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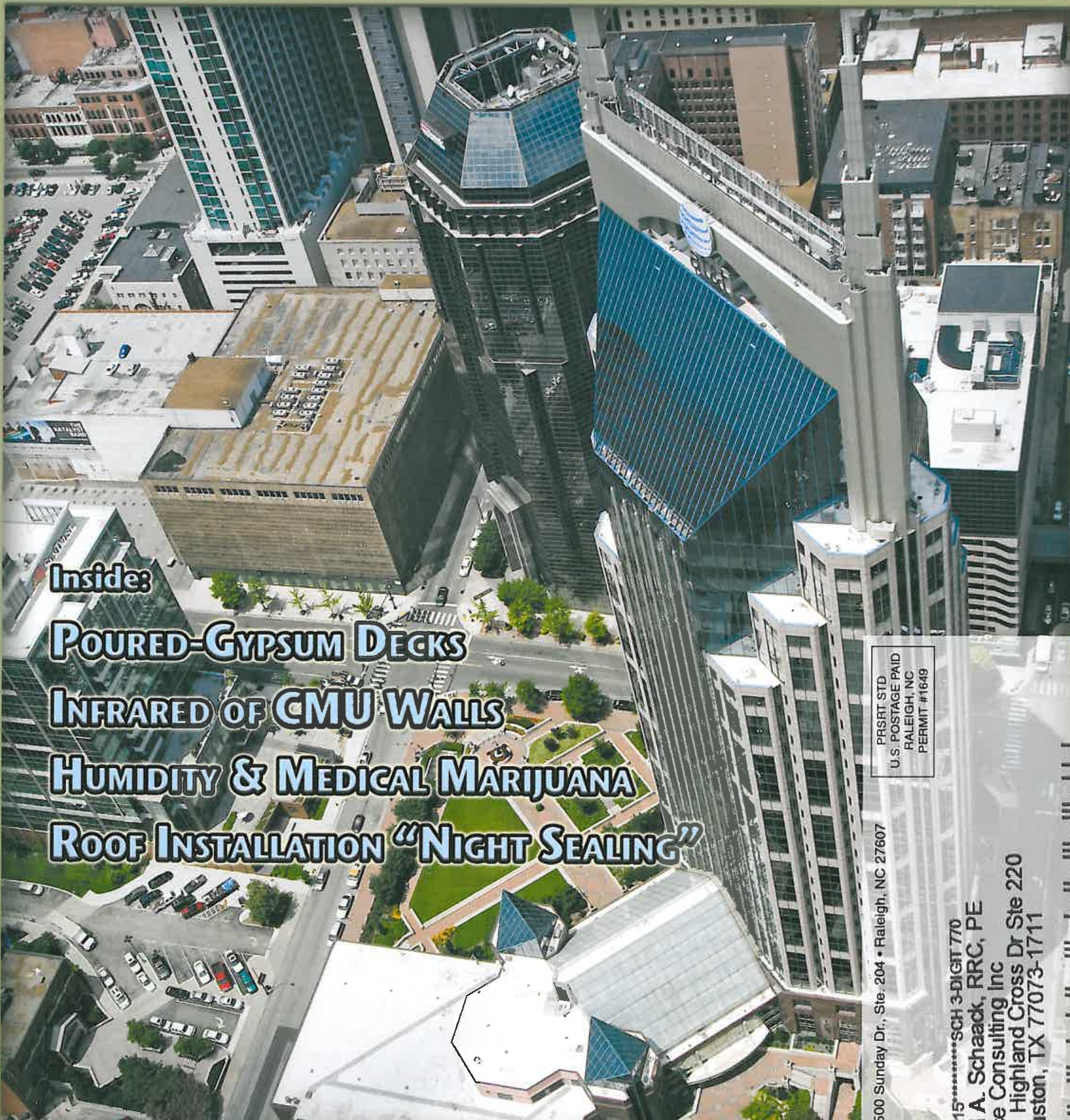

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Common Practices for Maintaining a Watertight Roof During Installation

By Karl Schaack, RRC, PE

"Tie-in," "tie-off," "water cut-off," and "night seal" are some terms commonly used to denote the method for terminating the roof during installation at the end of a work day for purposes of "drying-in" the roof. As defined by the National Roofing Contractors Association (NRCA), tie-off is "usually temporary plies or transitional seals that are installed to 'seal' the membrane or flashings to the substrate to prevent moisture from entering the membrane during construction."[1] Achieving a proper night seal is critical in maintaining the weathertightness of the roof and, subsequently, the building interior.

