. Cut and overlap each ply six (6) inches beyond the previous layer. Apply a top coat of roofing cement and reset in gravel.

broken base flashing

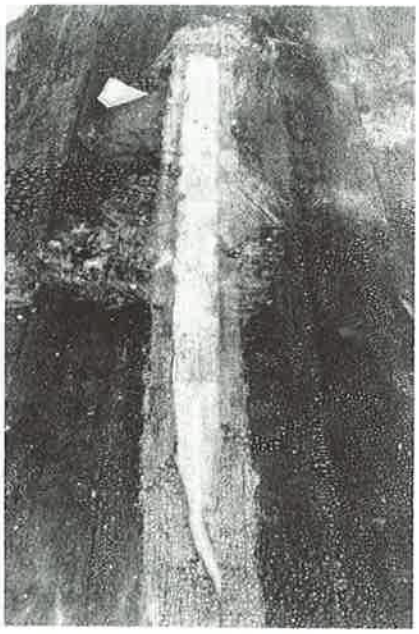
COUNTER FLASHING – If metal counter flashing exists, it should be in good enough condition to divert any water away from the vertical surface down over the base flashing. If set into reglets, the metal should be securely held in place using lead wedges. Sealant should be used to waterproof the reglet. A qualified sheet metal contractor should be called in to rectify counter flashing problems.

FISHMOUTHS – After cleaning defective area, cut and fold back the delaminated ply. Remove any moisture by mopping, wiping or allowing it to evaporate. Apply a coating of roofing cement under each delamination, then lay the plies back into place, flattening them and embedding them in the roofing cement. Finish repair with two plies of fabric, roofing cement and gravel as described under "Blisters."

METAL ROOF EDGING – At deteriorated metal strip flashing, remove all gravel and debris. Prime the surface and trowel with a coating of roofing cement over the damaged area. Firmly embed a layer of fabric into the cement and apply a cover coat of cement. At joints in the metal, the above application should be repeated to reinforce areas of stress due to thermal movement. Gravel should then be replaced.

PITCH PANS – Fill all pitch pans with roofing cement, topping from the center and sloping to the sides. Check along the strip flashing and repair as described under "Metal Roof Edging."

RIDGES – Prepare surface by cleaning and inspecting the ridged area for damage. If split or cracked, cut out the ridged area and remove any moisture by wiping, mopping or allowing it to evaporate. Fill the void with roofing cement and apply the two layers of fabric as described under "Blisters." If the ridge is not cracked or split, it must first be slit to lay flat before cementing down and patching over. To finish, both repairs should include the re-embedment of gravel in roofing cement.



bare spot on a built-up roof

ridge

SLIPPAGE – If the slope is too great for the type of bitumen used, or poor installation allows the felts to slide, repair by mechanically fastening the membranes through the insulation to the decking. The fastener disk should be set in roofing cement then flashed in with two layers of fabric and roofing cement following the procedures described under "Blisters." Each row of fasteners should run parallel to the slope.

SPLITS AND TEARS – Prepare surface by removing any gravel and cleaning the surface. Prime the area to be repaired and follow the procedures described under "Ridges."

STACK VENTS – If the existing metal vent flashing is in poor condition, have a new one fabricated by a sheet metal contractor. Install using flashing repair as described under "Metal Roof Edging."

Excerpts from this article appeared in the Winter 1983 issue of Better Buildings Magazine.

services

Representative Projects

Over the last few months, we have been involved in a variety of projects in a geographical area from Minnesota to southern Georgia to Bermuda. The following is a representative sample of these recent commissions.

Recent real estate consulting services include monitoring the construction of a shopping center in Decatur, Georgia for Steve Allen & Associates, an Atlanta real estate developer. We recently completed a pre-mortgage survey of a nine-story building in lower Manhattan for the Travelers Insurance Company's Real Estate Investment Department. The Atlanta office provided a preliminary preacquisition inspection of an office park there for Merrill Lynch Hubbard.

When a 40-story commercial office building in Boston developed structural and curtain wall problems, Hoffmann Architects was commissioned to provide immediate, remedial services. For a 22-story Co-op in New York City, we are providing architectural and engineering services for waterproofing the building and solving masonry, roofing, and terrace problems.

The firm is currently performing a structural analysis and preparing plans and specifications for the rehabilitation of a parking garage in New Jersey for Sheldon Gross Realty, Inc.

Recent roofing projects include the investigation and analysis of the roofs on two buildings at Rockefeller Center in New York City, and the survey and preparation of plans and specifications for reroofing of an AMF Sports Center in Chicago. We have also prepared plans and specifications for an EPDM roof currently being installed on the high school in Ridgefield, Connecticut. As part of General Electric's Silicone Roofing System warranty inspection program, we have investigated roofs from Hibbing, Minnesota to St. Georges, Bermuda. Our involvement in a similar program for Dow Corning includes inspections near Spartanburg, South Carolina and Brunswick, Georgia.

