RECOVERING EXISTING ROOFING WITH SINGLE-PLY MEMBRANES

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With improved materials, specifications, and installation procedures, elasto/plastic roofing is becoming the reroofing system of the 1980s. In recent years, single-ply roofing grew from a demand for better performance in reroofing systems, especially those systems with additional insulation. Elasto/plastic materials greatly reduced our age-old problems of movement, moisture, and thermal shock.

Before the 1970s, single-ply membranes were specialty products, designed primarily for subgrade waterproofing. Though some roof installations were attempted, material performance was, at best, questionable. Early butyl rubber and polyvinyl chloride membranes were weakened with age by ultraviolet rays and lacked sufficient tear resistance. During installation the quality of workmanship was often poor as application techniques and details were still being developed.

Today, the development of new single-ply materials and specifications and the modification of older systems continues. With all the various materials and systems available, **selection** of the best material and specification are two of three primary factors for achieving long-term performance with cost and energy efficiency. The third primary factor in reroofing is the quality of workmanship.

In selecting a single-ply system for reroofing, different materials with separation sheets or insulation have been developed to recover the many types of existing roof and deck design. We have had long-term experience using four basic elasto/plastic materials:

1. E.P.D.M.
2. P.V.C.
3. Modified Bitumen
4. Reinforced Neoprene

These materials have been specified in different thicknesses measuring from 32 to 160 mils. Specifications for application of the materials have been with ballast on loose-laid sheets, adhesive to fully-adhere, and mechanical fasteners. Each material has worked best with one of the application methods.

E.P.D.M. AND P.V.C. SYSTEMS

In recent years, the majority of single-ply roofs have been E.P.D.M. and P.V.C. sheets loose-laid with ballast. Roof and design characteristics or limitations that are considered for reroofing with the ballasted systems include:

1. Roof Slope - less than 2″/1′ slope.
2. Roof Weight - holding power of at least an additional 8-12 psf of dead load.
3. Chemical Contamination - roofs free of possible chemical contamination - liquid or vapor.
4. Roof Traffic - roofs without traffic.
5. Wet Substrates - roofs less than 25% wet.
6. Additional Insulation - roofs requiring additional insulation.
7. Large and Open Roofs.

These characteristics or limitations will be discussed in order.

1. Roof Slope

Roof slope cannot exceed 2″ per 1′ for ballasted systems since all materials are loose laid.

2. Roof Weight

Ballast is applied at a rate of eight to twelve pounds per square foot depending on potential wind uplift. Higher buildings or unprotected roofs usually require more stone or even patio blocks within ten feet of the perimeter. Prior to consideration of the ballasted roof, the specifier or owner must determine the load limitations. A structural check will usually require the building plans, the weight of existing and new roofs, and plans of future additions or load changes. Weight of the loose gravel or felts to be removed from the existing roof should also be considered.

3. Chemical Contamination

The third factor in considering single-ply ballasted systems is chemical attack. Certain chemicals emitted from roof equipment or vents will damage the E.P.D.M. or P.V.C. membranes. The following materials can damage E.P.D.M. or P.V.C. membranes:

- Chlorinated Solvents
- Aliphatic Hydrocarbons
- Aromatic Hydrocarbons
- Lacquer Solvents
- Lubricating Oils
- Fuel Oil
- Gasoline
- Asphalt
- Creosote
- Benzine
- Hexane
- Ethers
- Kerosene

- Mineral Oil
- Naptha
- Ekolene Solutions
- Dioctyl Phthalate
- Strong Acids and Bases

Any chemcials that are deposited on the roof surface must be submitted to the roofing manufacturer for analysis prior to reroofing. Roofs with limited areas of solvent or oil emission, may be protected with metal or neoprene sheeting substituted in contaminated areas if approved by the manufacturer. Neoprene may be mixed and spliced with E.P.D.M. sheets, and metal with P.V.C.

