ROOF SEAM FASTENER SYSTEM

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ABSTRACT

A roof seam fastener system including a mechanical fastener member for mechanically attaching a roof membrane to a roof structure. The roof seam fastener system comprises a fastening assembly that creates a seal to either the roof membrane or a roofing substrate located directly below the fastening assembly. This fastening assembly also creates a seal against the mechanical fastener member. This combination results in redundancy which prevents any water penetration into the seam from entering the roofing envelope. The roof seam fastener system improves wind uplift resistance of the roof membrane and minimizes other weather related damage.
ROOF SEAM FASTENER SYSTEM

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention
[0002] The invention relates in general to a mechanical attachment system for securing roof membranes, and more particularly, to a mechanical attachment system for securing roof membranes wherein a seal is achieved between the mechanical attachment device and the roof membrane and/or material directly below it, minimizing weather related damage.
[0003] 2. Description of Related Art
[0004] Single-ply roofing systems are typically installed using three basic methods: ballasted, fully adhered, and mechanically attached. Mechanically attached single-ply roof membranes are attached to a structure using various types of metal and plastic fasteners which are installed through strips or plates made from metal, plastic or a combination of the two.
[0005] One typical installation method is illustrated in FIG. 1. In this method, a roof membrane substrate 2 is positioned adjacent to a roof deck 4. A first sheet of roofing membrane 6 having a first edge 8 is laid onto the roof membrane substrate 2. A fastener assembly, generally illustrated as 10, is installed along this first edge 8 of the first sheet of roofing membrane 6 to secure the roofing membrane 6 to the roof membrane substrate 2. The fastener assembly 10 comprises a clamping device 12, which is positioned on top of the first edge 8 of the first roofing membrane 6, and a fastener 14, such as a nail, screw or the like. The fastener 14 extends through the clamping device 12, first roofing membrane 6, and roof membrane substrate 2 and then into the roof deck 4. An adjacent or second sheet of roofing membrane 16, having a second edge 18, is then applied such that this second edge 18 overlaps the first edge 8 of the first membrane 6 and the fastener assembly 10. A portion 9 of the first edge 8 and second edge 18 of the overlapping first and second membranes 6, 16 are then seamed together 20. This seam can be created by any well known process such as heat, contact adhesives, self-adhering tapes, solvents, ultrasonic welding, dielectric welding, radio frequency welding or the like. Air and/or moisture vapor can be trapped between the second roofing membrane 16 and the roof membrane substrate 2.
[0006] Although this method of attaching a roofing membrane is commonly used, there are several drawbacks to this attachment method. As shown in FIG. 2, this particular method is susceptible to failure caused by uplift forces 11 during wind loads or constant positive pressure loads due to asymmetrical loading, as shown by arrow 13, of the fastener assembly 10. The asymmetrical loads cause crushing of the roof membrane substrate 2, due to the fastener 14 rocking under the load, immediately below the roof membranes 6, 16. Once this occurs, the compression of the fastener assembly 10 against the roof membrane substrate 2 is lessened. This compression is necessary to prevent the roof membranes 6, 16 from slipping and tearing around the fastener 14. Another disadvantage of this system is that the seam 20 also experiences a significant amount of peeling force, as shown by arrows 15a and 15b.
[0007] In an attempt to overcome the difficulties of this roof membrane attachment method shown in FIGS. 1 and 2, manufacturers have begun to create an additional or second seam 22, for joining a portion 24 of the second roofing membrane 16 to a portion 25 of the first roofing membrane 6, as shown in FIG. 3, on the opposite side of the fastener assembly 10. Accordingly, the roof membranes 6, 16 are seamed along both sides of the fastener assembly 10 so that any uplift forces 11 caused by wind, as shown in FIG. 4, are applied symmetrically, as shown by arrows 17a, 17b and 17c, to the fastener assembly 10. This symmetrical application of force prevents crushing of the membrane substrate 2 and eliminates peel forces which can be exerted on the seams 20, 22. Accordingly, the forces acting on the seams 20, 22 are in a shear mode instead of peel forces. This results in increased seam performance.
[0008] As illustrated in FIG. 5, in an effort to reduce labor costs, rolls of the roofing membrane 6, 16 may be factory seamed together at 26 prior to delivery to the project site to create large panels, generally indicated as 28. The overlap of the membranes 6, 16 is sufficient so as to create a fastening tab 30. These panels of roofing membrane 28 are laid onto the roof membrane substrate 2. A portion of the roofing membrane 16 is lifted upward so that the fastener assembly 10 can be installed through the fastening tab 30. Although this method offers labor saving during the installation, it is still subject to the asymmetrical loading and peel force described above and illustrated in FIG. 2. In order to overcome the problems of asymmetrical loading and peel force, this method can include a second seaming operation performed on site after the application of the fastening assembly 10, as described above with respect to FIG. 3 and shown again in FIG. 6.
[0009] As an alternative to the seam overlap attaching methods discussed above, another method for attaching a roofing membrane to a roof membrane substrate is shown in FIG. 7. This method includes the use of a supplemental member 32 formed of a compatible material located beneath a roof membrane 34 which are attached to the roof membrane substrate 2. The fastener assembly 10 secures this supplemental member to the roof membrane substrate 2. The supplemental member 32 can have a circular shape or any other shape. The roof membranes 34 are overlapped sufficiently to allow a seam and then attached on their underside via seams 35, 36 to the supplemental member 32 by using one of the seaming methods described above. One advantage of this method is the ability to locate fastener assemblies independent of the roof membrane overlaps. This can be particularly advantageous when the rolls of roof membrane are excessively wide or too narrow in relation to the attachment pattern required to secure the roof membrane to the structure. Another advantage is that the fastener 14 does not penetrate the roof membrane 34 and thus asymmetrical loading of the fastener assembly 10 is achieved and the seam is oriented such that forces exerted thereon are in a shear mode as opposed to a peel mode.
[0010] Another variation of this method is shown in FIG. 8 where roof membrane panels 38 are overlapped sufficiently to allow seaming and installing of the fastener 14 of the fastener assembly 10 through the roof membrane into the roofing membrane substrate 2 and the roof deck 4. The supplemental member 32 can be a circular (or any other shape) piece of roof membrane (or other compatible material) which is placed over the fastener assembly 10 and seamed at 39, 40 to the roof membrane 38. A drawback to this method is the significant number of individual supplemental members 32 required to make the roof membrane 38 watertight.
[0011] The roof membrane 38 can also be attached to the structure utilizing a linear fastener assembly 10 that is independent of the seam overlaps as shown in FIG. 9. This method
is similar to that discussed above and shown in FIG. 7. However, instead of individual attachment patches, the fastener assembly 10 is installed through a longitudinal attachment strip 42. The longitudinal attachment strip 42 has a width which is sufficient to overlap the fastener assembly 10 and to allow areas for seams 39, 40 to the roof membrane 38. Panels of the roof membrane 38 are overlapped sufficiently to form seams 39, 40 and then attached along its underside to longitudinal attachment strip 42 using one of the sewing methods discussed above.