If you would like further information about the services we offer, please let us know.

Glossary of Roofing Terms

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

Air Lance – A device used to test, in the field, the integrity of field seams in plastic sheeting. It consists of a wand or tube through which compressed air is blown.

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 not extend through the surfacing bitumen.

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.

Backnailing – The practice of blind-nailing roofing felts to a substrate in addition to hot-mopping to prevent slippage.

Ballast – Paving blocks or rounded river bottom stones used to hold down a loose laid or IRMA roof.

Base Flashing – A flashing used to cover the end of a membrane.

Base Sheet – A saturated or coated felt placed as the first ply in a multi-ply built-up roofing membrane.

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 hydro-carbons, 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. (3) In the roofing industry, there are two basic bitumens: asphalt and coal-tar pitch. Before application, they are either (a) heated to a liquid state; (b) dissolved in a solvent; or (c) emulsified.

Blister – An enclosed pocket of air mixed with water vapor, trapped between layers of felt, foam or other impermeable layers.

Alligatoring

Blister

Brooming – Embedding a ply by using a broom to smooth it out and ensure contact with the adhesive under the ply.

BTU – (British Thermal Unit) The heat energy required to raise the temperature of one (1) pound of water one (1) degree Farenheit.

Built-Up Roofing – (BUR) A continuous, semiflexible membrane consisting of plies of saturated felts, coated felts, fabrics or mats assembled in place with alternate layers of bitumen, and surfaced with mineral aggregate, bituminous material, or a granule surfaced sheet.

Calender –A precision machine used for preparation of highly accurate continuous sheeting or plying up of rubber compounds and frictioning or coating of fabric with rubber or plastic compounds.

Cap Sheet – A granule-surfaced coated felt used as the top ply of a built-up roofing membrane.

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.

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.

Caulking – A composition of vehicle and pigment, used at ambient temperatures for filling joints, that remains plastic for an extended time after applications.

Chlorinated Polyethylene – (CPE) Family of polymers produced by chemical reaction of chlorine on the linear backbone chain of polyethylene. CPE can be vulcanized but is usually used in a nonvulcanized form.

Chlorosulfonated Polyethylene – (CSPE) Family of polymers that are produced by polyethylene reacting with chlorine and sulfur dioxide. They are used in both vulcanized and nonvulcanized forms. Most membranes based on CSPE are nonvulcanized. ASTM designation for this polymer is CSM.

Cigar – A long tubular wrinkle in a single ply membrane.

Coal Tar – A dark brown to black cementitious material produced by the destructive distillation of coal.

Coated Fabric – Fabrics which have been impregnated and/or coated with a plastic material in the form of a solution, dispersion, hotmelt, or powder. The term also applies to materials resulting from the application of a preformed film to a fabric by means of calendering.

Coated Sheet – (Or Felt) (1) An asphalt felt that has been coated on 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 Patch – To repair a roof leak by using prepared roofing or membrane and plastic cement.

Cold-Process Roofing – A continuous, semiflexible membrane consisting of plies of felts, mats, or fabrics laminated on a roof with alternate layers of roof cement and surfaced with a cold-applied coating.

Collar – Metal flashing for a vent pipe.

Condensation – The conversion of water vapor or other gas to liquid as the temperature drops or atmospheric pressure rises.

Coping – A covering on top of a wall exposed to the weather, usually sloped to carry off water.

Counterflashing – Formed metal or elastomeric sheeting secured on or into a wall, curb, pipe, roof-top unit, or other surface, to cover and protect the upper edge of a base flashing and its associated fasteners.

Creep – The dimensional change with time of a material under load, following the initial instantaneous elastic deformation. Creep at room temperature is sometimes called cold flow.

Cricket – A small false roof used to throw off water from behind an obstacle such as a chimney.

Cure – To change the properties of a polymeric system into a more stable, usable condition by the use of heat, radiation, or reaction with chemical additives.

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.

Dead Level – Absolutely horizontal, or zero slope.

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

Flashing

Felt

Deck – The structural surface to which the roofing or water-proofing system (including insulation) is applied.
Degradation – A deleterious change in the chemical structure, physical properties, or appearance of a plastic.
Delamination – Separation of the plies in a membrane or separation of insulation layers after lamination.
Drain – A device that allows for the flow of water from a roof area.