4. **Roof Traffic**

Roofs with extensive foot or cart traffic should not be considered for reroofing with ballasted E.P.D.M. and P.V.C. systems. These membranes are very susceptible to puncture damage, and low density, polystyrene insulation may be crushed. Roofs with normal or minimal traffic should have three-foot walkways to roof drains and to units that will require cleaning or maintenance.

5. **Wet Substrates**

Recovering roofs that are water-saturated is bad practice. Although loose-laid systems will often distribute and vent moisture laterally, the drying time may be years. In that time period, roof decking, old materials and new insulation may deteriorate beneath the membrane.

6. **Additional Insulation**

In selecting a reroofing specification, the owner's primary consideration is usually cost. Loose-laid systems can utilize the inexpensive polystyrene insulation over asphalt roofs. However, coal tar pitch or recoated roofs emit fumes that may disintegrate polystyrene. Over these roofs, urethane, isocyanurate, fiberglass or perlite insulation should be specified in place of the polystyrene.

7. **Large and Open Roofs**

On large, open areas of roof where flashings are minimal, the loose-laid P.V.C. or E.P.D.M. system with additional insulation is very cost effective. On smaller areas or roofs with a high percentage of flashings, the loose-laid systems can be very expensive. New two-part metal fascia and flashing systems have recently been developed to reduce perimeter flashing costs. Still, other systems are more cost efficient.

In addition to following manufacturing specifications and details, the specifier can add some requirements and emphasize others to improve the quality of installation.

In a loose-laid application with polystryene insulation, ensure that a dry asphalt base sheet is adhered over small areas of wet mastic patches or coatings. Insulation that is loose-laid should be installed in two layers with the joints broken to reduce energy loss. If the insulation is used just as a separation sheet, ½ inch fiberboard or one inch polystyrene in a single layer will suffice.

Membrane thickness should not be less than 45 mils, and secure perimeter fastening of the membrane is essential. Membrane attachment should be completed daily using manufacturers' and Factory Mutual approved details. Fastening strips must be level with the top of insulation and securely attached to the deck or vertical walls. Where built-up flashings have pulled away from the walls at the top or base joint, they should be removed to ensure a secure attachment.

Roof drains, membrane splices, flashing corners, roof tie-ins, and counter-flashings require special attention in reroofing. Drains should be cleaned and all gravel scraped back. Drain heads should be checked for cracks, ring and clamps replaced, and a minimum 4″ wide seal of water-cut-off mastic trowelled beneath the membrane and clamping ring. All membrane and flashing splices require a bead of sealent as they are completed. Flashings at corners of roof curbs or walls must be overlapped and fully spliced a minimum of three inches (4″-6″ recommended). Areas for permanent roof tie-ins should be scraped of gravel, the membrane mechanically attached to the roof deck, and a splice completed to neoprene or metal that can be stripped into the built-up roof with steep asphalt and three plies of roofing felt. At a roof tie-in, the single-ply membrane should always be on the high side of the slope and never in a valley or ponding area. The only exceptions to this rule are specialty-type projects where roof valleys are recovered. Counter-flashings will vary in different reroofing applications. Normally, existing counter-flashings will be removed, reset and resealed. Termination bars are often unreliable in old walls or curbs and may require future maintenance. If used, a quality installation and bar design should be specified. Minimum standards for bar design include:

- Material - Aluminum
- Thickness - 1/8″
- Width - 1″
- Length - 10′ +
- Fastener spacing - 6″
- Fasteners - Sleeve-type or screws

The last phase of installation is the placement of the ballast. Gravelling should be completed daily or as required to hold the membrane and insulation in place. Urethane insulation may curl if not weighted down soon after application. Loaded, motorized gravel carts will compress and damage the lower density polystyrene insulation. Higher density insulation, additional insulation, or a top layer of fiberboard should be used to insure a consistent insulating value. Distribution of the ballast is important, particularly at the perimeter. A distribution of one thousand pounds per square should be assured within ten feet of the outside edges or walls.