From a designer's perspective, the details for achieving a proper tie-in are often considered a "means and method" and rely on the contractor for proper construction. The purpose of this article is to provide some observations and comments regarding issues associated with tie-ins commonly encountered on construction projects.

Tie-ins are particularly important during roof replacement on existing facilities in an attempt to maintain the roof and building in a watertight manner. Since the old roof is being replaced, the watertightness of the existing roof is most likely considered to be suspect. During replacement, the newly installed roof has to be tied into the existing roof or structure on a daily basis to maintain watertightness. Depending on the types of roof coverings of the new and existing roofs, the materials may or may not be compatible or of the same composition, which can provide challenges. At the tie-in between new and old roofs, the new roof should be sealed at the deck interface to prevent the potential for water migrating from the old roof to new roof (*Photo 1*). Then a subsequent tie-in should also be achieved at the roof surface from old to new.

Photo 1 – Tie-in at deck and staggered insulation.

Photo 2 – Plastic cement being applied along edge of tie-in.

For built-up and modified-bitumen roofs, plastic roof cement (mastic) has historically been used generously for constructing tie-ins. But the author feels there are too many risks to rely solely on mastic. These risks include the porosity of fiberglass felts and the inability to visually detect small voids in the mastic. The mastic is commonly manually applied with trowels or by hand and, more likely than not, by the less skilled workers of the crew at "dark-thirty," rushing to finish for the workday (*Photo 2*).

For new built-up roofs, the membrane felt plies are typically extended over onto the old roof, then a glaze coat of hot asphalt is applied over the felt tie-in. Mastic is then often smeared along the terminations of the felt plies or just at fishmouths, "puckers," and other areas that appear to be suspect. Installing glaze-coated fiberglass felts as a tie-in over a void or insulation height differential can become troublesome as the felts can sag; or the hot asphalt can migrate through the felts, resulting in voids that could allow moisture intrusion. Nonporous felts such as coated base sheets or organic felts can be used to form tie-ins; however, their rigidity or propensity for tearing creates other concerns. Again, due to the porosity and relative rigidity of fiberglass felts, extreme care should be used to achieve a watertight seal. A gap, space, or void is commonly formed during application between the old and new roofs; and the tie-in material is installed to span this void, which could be troublesome for felts and mastic. Due to enhancement requirements for improved R-values, new roofs commonly have greater insulation thickness compared to the old roof that is being replaced. Therefore, the tie-in is also required to bridge a possible height differential between the old and new roofs (*Photo 3*). Modified-bitumen sheets and self-adhering elastomeric sheet products can be effectively used to construct proper ties-ins without the use of glaze coats of asphalt and surface-applied mastics. Self-adhering sheet products can temporarily adhere relatively well to bituminous, modified-bitumen, and even single-ply membrane roofs.

Another issue associated with insulation during the installation process is maintaining the stagger of the new insulation joints at the tie-in. Commonly, the author has seen that multiple layers of insulation are cut or terminated flush at the end of the daily installation in order to butt up against the linear cut or termination of the old roof or the previous day's installation. One option to maintain the insulation joint stagger is to loose-lay "dummy" partial boards that are positioned in proper stagger in each respective layer and then remove these boards when the tie-in material is removed to start the next adjacent new roof installation. These "dummy" boards can often be reused multiple times for the same function.

An option for the installation of a tie-in between roofs would involve installing insulation boards (loose-laid) within the space

Photo 3 – Tie-in at deck.

that may be created between old and new roofs. The fill boards should be stacked so that the tie-in material is elevated above the surface of the lower-profile adjacent roof surface so as to promote drainage away from the tie-in. Again, when an empty space is left between the two roofs, the tie-in material will typically sag and create a trough for water to collect and possibly cause problems at a vulnerable area (*Photo 4*).

Tie-ins at the deck level can be achieved by extending the new membrane or a piece of self-adhering sheet material over the ends of the insulation board and down to the deck and adhering or sealing the membrane to the deck. The membrane could be set in a bed of sealant on top of the deck, secured with fasteners or a termination bar, and then sealant-applied along the leading edge. A self-adhering sheet could also be used to create the tie-in by adhering onto the roof surface and extending down to and adhering

Photo 4 – Water accumulation on depression at tie-in.