Drain

Fishmouth

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.
Elastomeric – The term used to describe the elastic, rubber-like properties of a material.
Embedment – The process of pressing a felt, aggregate, fabric, mat or panel uniformly and completely into hot bitumen or adhesive to ensure intimate contact at all points.
Envelope – A continuous edge seal formed by extending one ply of felt beyond the edge of the assembly. After other plies or insulation are in place, the extended ply is turned back and adhered.
EPDM – A synthetic rubber based on ethylene, propylene, and a small amount of non-conjugated diene to provide sites for vulcanization. EPDM features excellent heat, ozone and weathering resistance, and low temperature flexibility.
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 roofing system. The exposure of any ply in a membrane may be computed by dividing the felt width minus 51mm (2 in.) by the number of shingled plies; thus, the exposure of a 914mm (36 in.) wide felt in a shingled, four-ply membrane should be 216mm (8½ in.). (2) The time during which a portion of a roofing element is exposed to the weather.
Fabric Reinforcement – A fabric, scrim, etc., used to add structural strength to a two or more ply polymeric sheet. Such sheeting is referred to as "supported."
Factory Mutual – (FM) An organization which classified roof assemblies for their five characteristics and wind-uplift resistance for insurance companies in the United States.
Factory Square – 108 ft.^{2} (10 M^2).
Fallback – A reduction in bitumen softening point, sometimes caused by refluxing or overheating in a relatively closed container.
Felt – A flexible sheet manufactured by the interlocking of fibers through a combination of mechanical work, moisture, and heat, without spinning, weaving, or knitting. Roofing felts are manufacturered from vegetable fibers (organic felts), asbestos fibers (asbestos felts) or glass fibers (glass-fiber felts).
Fishmouth – A half-cylindrical or half-conical opening formed by an edge wrinkle or failure to embed a roofing felt.
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 or counter-flashing 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.
Flood Coat – The top layer of bitumen used to hold the aggregate on an aggregate-surfaced, built-up roofing membrane.
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.
Fully Adhered – An application technique where the membrane is completely attached to the substrate by means of adhesive or bitumen.
Glass Felt – Glass fibers bonded into a sheet with resin and suitable for impregnation in the manufacture of bituminous waterproofing, roofing membranes, and shingles.
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 membrane, when application of additional felts, or the flood coat and aggregate surfacing are delayed.
Granules – The mineral particles of a graded size which are embedded in the coating.
Gravel – Coarse, granular aggregate, with pieces larger than sand grains, resulting from the natural erosion of rock.

Gravel

Expansion Joint

Gravel Stop – A flanged device, frequently metallic, designed to prevent loose aggregate from washing off the roof and to provide a continuous finished edge for the roofing.
Gutter – Metal or wood trough at edge of roof to drain rain water.
Headlap – The minimum distance, measured at 90 degrees to the eave along the face of a shingle or felt as applied to a roof, from the upper edge of the shingle or felt, to the nearest exposed surface.
Heat Seaming – The process of joining two or more thermoplastic films or sheets by heating areas in contact with each other to the temperature at which fusion occurs. In dielectric seaming, the heat is induced within films by means of radio frequency waves.
Holiday – An area where a liquid-applied material is missing.
Hygroscopic – Attracting, absorbing, and retaining atmospheric moisture.
IRMA – (Inverted Roof Membrane Assembly) A roofing system where the membrane is applied first then the insulation is laid over it and ballasted.
Leader – Another term for down-spout.
Lift – The layer of polyurethane foam resulting from a single pass of the spray gun, normally ranging from ½ to ¾ inch in thickness.
Mechanically Fastened – An application technique where the membrane is fastened to the building by penetrating fasteners which are then sealed, or by non-penetrating fasteners such as disks or tracks which are attached to the building under the membrane.
Membrane – Applies to a continuous sheet of material whether it is prefabricated as a flexibly polymeric sheeting or is sprayed or coated in the field.
Metal Flashing – Frequently used as through-wall, cap- or counter-flashing.
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 membrane not associated with insulation or deck joints.
Mop-and-Flop – A 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 adhered to the substrate.

Mopping – The application of hot bitumen with a mop or mechanical applicator to the substrate or to the plies of a built-up roof. There are four types of mopping: (1) *solid* – A continuous coating; (2) *spot* – bitumen is applied in roughly circular areas, generally about 460mm (18 in.) in diameter, leaving a grid of unmopped, perpendicular areas; (3) *strip* – bitumen is applied in parallel bands, generally 200mm (8 in.) wide and 300mm (12 in.) apart; (4) *sprinkle* – bitumen is shaken onto the substrate from a broom or mop in a random pattern.

Neoprene – (Polychloroprene) Generic name for a synthetic rubber based primarily on chloroprene. Vulcanized generally with metal oxide. Resistant to ozone and aging and to some oils.

Ninety-Pound – A prepared roll roofing with a granule-surfaced exposure that has a mass of approximately 4400 g/m^2 (90 lb./108 ft.^{2}).

Nylon – Used as a scrim in fabric reinforced sheeting.

Orange Peel – A finished polyurethane foam surface very moderately textured approximating the appearance of an orange peel.

Overhang – That portion of roofing extending beyond the deck.

Overspray – Minute droplets of foaming mixture that become windborne, foaming in transit and becoming deposited to other than the intended surface.

Parapet – The part of a wall that extends above the roof line.