MODIFIED BITUMEN SYSTEMS

The fastest growning and most versatile single-ply material is the modified bitumen. In reroofing, this system is fully adhered either directly to the old roof, to a separation sheet or to insulation. Roof and deck characteristics that are best for reroofing with adhered modified bitumen are:

1. Flat or Sloped Roofs
2. Roofs with Weight Limitations
3. Roofs with Chemical Contamination or Traffic
4. Roofs not requiring Additional Insulation
5. Roofs with Flashings

These characteristics or limitations will be discussed in order.

1. **Flat or Sloped Roofs**

Some modified bitumen membranes will adhere tightly to existing roof felts on steep sawtooth or vertical walls without mechanical fastener support. Elastomeric sheets reinforced with fiberglass and polyester are heated with torches to melt and adhere the modified bitumen to the felts.

2. **Roofs with Weight Limitations**
In reroofing, modified bitumen sheets are best applied in conjunction with a layer of thirty pound felt or base sheet. The base sheet is first applied over the existing roof or additional insulation with steep asphalt or mechanical fasteners. Loose and embedded gravel is removed if no insulation is to be added. Total weight of the adhered systemis usually less than two pounds per square foot. In rerooofing gravel roofs, the net result can be a load reduction of one or two pounds per square foot.

3. **Chemicals and Traffic**
The surface of modified bitumen is exceptionally durable. It is unaffected by many chemicals that attack other single-ply materials, and the roof itself may serve as a traffic walkway. Its chemical resistance is the same as a built-up roof. A coating of emulstion may be added on some sheets to achieve a UL Class A rating, or gilsonite roof paints may be applied to color the grey membrane. A standard clay base emulsion (non-fibrated) provides a satisfactory surface when applied at a rate of approximately 3 gallons per 100 square feet with soft bristle brushes. The emulsion drys within two hours, but may be damaged by heavy rain within 12 hours after application. If a gilsonite paint is to be applied over the emulsion, the emulsion must first be allowed to set for thirty days. The paint can be applied at a rate of approximatey one gallon per 100 square feet with rollers.

4. **Roofs without Insulation**
Modified bitumen systems are most competitive when applied directly over roofs without additional insulation. Before application of the modified bitumen, the existing roof surface requires the following preparation:

- Wet insualation in the exiting roof system must be removed..
- Embedded and loose gravel should be scraped and vacuumed.
- The roof surface must be leveled of high ridges or blisters and repaired.
- An asphalt, quick-dry primer should be applied (one gallon per square) to provide good adhesion. Over coal tar roofs, a coating of steep asphalt may be added to reduce pitch fumes.
- If the substrate is damp in areas or lacks good interply or insulation attachment, a coated base sheet should be added with mechanical fasteners.

The modified bitumen membrane is then torch-applied over the roof mat and flashings. Installation is simple and cost efficient.

When reroofing with additional insulation, the contractor may apply the insulation directly over the embedded gravel with a solid pour of steep asphalt or mechanical fasteners. In all cases, the perimeter should be mechanically attached in accordance with Factory Mutual recommendations. Insulation used with the system should be a felt backed urethane, fiberglass, perlite or fiberboard as used with built-up roof systems.

Over damp substrates, roof vents may also be used. The deck may be pierced if interior venting is acceptable.

5. **Roofs with Flashings**
Over roofs with a high percentage of flashing, modified-bitumen systems can be very efficiently applied. The roof membrane doubles as the flashing. All types of built-up flashings may be adhered to without mechanical attachment at the base-joint or termination. Modified bitumen is tied in to built-up roofing by simply heating and adhering the sheet to the adjacent roofing felts. Again, no mechanical attachment or special tie-in materials are required. Tie-ins are so efficient that modified bitumen is used often for small repair areas or partial roof sections. For example, valleys on sawtooth or barrel type roofs may be covered with a secure tie-in to the slope and flashing.