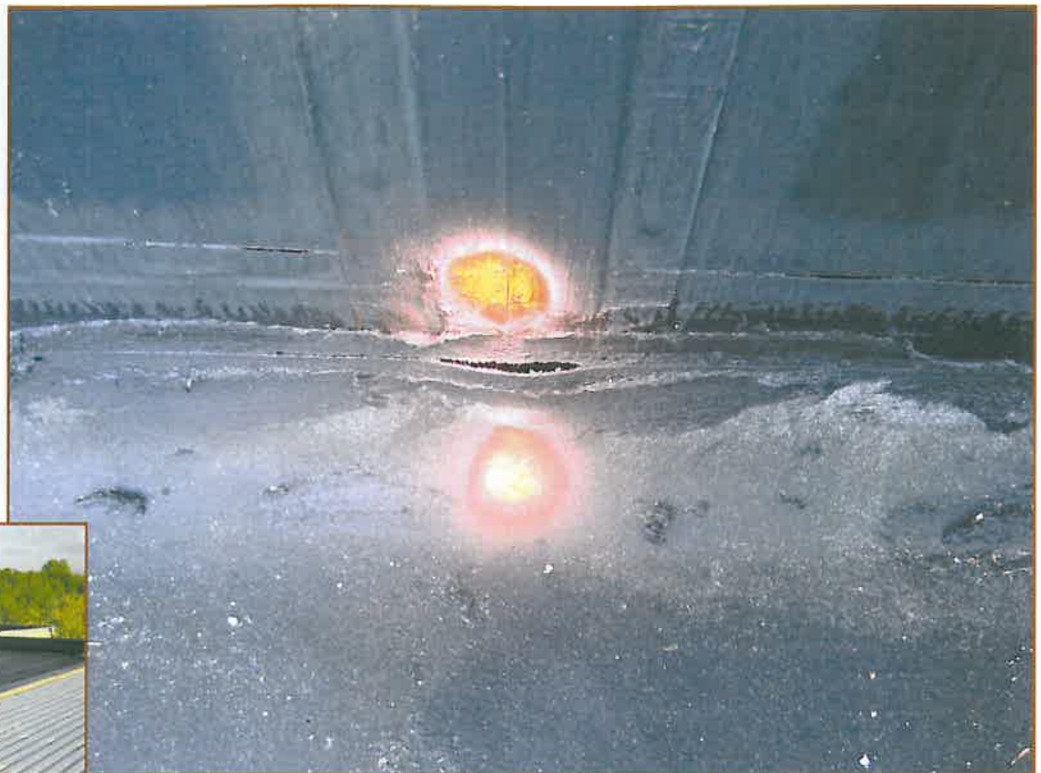


Photo 6 – Disbonded felts along parapet wall.

Photo 5 – Tie-in of modified bitumen on metal deck.

to the deck. Installing a termination bar anchored to the deck along the tie-in provides a very durable tie-in.

When the roof membrane is extended down and adhered to the top rib of a fluted steel deck, and the edge of the sheet is perpendicular to the long dimension of the flute, a gap or space exists between the membrane and the flutes (*Photo 5*). Spray foam can be applied into the flutes between the membrane and the metal deck. Cut sections of iso could also be placed and set in sealant or mastic within the flutes. This would be done to prevent water migrating through the flutes and possibly into the newly installed insulation or being entrapped within the flutes under the new roof. After completing the tie-in at the deck level, the fill boards can be placed over the tie-in material and the primary tie-in constructed at the top surfaces of the old and new roofs.

Mastic is commonly used for drying-in bituminous-based roof systems at base flashings, drains, and penetrations during the construction process. At curbs and walls, the roofing membrane plies or ply sheets are often extended to the top or 1 to 2 in. above the top of the cant and are smeared with mastic to make them watertight on a daily basis prior to the application of backer plies or a finish flashing ply that is to be installed at a later date. However, due to the relative rigidity of fiberglass felts, they will often become disbonded from the substrate and could allow moisture infiltration behind the felts, wetting the cant strip and migrating into the roof or building interior

Photo 7 – Open fishmouth at top edge of felts.

(*Photo 6*).