Partially Adhered – An application technique where the membrane is adhered only to mechanical fasteners which are prefastened to the substrate.

Penetration – The measurement of the hardness or plasticity expressed as the distance that a standard needle vertically penetrates a sample of the material under known conditions of loading, time, and temperature.

Permeability – (1) The capacity of a porous medium to conduct or transmit fluids. (2) The amount of liquid moving through a barrier in a unit time, unit area, and unit pressure gradient not normalized for but directly related to thickness.

Permeance – The rate of water vapor transmission per unit area at a steady state through a membrane or assembly, expressed in ng/Pa-s-m^2 (grain/ft.^{2}-h-in. Hg).

Phased Application – The practice of applying the felt plies of a built-up roofing membrane in two or more operations, separated by a delay normally of at least one (1) day (not a recommended practice).

Picture Framing – A rectangular pattern of ridges in a membrane over insulation or deck joints. Also called photographing.

Pinholes – Minute cylindrical holes in the surface of urethane foam resulting from irregular expansion. Not suitable for coating without correction as the coating material will not bridge the void under pressure application. May also occur in the coating system.

Pitch or Slope – The angle of inclination that a roof forms with a horizontal. The incline or slope of the roof, usually referred to as quarter pitch, third pitch, etc.

Pitch Pocket – A flanged, open-bottomed metal container placed around a column or other roof-penetration, and filled with hot bitumen or flashing cement to seal the joint.

Pitch Pocket

Ponding

Plastic – A material that contains as an essential ingredient one or more organic polymeric substance of large molecular weight, is solid in its finished state and at some stage in its manufacture or processing into finished articles, can be shaped by flow.

Plasticizer – A plasticizer is a material, incorporated in a plastic or a rubber to increase its ease of workability, flexibility, or extensibility.

Ply – Each layer in a roofing membrane; a four-ply built-up roof membrane has at least four plies of felt at any vertical cross section cut through the membrane.

Point of Felt – Weight in pounds per 480 square feet of dry felt. Example: 50 point dry felt weighs 50 pounds per 480 square feet.

Polyester Fiber – Generic name for a manufactured fiber used for fabric reinforcement.

Polyisobutylene – (PIB) The polymerization product of isobutylene. It varies in consistency from a viscous liquid to a rubber-like solid with corresponding variation in molecular weight from 1,000 to 400,000.

Polyvinyl Chloride – (PVC) A synthetic thermoplastic polymer prepared from vinylchloride. PVC can be compounded into flexible and rigid forms through the use of plasticizers, stabilizers, filler, and other modifiers, rigid forms used in pipes, flexible forms used in manufacture of sheeting.

Pond – A surface which is incompletely drained.

Popcorn – A heavily textured finished polyurethane foam surface approximating the appearance of a caramel popcorn ball. Too heavily textured for coating.

Primer – A thin liquid bitumen applied to a surface to improve the adhesion of heavier applications of bitumen and to absorb dust.

Puncture Resistance – Extent to which a material is able to withstand the action of a sharp object without perforation.

Reentrant 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 the attachment of counterflashing.

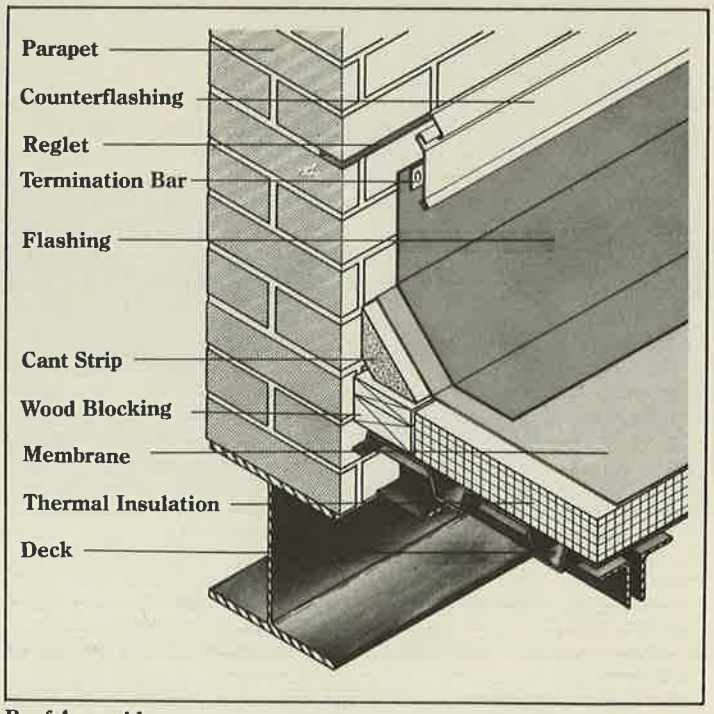
Reinforcement – A strong inert material bound into a plastic to improve its strength, stiffness and impact resistance. Reinforcements are usually long fibers of glass, sisal, cotton, etc. in woven or non-woven form. To be effective, the reinforcing material must form a strong adhesive bond with the resin.