[0012] FIG. 10 shows another variation for attaching the roof membrane panels 38 which is similar to that discussed above and shown in FIG. 8. This method also involves overlapping the roof membrane panels 38 sufficiently to allow seaming and installing the fastener assembly 10 through the roof membrane to the roof membrane substrate 2 and roof decking 4. This method differs from the method discussed with respect to FIG. 8 in that the roof membrane panels 38 are attached utilizing a longitudinal attachment strip or cover strip 42 as shown and discussed with respect to FIG. 9, rather than individual supplemental members. The linear fastening system is positioned over the fastener assembly 10 and is seamed at 39, 40 to the membrane panels 38. This method can minimize the number of patches required and can allow the use of automated welding devices.

[0013] While all of the methods discussed above and currently in use initially create a watertight system, they do not prevent subsequent damage that may be the result of cyclic loads resulting from wind or damage to the roof membrane due to natural phenomenon or abuse. There is a need in the art for fastening assembly that addresses these issues and prevents moisture or air from moving within the roof assembly, minimizing any weather related damage to the roof membrane substrate and roof decking.

SUMMARY OF THE INVENTION

[0014] It is therefore an object of the invention to provide a mechanical attachment system for securing a roof membrane to a roof structure that creates a watertight system that reduces subsequent wind damage and other weather related abuse. It is a further object of the invention to provide a mechanical attachment system that prevents moisture or air from moving from the roof envelope to the seam channel or from the seam channel to the roof envelope.