Incorporating reinforcing fabric in the mastic would greatly improve the ability of the mastic to keep the felts bonded to the substrate and maintain temporary weathertightness. Caution should also be used with mastic at curbs and walls due to possible compatibility issues associated with atactic polypropylene (APP) modified-bitumen products and potential fire issues associated with torch-applied modified-bitumen products. Mastics commonly used for temporary measures are typically lower-grade products available at the local supply house that commonly have higher solvent content and are more subject to igniting when exposed to propane flame or to cause excessive softening of the modified-bitumen flashing sheet from the solvents as they flash off. Sometimes the felts or ply sheet are applied in asphalt, and the temporary weatherproofing relies on the adhesion of the sheets with the asphalt to the substrate. The top edge of the plies should be properly sealed, as they can become disbonded from the substrate and form "funnels" to allow moisture migration (*Photo 7*).

At plumbing vent pipes and other penetrations through the roof, after the plies are cut to fit around the penetrating element, mastic is typically applied around the base of the penetration for temporary watertightness since the sheet-metal flashings are not yet on site. However, if a void is present between the felts or ply sheet and the penetration (commonly formed when the insulation board is not cut snug around the penetration), the mastic can slough off or be washed away by rooftop drainage, creating an opening for potential water infiltration. In addition, extension cords, ropes, or cables that are commonly draped and moved across the roof surface during the roof installation or other general construction processes could also displace the mastic, resulting in voids or openings to allow water infiltration.

Using reinforcing fabric will aid in maintaining weathertightness in this type of application. A square-shaped cut piece of modified bitumen with a hole the size of the penetration can be applied over the penetrating element to form a snug fit, and either mastic or even sealant can be better applied at the base of the penetration to form a relatively good temporary seal"(*Photo 8*). However, having the lead flashing or other permanent sheet-metal flashing (i.e., flashing pan) present to install around the penetration and applying the strip-in mem-

Photo 8 – Sealant applied around penetration on modified bitumen.

Photo 9 – Plastic sheet and tape applied over top of flashing pan.

brane would serve as a more permanent option for daily watertightness for the project duration.

Adhering flexible bituminous sheet flashing or modified bitumen to the membrane and the penetration in a "finger-flashing" technique could also function as a suitable temporary protection. After flashing pans are installed (and the filler material is not present), plastic sheet and adhesive tape (duct tape) work relatively well for temporarily sealing the tops of these metal pans (*Photo 9*). Often, mastic is placed within the metal pans to serve as a temporary watertightness measure; however, the penetrating element and sides of the pan become contaminated by the mastic and require adequate cleaning to ensure that a proper bond will form if a filler material is used in the base of the pan and an elastomeric pourable sealer is used to top off the pan.

Making roof drains watertight on a daily basis can also provide challenges. With BUR, typically the felts are trimmed around the drain bowl and the trimmed edges smeared with mastic as a dry-in method. However, the felts can separate from the bowl; and, again, the mastic can become displaced due to water running into the drain. In addition, if a tight seal is not achieved, water could back up under the plies during a heavy rainfall.

It is recommended that the lead flashing sheet be primed, set in mastic, and formed within the drain bowl and over the joint between the bowl and felts to provide a better daily seal. Stripping in the lead flashing and securing the clamp ring daily provide the best long-term watertight solutions during construction. If the lead is not stripped in to the membrane, water can migrate under the lead, even if embedded in mastic, as drainage is directed at the exposed leading edge of the lead sheet. Torch-applied modified-bitumen sheets, particularly APP products, can be effectively "molded" with troweled edges to conform to the drain bowl and result in a relatively good daily seal without the installation of the lead sheet. It has been commonly observed that the lead-reinforcing sheets may be set in a bed of mastic on top of the bituminous membrane, but the strip-in plies or membrane is delayed to a later time. This practice will most likely result in water migration below the lead sheet due to the thickness of the lead being somewhat elevated above the surface of the membrane, and the edge of the lead bucks water that is directed toward the roof drain.

Making bituminous-based roof systems watertight along low-profile roof edges offers different challenges. Rigid fiberglass felts cannot be affectively bent down over the outer face of the nailer without fracturing. One option for achieving a watertight seal could consist of utilizing a flexible sheet (i.e., vinyl sheet flashing or self-adhering elastomeric sheet) at this location. This detail would consist of trimming the felts flush with the roof edge; adhering or embedding the flexible sheet in a full bed of mastic; extending the sheet over the edge of the roof, and either fully adhering or securing it to the outer face of the nailer with cap nails; and extending over the top edge of wall finish material (i.e., brick, siding, etc.), if present. During new construction, the flexible sheet could be extended over the nailer and steel angle or structure and tied into weather-resistive barrier or dampproofing material that is applied to the backup wall. Modified-bitumen sheets typically have the flexibility to extend over the 90-degree angle without the use of a supplemental sheet.