Ridge or Hip – The horizontal line where two opposite sides of a roof join at the apex of the roof.

Ridging – An upward, tenting displacement of a membrane, frequently over an insulation joint.

Rise – The direction of volumetric growth in the polyurethane foaming process.

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 Assembly

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.

Rubber – A polymeric material which, at room temperature, is capable of recovering substantially in shape and size after removal of a deforming force. Refers to both synthetic and natural rubber. Also called an elastomer.

Rust – A rust colored discoloration of foam surface resulting from exposure to air and ultra-violet.

Saddle – A ridge in the roof deck, whose top divides the elevation of the roof so that water will be diverted to the drainage heads.

Scrim – A woven, open mesh reinforcing fabric made from continuous filament yarn. Used in the reinforcement of polymeric sheeting.

Scupper – A device that allows for the flow of water from a roof area through a wall or other perimeter obstruction.

Seam Strength – Strength of a seam of material measured either in shear or peel modes. Strength of the seams is reported either in absolute units (e.g., pounds per inch of width) or as a percent of the strength of the sheeting.

Shingling – The procedures of laying parallel felts so that longitudinal edge of each felt overlaps the adjacent felt. Normally, felts are shingled on a slope so that the water flows over rather than against each lap.

Silicone – A two-part, chemically cured, liquid-applied material which will cure to a silicone rubber membrane.

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 – The tangent of the angle between the roof surface and the horizontal. It is measured in inches per foot. The Asphalt Roofing Manufacturers Association (ARMA) ranks slope as follows:

Level Slope ..... Up to ½ inch per foot
Low Slope ..... ½ inch per foot to 1½ inches per foot
Steep Slope ..... Over 1½ inches per foot

Smooth – A finished polyurethane foam surface with virtually no texture approximating the appearance of deep, freshly fallen snow.

Smooth-Surfaced Roof – A built-up roof without mineral aggregate surfacing.

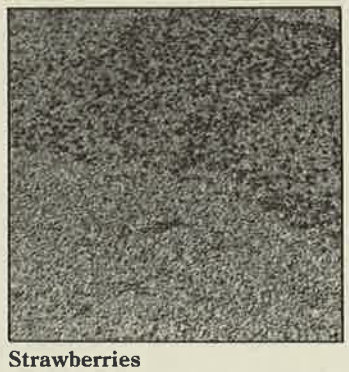
Softening Point – The temperature at which a bitumen becomes soft enough to flow as determined by an arbitrary, closely defined method.

Softening Point Drift – A change in the softening point during storage or application.

Split – A membrane tear resulting from tensile stress.

Square – A term used by roofers to indicate an amount of roof area equal to 100 square feet (92.2 m^2). Sufficient roofing material to cover 100 square feet of roof area.

Vent



Strawberries

Stack Vent – A vertical outlet in a built-up roofing system to relieve the pressure exerted by water vapor between the roofing membrane and the vapor retarder or deck.

Strawberry – A small bubble or blister in the flood coating of a gravel-surfaced membrane.

Stress Plate – A flat disk used at the head of a fastener to resist downward punching through a membrane or insulation.

Stripping – (Strip Flashing) (1) The technique of sealing a joint between metal and built-up membrane with one or two plies of felt or fabric and hot- 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 placed (structural deck or insulation).

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.

Surfectants – Chemical additives used in foam systems to make the cell structure uniform and fine grained.

Tear Strength – The maximum force required to tear a material, the force acting substantially parallel to the major axis of the test specimen. Values are reported in stress (e.g., pounds) or stress per unit of thickness (e.g., pounds per inch).

Tensile Strength – The maximum tensile stress per unit of original cross sectional area applied during stretching of a specimen to break; units – SI-metric Megapascal or kilopascal, customary pound per square inch.

Termination Bar – A strip of metal or plastic used to fasten and protect the edge of a membrane or flashing.

Thermal Resistance – (R) An index of 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 Insulation – A material applied to reduce the flow of heat.

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

Thermoplastic – Capable of being repeatedly softened by increase of temperature and hardened by decrease in temperature. The thermoplastic form allows for easier seaming both in the factory and in the field.

Through-Wall Flashing – A water-resistant membrane or material assembly extending totally through a wall and its cavities, positioned to direct any water within the wall to the exterior.

Tree Bark – An unacceptable foam surface very heavily textured in ridges approximating the appearance of the bark of an oak tree.

Ultimate Elongation – The elongation of a stretch specimen at the time of break. Usually reported as percent of the original length. Also called elongation at break.

Underwriters' Laboratories – A non-profit organization maintained in the interest of insurance companies to determine fire resistance of various materials.

Valley – The place of meeting of two slopes of a roof, forming a depression that carries water to an outlet or drainage head.