[0015] Accordingly, the present invention is directed to a roof seam fastener system, including a mechanical fastener member, for mechanically attaching a roof membrane to a roof structure, wherein the roof seam fastener system comprises a fastening assembly that creates a seal to either the roof membrane or a roofing substrate located directly below the fastening assembly. This fastening assembly also creates a seal against the mechanical fastener member. According to a first embodiment, the fastening assembly comprises a clamping plate having at least one washer laminated on one or both sides thereof. The fastener member includes a shaft extending through the clamping device and the at least one washer. The washer creates a seal with the roofing membrane and/or the roofing substrate as well as the shaft of the fastener member. According to a second embodiment, the fastening assembly comprises a clamping plate and a joining material positioned adjacent to the clamping plate. This joining material can comprise a field applied sealant or adhesive material. According to a third embodiment, the fastening assembly comprises a clamping plate having a washer laminated on one or both sides thereof or washers placed loosely on the top and/or bottom of the plate. The fastening assembly may be positioned either above or below the roof membrane.

[0016] These and other features and characteristics of the present invention, as well as the methods of operation and functions of the related elements of structures and the combination of parts and economies of manufacture, will become more apparent upon consideration of the following description with reference to the accompanying drawings, all of which form a part of this specification, wherein like reference numerals designate corresponding parts in the various figures. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention. As used in the specification, the singular form of "a", "an", and "the" includes plural referents unless the context clearly dictates otherwise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. 1 shows a mechanical attachment system for attaching a roof membrane to a roof substrate according to the prior art;
[0018] FIG. 2 shows the wind effects of the mechanical attachment system of FIG. 1;
[0019] FIG. 3 shows an alternative mechanical attachment system for attaching a roof membrane to a roof substrate according to the prior art utilizing a double seam;
[0020] FIG. 4 shows the wind effects of the mechanical attachment system of FIG. 3;
[0021] FIG. 5 shows another mechanical attachment system for attaching a roof membrane to a roof substrate according to the prior art using rolls of roofing material pre-seamed together;
[0022] FIG. 6 shows yet another mechanical attachment system for attaching a roof membrane to a roof substrate according to the prior art using pre-seamed, double seamed membrane material;
[0023] FIG. 7 shows another mechanical attachment system for attaching a roof membrane to a roof substrate according to the prior art using attachment discs positioned below the roof membrane;
[0024] FIG. 8 shows another mechanical attachment system for attaching a roof membrane to a roof substrate according to the prior art using attachment discs positioned above the roof membrane over the fastening assembly;
[0025] FIG. 9 shows yet another mechanical attachment system for attaching a roof membrane to a roof substrate according to the prior art using strips of attachment material positioned below the roof membrane;
[0026] FIG. 10 shows still another mechanical attachment system for attaching a roof membrane to a roof substrate according to the prior art using strips of attachment material positioned above the roof membrane over the fastening assembly;
[0027] FIGS. 11a and 11b show the mechanical attachment system of the present invention according to a first embodiment;
[0028] FIGS. 11c and 11d show expanded views of the attachment system of FIGS. 11a and 11b;
[0029] FIG. 12a shows the mechanical attachment system of the present invention according to a second embodiment;
[0030] FIG. 12b shows an expanded view of the attachment system of FIG. 12a.
FIG. 12c shows the mechanical attachment system of the present invention according to a third embodiment; FIG. 12d shows an expanded view of the attachment system of FIG. 12c; FIG. 13 shows the mechanical attachment system of the invention in practice according to a first arrangement; FIG. 14 shows the mechanical attachment system of the invention in practice according to a second arrangement; and FIG. 15 shows the mechanical attachment system of the invention in practice according to a third arrangement.

DETAILED DESCRIPTION OF THE INVENTION

For purposes of the description hereinafter, spatial or directional terms shall relate to the invention as it is oriented in the drawing figures. However, it is to be understood that the invention may assume various alternative variations, except where expressly specified to the contrary. It is also to be understood that the specific components illustrated in the attached drawings, and described in the following specification, are simply exemplary embodiments of the invention. Hence, specific dimensions and other physical characteristics related to the embodiments disclosed herein are not to be considered as limiting.