The author has occasionally observed that the modified bitumen and other materials that were extended over the edge had been cut away by the technician installing the sheet-metal edge flashing with an apparent perception of impacting the sheet

Photo 10 – Trimmed edge of single-ply at perimeter.

metal installation (i.e., cleat or fascia). The trimming is typically performed on an extensive length of roof edge with the anticipation that the extent of the sheet metal installation work would be completed on that same day, consequently exposing the building to potential water infiltration. The material should be left in place to provide continued protection of the nailer and building, should moisture migrate past the metal flashing. Maintaining a watertight seal at this location is extremely critical when rooftop drainage is directed over the roof edge and the gutters were removed or have yet to be installed (common practice), as the water will cascade down the wall and most likely find unsealed voids or openings in the wall, resulting in moisture intrusion into the building.

At walls and curbs, it is recommended for bituminous roofs that the backer ply sheets (either felt plies or modified-bitumen base ply) be installed on a daily basis to provide better weather protection—particularly at inside and outside corners where field felt plies or membrane ply sheets are cut to conform to changes in plane or direction at the cant. Without the backer-ply flashing, mastic is typically smeared over the cuts and corners in an attempt to create a seal, which again often becomes vulnerable to moisture infiltration.

As with bituminous roofs, it is recommended to install flashings at curbs, walls, and penetrations on a daily basis for single-ply roofs. If not achieved, then supplemental weathertight measures should be implemented. At low perimeters, the single ply can be readily draped over the roof edge and secured or adhered in place. Trimming the bottom edges of the draped portion of the membrane with a straight edge provides a neat appearance for the temporary roof until the metal flashing can be installed. This practice can be important—particularly during reroofing and along exposed visible edges of existing occupied buildings, resulting in not only a weathertight seal but also a better visual appearance (*Photo 10*).

Urethane sealant is commonly used as the "mastic" for single-ply installation when it comes to making daily seals at terminations and penetrations. Single-ply membranes can be readily cut to conform relatively close to a penetration where a mound of sealant, applied over and around the base of the penetration, performs relatively well as a temporary seal (*Photo 11*). On a mechanically attached single-ply membrane, fasteners are typically installed through the membrane around penetrations and along perimeters. If the membrane flashing cannot be installed on a daily basis, then the fastener heads and perimeters of the plates should be covered with sealant to provide adequate temporary weathertightness.

Photo 11 – Sealant applied around penetration in single ply as temporary seal.

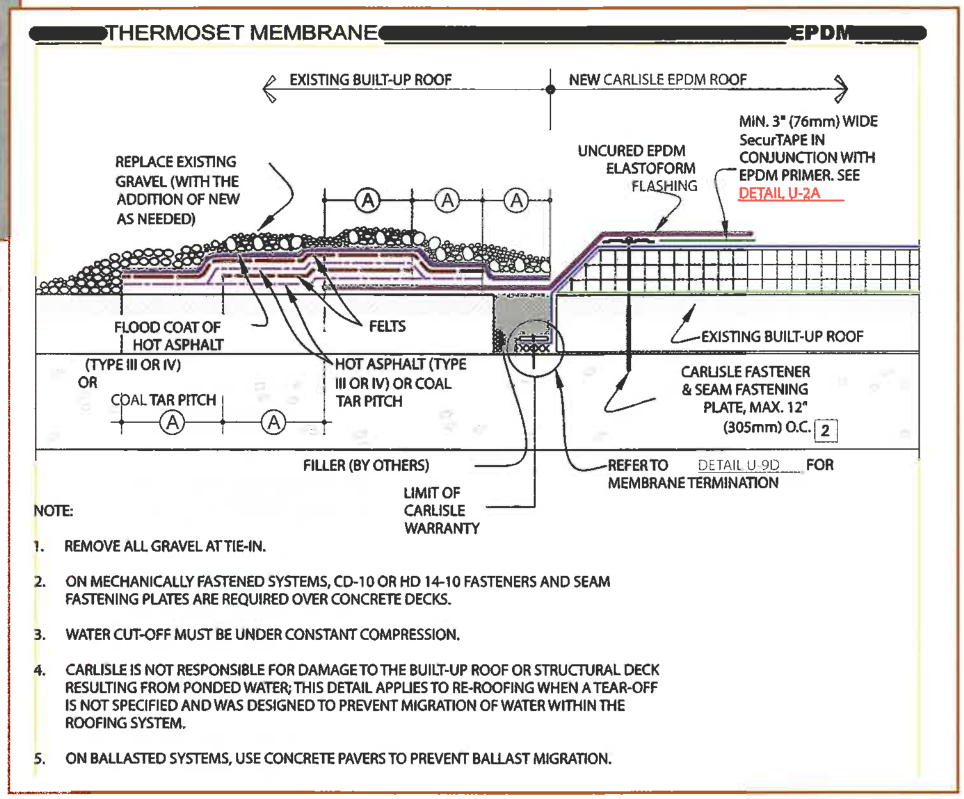
At roof drains, water block is installed between the bottom of the single-ply membrane and drain bowl for watertightness. The clamp ring should be secured daily to provide proper compression and contact among the membrane, water block, and bowl to achieve a proper bond as the sealant cures. If the clamp ring is not installed, a void or separation exists between the water block and either the membrane or drain bowl, and the sealant cures prior to the installation of the clamp ring, then an adequate bond may not form and may result in moisture migration.