Vapor Migration – The movement of water vapor from a region of high vapor pressure to a region of lower vapor pressure.

Vent – An opening designed to convey water or other gas from inside a building or a building component to the atmosphere.

Vent or Vent Pipe – Small iron pipe outlet extending up through the roof.

Verge of Popcorn – A finished foam surface, moderately textured, approximating the appearance of the surface of a cracker without holes.

Vulcanization – An irreversible process during which a rubber compound, through a change in its chemical structure (e.g., crosslinking), becomes less plastic and more resistant to swelling by organic liquids, and elastic properties are conferred, improved, or extended over a greater range of temperature.

Glossary is published by Hoffmann Architects, specialists in investigative and rehabilitative architecture/engineering. Our offices are located at 3074 Whitney Avenue, Hamden, CT 06518 Phone (203) 281-4440 and 1925 Century Boulevard, Suite 4, Atlanta, GA 30345 Phone (404) 633-7817.

Roofing Consultants

With most construction litigation a result of defective roofing, extra special care should be taken to assure a trouble free system, especially in a reroofing situation. Unfortunately, design consultants often have no working knowledge of roofing, and many times contractors have limited knowledge of the theory behind it. Unless the roofing system is both properly designed and well applied, its chances for success are limited. So how do you make sure that your money is well spent and the roof won't have to be prematurely replaced?

One very good option is a competent independent roofing consultant. According to the American Society for Testing and Materials (ASTM) E936, the characteristics of a good consultant are:

The roofing consultant should be individuals or firms of established competence having professional qualifications as roofing consultants who are engaged in the field of roofing technology. The roofing consultant should be knowledgeable in field investigations, sampling procedures, laboratory analysis and testing, design counseling and review, be able to prepare complete contract documents, such as: specifications, drawings and details for roofing systems, structural analysis and design of roof decks, observe roof construction work for compliance with the contract as well as specifications and details, report preparation and life-cycle costing services.

Roofing consultants should accept assignments only to the extent that they are fully qualified to carry them out to a successful conclusion, based upon education, training and experience. If not, they should utilize the services of other qualified consultants for assistance.

Roofing consultants should have a thorough knowledge of the conditions to which the roof assembly will be exposed during construction, as well as during its lifetime.

The roofing consultant's professional conduct should be responsible, prudent, honest and impartial, and he or she should strive for the highest levels of excellence that effort, training, management, and scientific method will allow. He or she should not accept any assignment involving conflict of interest, directly or indirectly, unless all parties involved have been appropriately informed of all pertinent facts. He or she should accept compensation exclusively from the client who has engaged him or her, and should not agree to any form of contingency fee or other arrangement where he or she could be financially interested in the outcome of an assignment.

A consultant should perform his or her consulting work without any fear or favor, reporting the facts as he or she sees them, even if they are unfavorable to his client. He or she should treat all information obtained during any engagement as confidential, and not reveal anything to others without his or her client's specific approval. He or she should give professional opinions only in the field of competence, and draw conclusions only on the basis of fact and knowledge, rather than on the basis of assumptions or

generalities. If he or she encounters a problem for which he or she has no justifiable answer or solution he or she shall so state.

And how is this consultant to be found? To assist you in your search for the best consultant for your projects, we have prepared an unbiased checklist to help you compare firms, following the ASTM guidelines. To make things easier, we've also filled one out for you on our firm.

If you would like a copy of our Roofing Consultant Guide please let us know.

technical notes

Estimating Weight of Ponded Roof Water

By William Sisson
Superintendent of Operations
Nipak, Inc., Pryor, OK

Undesirable water ponding can occur when drains on a so-called flat roof become clogged with loose gravel, leaves, or other debris. A more serious condition can develop when the building settles, as all buildings will, permitting more than anticipated deflection, or a reduction in the design slope at the roof. This settlement can result in ponding or can increase existing ponding by causing drains to be pushed above the surface of the roof.

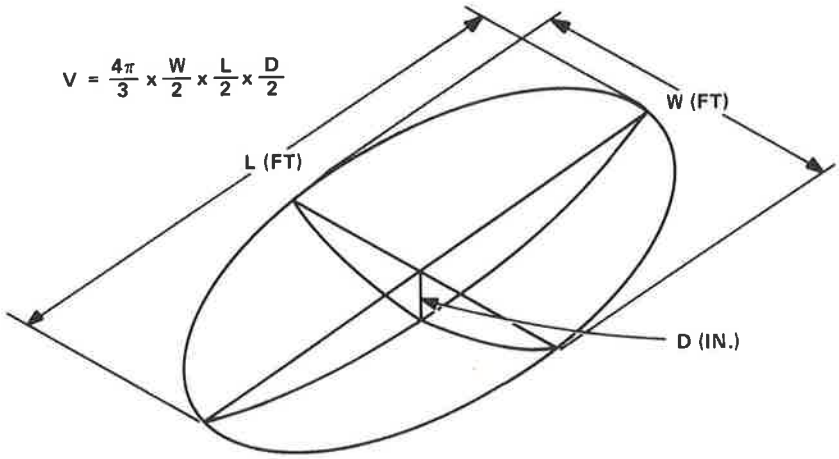
Water ponds on a roof are deceptively heavy. Such weight can cause leaks at any weak point in the roof membrane. Water also leaches oils from the bitumen, causing the roofing felt to be exposed sooner than if the surface were allowed to weather normally.