Now reference is made to FIGS. 11a-11d which show the mechanical attachment system according to a first embodiment of the invention. In this embodiment, a fastening system, generally indicated as 50, comprises a clamping plate 52 and a fastening member 54. A washer 56 is positioned adjacent to the clamping plate 52 and is clamped between the clamping plate 52 and the material located directly below the clamping plate 52. The clamping plate 52 can be formed from a metal or plastic material or any other material having sufficient strength to perform a clamping function. The washer 56 can be formed from a flexible and/or compressible material, such as a rubber or plastic material or any other well-known material used for forming washers. The washer 56 can be clamped between the clamping plate 52 and a roof membrane 58, as shown in FIGS. 11a and 11c. Alternatively, the washer 56 can be laminated to the clamping plate 52 to form a washer/clamping plate assembly 57 prior to application to a roof membrane 58. The washer 56 can be laminated by any well-known means, such as heat welding or the application of a separate adhesive material. The washer 56 forms a seal 65 to the underlying surface. This underlying surface can comprise either the roof membrane 58 or a roof substrate 59 in the situation illustrated in FIG. 14 wherein the fastening system 50 is attached between the roof membrane 58 and the roof substrate 59.

The fastening member 54 can comprise a threaded fastener having a shaft 60. The washer 56 can include a preformed first aperture 62. A corresponding or second aperture 64 is also formed in the clamping plate 52. The shaft 60 of the fastening member 54 extends through apertures 62, 64 to secure the fastening system 50 to the roof membrane 58. The first aperture 62 has a first diameter which is smaller in size than a second diameter of second aperture 64. Through this aperture 62, a seal 63 is created between the washer 56 against the fastener shaft 60. As an alternative to the preformed aperture 62 in the washer 56, the washer 56 can be a solid member and the shaft 60 of the fastening member 54 penetrates the solid washer 56 during installation.

A second washer can be applied to a top surface of the clamping plate 52. This second washer allows for additional seaming or sealing against the fastener shaft 60. This second washer is also useful in situations where the roof membrane 58 is positioned above the fastening system 50, such as illustrated in FIG. 14. In the event that the second washer does not seal against the fastener shaft 60, a grommet may be used directly beneath a fastener head 70 of the fastening member 54.

A second embodiment is illustrated in FIGS. 12a and 12c which show the use of a joining material 72 between the clamping plate 52 and the roof membrane 58. This joining material 72 creates a seal 90 against the fastener shaft 60 and the roof membrane 58. The joining material 72 can comprise a sealant, adhesive, tape, caulking and any other material capable of creating a seal. This joining material may be preapplied to the clamping plate or it may be applied at the field during installation.

A third embodiment is illustrated in FIGS. 12c and 12d which combine the features of the first and second embodiments. In this embodiment, the washer 56, 66 is applied to one or both sides of the clamping plate 52 to form an assembly 74. The joining material 72 can be applied to one or both sides of the washer/clamping plate assembly 74 to seal this assembly 74 to the roof membrane 58 and the fastening member 54.

The fastening member 54 may be applied on site or, alternatively, the fastening member 54 may be formed as an integral component with the clamping plate/washer assemblies 57, 74. Also, the fastening member 54 may be any well-known type of fastener capable of exerting a clamping force against the washer or sealant material. Some examples of fastening members 54 include threaded fasteners, rivets, expansion bolts or interference fit fasteners that are driven into place. Some types of structural decks may require other specially fasteners that also meet the clamping criteria.

The use of the above fastening systems 50 and attachment methods used in combination with the roof membranes 58 result in a method that provides a redundant seal around the holes created in the roof membrane 58 by the fastening member 54. This redundant seal, when used in combination with any of the known double seaming, disc or strip fastened systems, as detailed in detail with respect to FIGS. 1-10, prevents moisture or moisture laden air within the roof envelope of the fastening system 50. The use of the inventive fastening system 50 also prevents any moisture which enters the seam channel as a result of a faulty outside seam or a puncture over the seam channel from entering the roof envelope.