At walls and curbs, the single-ply flashing can either be adhered or installed loose, depending on the vertical height of the substrate and project or manufacturer requirements. When the flashing is terminated on the vertical substrate, water block is commonly applied between the top edge of the flashing membrane and the vertical substrate. It is recommended to install the mechanical attachment (i.e., termination bar) along the top edge on the same day to ensure continuous proper seal and weathertight construction. If roof curbs are present and have removable hoods or equipment, or the hood or equipment has yet to be delivered, it is recommended to extend and adhere the single-ply membrane flashing up and over the top of the curb to maintain weathertightness—not only during the construction period,

Photo 12 – Spray foam applied along tie-in of single ply on metal deck.

Photo 13 – Sealant applied along edge of fleece-backing single ply over lightweight insulating concrete.

Figure 14 – Manufacturer guideline for tie-ins.



but also in the future if the equipment is removed or displaced.

When constructing a tie-in with single-ply membrane over a steel deck, the membrane can be extended down and adhered to the top ribs of the deck. Low-rise foam or cut pieces of ISO set in sealant can be positioned in the flutes between the bottom of the membrane and the steel deck when the tie-in is perpendicular to the flute direction (*Photo 12*). Drilling holes in the flutes of the deck on the upslope side of tie-ins is a practice utilized to prevent water accumulation or buildup at the tie-in. Using termination bars to secure single-ply tie-ins to the substrate can be a very effective watertight method.

Achieving a proper edge seal of the membrane is critical with fleece-backed single-ply sheets, as the fleece can be exposed along the leading edge and absorbs moisture if not properly protected.

If the subject roof membrane is applied directly over lightweight insulating concrete-fill substrate or a base sheet that has been mechanically attached to lightweight insulating concrete fill, then the edge of the newly installed membrane should be sealed to the surface of the lightweight insulating concrete fill with either mastic or some type of sealant (*Photo 13*). If the subject roof system is bituminous, the ply sheet or plies could be extended beyond the base sheet and adhered directly to the surface of the lightweight insulating concrete to achieve the night seal.

When tie-ins or night seals are constructed, the materials used most likely need to be completely removed the following day when the roof installation commences on the adjoining areas. The materials used to construct tie-ins are often less expensive and may not be of the same composition (i.e., organic felts, urethane sealant, etc.) as those used for the finished roof. In addition, these materials may inhibit proper bonding or adhesion of the finished products or may be incompatible with the new materials. Some of the primary membrane material manufacturers offer technical assistance—either details or specification information—by providing guidelines or recommendations for the installation of tie-ins for various conditions (*Figure 14*).

Proper planning with the proper materials present on a daily basis will allow the installation of adequate materials and flashings in order to achieve a watertight roof and alleviate potential issues and headaches that are associated with leaks or water infiltration that commonly occur during construction.

FOOTNOTE

1. *NRCA Handbook of Accepted Roofing Knowledge* (HARK) Manual.

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