Also, if water ponds over cracks or other weak spots, the continuing pressure and weight of the water will cause broadening of the cracks and eventual failure.

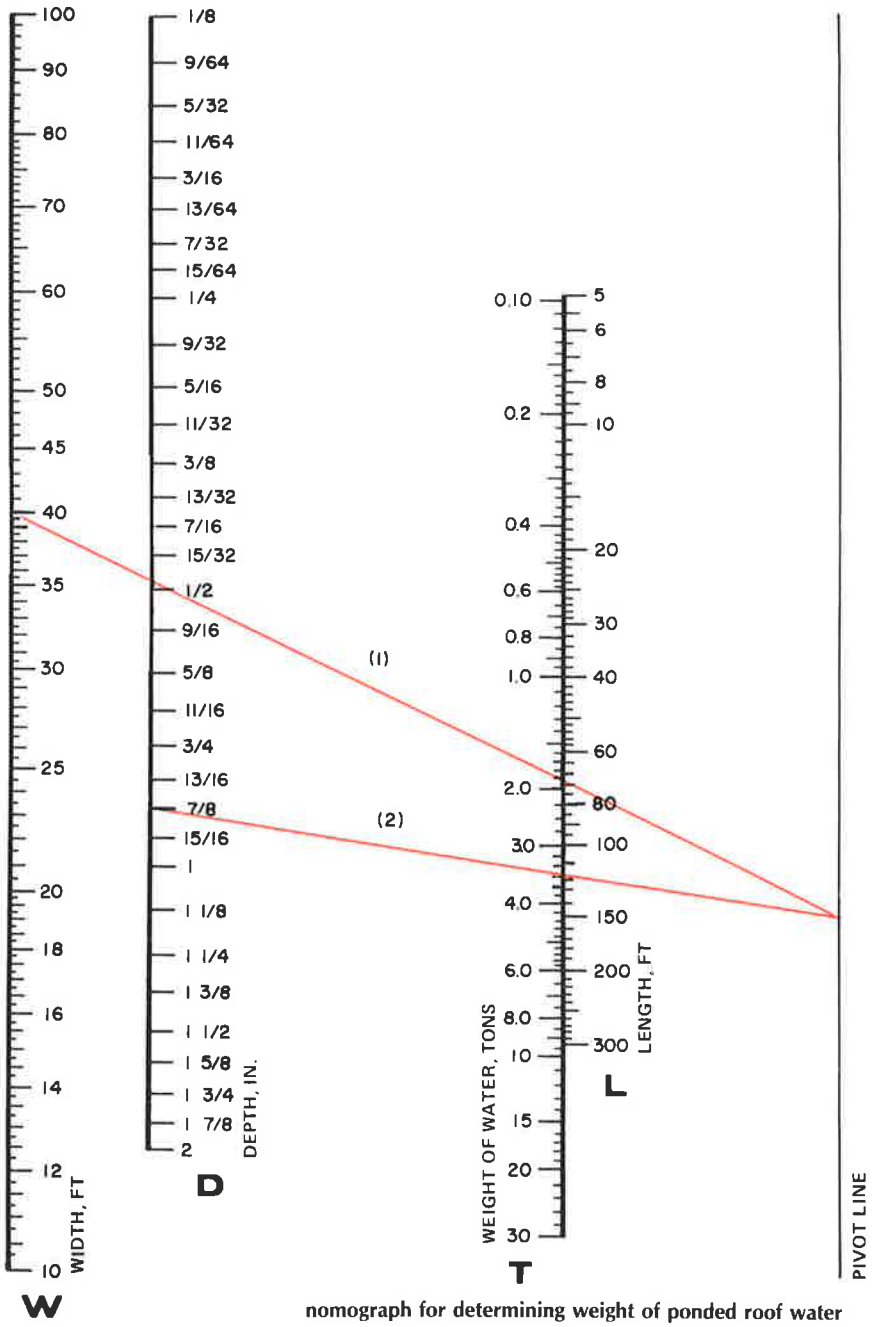
This nomograph, based on an ellipsoid approximation of a sagging roof, can be used to estimate the load in tons of ponded water. Measure the length, width, and depth of the pond, and the nomograph will do the rest.

ponded roof water

Example: What is the load on a section of roof if the dimensions of a roof pond are: width, 40 ft; length, 70 ft; depth, 7/8 in.?