In specifying modified bitumen for reroofing, the specifier may again add some requirements and emphasize others to improve the quality of installation. When covering old roofs with insulation, a moisture survey or careful inspection should be made to determine the amount and degree of wet insulation. Water saturated insulation (25% +) must be removed, and damp areas should be vented. Roof vents or interior venting will usually work with fiberglass insulation. For other insulating materials, damp areas may be covered with a channel vented base sheet, strip-mopped in place with steep asphalt or mechanically attached with non-rust fasteners. Some modified bitumen warranties will not cover future problems caused by a moisture or movement condition of the original roof.

Other conditions of the existing roof that should be checked include perimeter and field attachment, roof drains, and flashing attachment. If the attachment of the roof perimeter of the old roof itself is questionable, a coated base sheet or layer of insulation should be mechanically fastened through the old roof and roof deck. Roof drains should be checked for cracks. Built-up flashing must be securely fastened to walls and curbs prior to adhering the modified bitumen. Deteriorated wall or projection flashings should be removed.

When adhering modified bitumen directly to old roofing felts or flashings, a quick-dry, asphalt primer should be applied first to ensure good adhesion. The primer must be dry before application of the modified bitumen or burning may result. When installing insulation with modified bitumen, mechanical attachment is recommended where possible. Specifications should be provided by the insulation manufacturers. The insulation, coated base sheet and modified bitumen should be applied together. Phased construction is not recommended.

NEOPRENE SYSTEMS

One of the oldest single-ply materials is neoprene sheeting installed with mechanical fasteners or adhesive. Substrate characteristics that are best suited for this system include:

1. Sloped Roofs - greater than 2″/1′ slope
2. Roofs with Weight Limitations
3. Roofs with Chemical Contamination
4. Roofs Requiring Additional Insulation

1. **Sloped Roofs**
Mechanically attached systems with neoprene perform best over sloped roofs with wood or steel decks. Sheets are normally fastened with steel nailing strips, spaced according to the slope of the roof. Reinforced neoprene is also resistant to tearing from wind flutter.

2. **Roof with Weight Limitations**
The neoprene roofing system weighs less than one pound

per square foot. It may be applied directly over smooth-surfaced roofs or with insulation. Composite urethane insulation in large sheets may add stability to light-weight metal decks when mechanically attached with screws and plates.

3. **Roofs with Chemical Contamination**
Neoprene sheeting has better resistance to chemicals than E.P.D.M. or P.V.C. membranes. In addition, some neoprene materials will not support a flame and may be applied with a UL Class A rating.

4. **Roofs with Additional Insulation**
Mechanically fastened roof systems work best with high density roof insulation. Composite urethane or fiberboard insulation is recommended. With these materials, fasteners will not likely loosen, and buckling or curling of insulation is not a problem. Roof insulation is attached in accordance with the insulation manufacturer's specifications. Over existing roofs on metal or wood decks, one screw and plate for every two square feet is required. On gypsum or tectum decks, one tube-lock fastener every three square feet is needed. Fastener heads or plates should be covered with a patch of neoprene or rubber tape to protect the membrane for potential puncture damage.

When specifying a mechanically fastened system, ensure that the existing roof and insulation are completely dry and that the roof deck is intact for secure attachment. In addition to the recommended grid coverage, metal bars or nailing strips should be fastened over both sheets on all field splices. Nailing strips are best covered with narrow strips of uncured neoprene flashing. The same material is fully-adhered over any built-up wall flashings on curbs or parapets with mechanical termination required beneath the base joint and at the top of the flashing.

During the past two years, several new single-ply materials have been introduced in the reroofing market. Different methods of attachment have been tried. Many products and specifications have failed, others have been changed, and some are working. In reroofing where the variables for failure are greatest, a single-ply system can be the best roof available provided the proper material and specification are selected, and the workmanship is excellent.