FIGS. 13-15 show various applications of the fastening system 50 of the present invention for mechanically securing a roof membrane 58 to a roof substrate 59 and roof decking 80. FIG. 13 shows an application of the invention for securing a pair of overlapping roof membranes 58 wherein the fastening system 50 is positioned between edge portions 76, 77 of the overlapping roof membranes 58 and a double seam 78, 79 is formed on either side of the fastening system 50. Air/moisture vapor 81 is trapped between the roof membrane 58 and the roof substrate 59. FIG. 14 shows an alternative application of the invention wherein an attachment disc 82 is positioned adjacent the roof substrate 59, and a sealing device, which may be a washer 56 or joining material 72 is positioned on top of the attachment disc 82, followed by clamping plate 52 and mechanically attached by fastening member 54. The roof membrane 58 is placed over the fastening system 50 and double seamed at 78, 79 to the attachment.
disc 82. FIG. 15 shows yet another application of the invention utilizing a longitudinal cover strip 84 which overlays the fastening system 50 of the invention. The fastening system 50 secures the roof membrane 52 to the roof substrate 59 and roof decking 80. The longitudinal strip 84 is then double seamed at 78, 79 to the roof membrane.

[0045] The welded, frictional, or adhesive seal of the fastening system 50 to the underlying material of the present invention acts to improve the wind uplift resistance of the total roof system by preventing slipping and/or tearing of the roof membrane 52.

[0046] Although the invention has been described in detail for the purpose of illustration based on what is currently considered to be the most practical and preferred embodiments, it is to be understood that such detail is solely for that purpose and that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover modifications and equivalent arrangements that are within the spirit and scope of this description. For example, it is to be understood that the present invention contemplates that, to the extent possible, one or more features of any embodiment can be combined with one or more features of any other embodiment.

The invention claimed is:

1. A roof seam fastener system including a fastener member for attaching a roof membrane to a roof structure, said roof seam fastener system comprising:
   a. a fastening assembly that creates a seal to one of a roof membrane and a substrate located directly below said fastening assembly and wherein said fastening assembly further creates a seal against such fastener member.
   2. The system as recited in claim 1 wherein said fastening assembly comprises a clamping plate having at least one washer laminated on one or both sides thereof and such fastener member includes a shaft extending through said clamping device and said at least one washer.
   3. The system as recited in claim 2 wherein said clamping plate is formed from one of a metal or plastic material and said washer is formed from one of a flexible or compressible material.
   4. The system as recited in claim 2 wherein said clamping plate is formed from one of a metal or plastic material and said washer is formed from one of a rubber or plastic washer.
   5. The system as recited in claim 2 wherein said washer is laminated onto said clamping plate by one of welding, fusing, brazing, and adhesively bonding.

6. The system as recited in claim 2 wherein said fastening assembly is sealed to a top surface of said roof membrane.

7. The system as recited in claim 2 wherein said fastening assembly is sealed between said substrate and said roof membrane.

8. The system as recited in claim 2 wherein said at least one washer includes an aperture preformed therein for allowing said shaft of said fastening member to extend therethrough.

9. The system as recited in claim 2 wherein said at least one washer comprises a solid member and said shaft of said fastening member penetrates said solid member during installation of said fastening system.

10. The system as recited in claim 2 wherein said at least one washer has a first aperture extending therethrough and having a first diameter and said clamping plate has a second aperture having a second diameter and extending therethrough in alignment with said first aperture, and wherein said first diameter is less than said second diameter to facilitate sealing of said at least one washer to said fastening member upon insertion of said fastening member through said first and second apertures.

11. The system as recited in claim 1 wherein said fastening assembly comprises a clamping plate and a joining material positioned adjacent to said clamping plate.

12. The system as recited in claim 11 wherein said joining material comprises a field applied sealant or adhesive material.

13. The system as recited in claim 11 wherein said fastening assembly includes a fastening member having a shaft extending through said clamping device and said joining material.

14. The system as recited in claim 2 wherein said fastening assembly comprises a clamping plate having a washer laminated thereto and a joining material positioned adjacent to said washer.

15. The system as recited in claim 14 wherein said joining material comprises a field applied sealant or adhesive material.

16. The system as recited in claim 15 wherein said fastening assembly includes a fastening member having a shaft extending through said clamping device and said joining material.