Nomograph assumes ponded water on a sagging roof will take the approximate shape of an ellipsoid, the volume of which is equal to the product of its semiaxes multiplied by 4 pi/3.



nomograph for determining weight of ponded roof water

Solution: Align 40 on scale *W* with 70 on scale *L* and extend to pivot line. Then, connect point found on pivot line with 7/8 on scale *D* and, where line crosses scale *T*, read load as 3.3 tons.

AIA Claims Subcommittee Report

If building owners were aware of the vast amount of money spent repairing or replacing leaking roofs, they would be more willing to pay for a roofing expert during a building's construction.

This is the message from the Claims Coding Subcommittee of the AIA's Architects Liability Committee. The subcommittee recently commissioned the review of numerous insurance claims of roof problems to suggest ways that architects can prevent costly roof repairs for their clients.

"It is difficult, if not impossible, for the architect to observe and assess the total application of a roofing installation during construction. Most architects will admit – privately if not otherwise – that they are not experts and tend to rely on somebody else for the quality job they hope to get," reported the subcommittee.

In virtually all claims analyzed by the subcommittee, architectural inspection and general-contractor control of the roof installation were neglected.

Many problems resulted from a lack of understanding of roofing techniques by the designer and from the use of outdated roofing specifications, said the subcommittee.

The subcommittee determined that most of these problems could have been prevented had an expert supervised the roof installation.

staff and technical notes

Roofing Alert

The Roofing Systems Technical Committee (RSTC), a joint liaison committee of the National Roofing Contractors Association and the Asphalt Roofing Manufacturers Association, recently issued a technical bulletin regarding roofing over lightweight insulating concrete decks. These types of decks are recognized for moisture retainage and problems with the roof membrane system associated with trapped moisture. Some of the problems which can be experienced include reduced insulation values, blistering, weakening of the membrane, reduced membrane service life, membrane splits due to freezing, rusting of fasteners, metal forms and other metal accessories and reduced fastener holding power. To minimize these potential problems, RSTC has issued recommendations for specifying these type decks.

- Determine that the deck system has been specified in strict accordance with the deck manufacturer's recommendations. These determinations should be the sole responsibility of the deck manufacturer and should be accepted prior to a plan being put out for bid.
- Require that the deck manufacturer and deck applicator certify in writing that the deck was installed properly and is satisfactory to accept the roof system.
- Select a deck application method (or system) which is approved by the deck manufacturer.
- Specify a roof membrane system specifically designed and recommended by the roofing materials manufacturer for this purpose.
- Provide underside venting by using form boards or ventilated steel deck, and provide for topside venting by mechanically fastening the base ply to the deck and by providing for venting at roof edges.

Quarterly is a publication of Hoffmann Architects, specialists in investigative and rehabilitative architecture/engineering, including the analysis and solution of roofing, masonry, glazed curtain wall and structural problems. Our offices are located at 3074 Whitney Avenue, Hamden, CT 06518, Phone (203) 281-4440 and 1925 Century Boulevard, Suite 4, Atlanta, GA 30345, Phone (404) 633-7817.

We welcome contributions to HA/Q from our clients and friends. Please send news and technical information to Karen L. Warseck, Editor, Hoffmann Architects/Quarterly at the Atlanta address. Address changes and additions to the mailing list should be sent to Nancy H. Bostwick in Hamden.

Staff News

Hoffmann Architects is pleased to introduce the new members of our staff, **Jane E. Estey, PE,** Structural Engineer, is responsible for the investigation analysis and design of structural rehabilitation projects. A graduate of Worcester Polytechnic Institute and a master's candidate at the University of Connecticut, she is a registered Professional Engineer and a member of the American Society of Civil Engineers.
Amy C. Kilburn, AIA is a Project Architect at the firm, responsible for field investigations, design development and coordination and preparation of construction documents. A graduate of Pratt Institute of Design, she is a registered Architect and a member of the American Institute of Architects and the Connecticut Society of Architects.
George N. Lambert has joined the firm as an architectural draftsman. He received a B.A. in Architecture from Howard University and has taken continuing education courses in Computer Science and Computer Graphics.

Harwood W. Loomis, AIA presented lectures on the Building Design and Life Safety divisions of the Architectural Registration Exam for a seminar sponsored by the Connecticut Society of Architects. His article entitled "Consultant Services in Reconstruction Planning" was published in the March 1984 issue of SKYLINES, the newsletter of the Building Owners and Managers Association.

John J. Hoffmann, AIA was a delegate to the National Convention of the Building Owners and Managers Association (BOMA). He is co-founder and treasurer of the Southern Connecticut chapter.

Walter E. Damuck, AIA, Jane E. Estey, PE, and **John S. Van Jeune, CWI** attended a seminar on parking garage construction sponsored by the American Institute of Steel Construction.