A support frame for a solar panel comprises a channel member including a bottom panel, a front vertical panel extending upward from a front edge of the bottom panel, and a rear vertical panel extending upward from rear edge of the bottom panel. Front and rear support panels for engaging a bottom surface of the solar panel extend respectively from the upper ends of the front and rear vertical panels. The front and rear support panels lie in the same inclined plane. The support frame is secured to the roof structure by a clamping assembly.
FIG. 5A

FIG. 5B
SOLAR INSTALLATION SYSTEM

BACKGROUND

[0001] The present invention relates to a solar installation system for mounting solar panels or photovoltaic panels on industrial flat roofs and light-weight designed roofs.

[0002] Solar panels or photovoltaic panels convert solar energy into electricity and provide a promising means for meeting future energy needs. Solar panels are usually mounted on the roof of buildings to allow the maximum exposure to sunlight and least interference to the use of the building itself. Conventional mounting methods typically require substantial modifications to the roof structure that are usually difficult and time consuming to make. Solar panel installations often result in leaks in the roof of a building due to improper sealing of the holes through the roof. Furthermore, some conventional mounting methods can weaken the roof structure. Additionally, some mounting systems are not suitable for situations where high wind uplift loads are expected.

[0003] There is a continuing need for a mounting system that makes installations simple and quick, that can withstand high wind uplift loads, and that does not impair the integrity of the roof structure.

SUMMARY

[0004] The present invention relates to a mounting system for mounting a solar panel to a roof structure. The mounting system may be applied on top of an existing roof structure, is capable of withstanding very high wind uplift loads, can be easily and quickly installed, and does not impair the structural integrity of the roof structure.

[0005] The mounting system includes a support frame to support a solar panel in an inclined position, a clamping system to secure the support frame to the roof, and a waterproofing system to maintain the impermeability of the roofing system to water. The support frame comprises a channel member including a bottom panel, a front vertical panel extending upward from the front edge of the bottom panel, and a rear vertical panel extending upward from the rear edge of the bottom panel. Front and rear support panels for engaging a bottom surface of the solar panel extend respectively from the upper ends of the front and rear vertical panels. The front and rear support panels lie in the same inclined plane.

[0006] The clamping system comprises a base member, an optional load distributing member and clamping bar. The base member includes a base plate that fastens to the roof structure and a threaded rod that extends upward from the base plate. The load distributing member and clamping bar overlap the bottom panels of two adjacent support frames. A clamping nut threads onto the threaded rod of the base member and tightens against the clamping bar.

[0007] The waterproofing system comprises a waterproof patch with an opening for the threaded rod. The opening is preferably sized to snugly fit the threaded rod. The waterproof patch covers the base plate of the base member and may be bonded at its outer edges with the waterproof membrane of the roof structure. A sealing collar and waterproof nut are installed on the threaded rod to seal the opening around the threaded rod.

DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a perspective view of the solar panel mounting system according to one exemplary embodiment.

[0009] FIG. 2 is a perspective view of a support frame for the solar panel mounting system.

[0010] FIG. 3 is an exploded perspective view of the solar panel mounting system.

[0011] FIG. 4 is a plan view of the solar panel mounting system.

[0012] FIGS. 5A-5D illustrate a base member for the solar panel mounting system being secured to a roof structure.

[0013] FIG. 6 illustrates a cross-section of a typical roof structure showing the base member and a portion of the support frame.

DETAILED DESCRIPTION

[0014] Referring now to the drawings, and particularly to FIG. 1, a mounting system 10 according to one exemplary embodiment is shown. The mounting system 10 is used to mount a solar panel 100 to a generally flat roof structure and is designed to carry high loads. The mounting system 10 comprises a support frame 12 for supporting solar panels in an inclined position, a clamping assembly 30 for securing the support frame to a roof structure, and a waterproofing system 40 to prevent infiltration of water into the roof structure.

[0015] FIG. 2 illustrates an exemplary support frame 12. The support frame 12 is made from a single aluminum sheet that is bent to form an elongated, generally U-shaped support structure. The support frame 12 is designed to distribute loads over a large area of the roof and to withstand very high wind uplift loads. The support frame 12 includes a bottom panel 14 that rests on the roofing structure, a front vertical panel 16, a rear vertical panel 18, a front support panel 20 with an up-turned flange 22, and a rear support panel 24. The bottom panel 14 lies flat against the roof structure and distributes load over a relatively large area of the roof structure. The front and rear vertical panels 16, 18 extend generally perpendicularly from the bottom panel 14. If the roof is inclined, however, the front and rear vertical panels 16, 18 may be disposed at an angle relative to the bottom panel 14 such that the front and rear panels 16, 18 lie in vertical planes. The front and rear vertical panels 16, 18 function to deflect wind and help reduce wind uplift on the solar panels 100. The front support panel 20 and rear support panel 24 are disposed at an angle relative to the front and rear vertical panels 16, 18, respectively. The front and rear support panels 20, 24 lie in an inclined plane. The angle of the inclined plane relative to a horizontal plane is selected to maximize exposure of the solar panel 100 to solar radiation. The panels 14-24 all extend in the same longitudinal direction, which is parallel to the inclined plane of the solar panel 100.

[0016] As shown in FIG. 2, the solar panel 100 rests on top of the front and rear support panels 20, 24 in an inclined position. The up-turned flange 22 on the front support panel 20 prevents the solar panel 100 from sliding off of the support frame 12. Any suitable means may be used for securing the solar panel 100 to the support frame 12. In the exemplary embodiment, clamps 110 are used to secure the
solar panel 100 to the support frame 12. One advantage of clamps 110 is that no drilling or modification of the solar panels 100 is required. Thus, the solar panels 100 can be installed and removed without causing any damage to the solar panels 100.

[0017] The support frame 12 provides an air flow channel below the bottom surface of the solar panel 100 when the solar panel 100 is installed on the support frame 12, which aids in cooling the solar panels 100. The support frame 12 distributes the load of the solar panel 100 over a large area of the roof structure and resists high wind uplift loads.

[0018] One or more clamping assemblies 30 (FIG. 3) secure the support frame 12 to the roof structure. The basic elements of a clamping assembly 30 include a base member 32, an optional load distributing member 37, and a clamping bar 38. The base member 32 fastens to the roof structure as described below. The load distributing member 37 and clamping bar 38, in cooperation with the base member 32, apply a clamping force to the bottom panel 14 to secure the support frame 12 to the roof structure. In general, the load distributing member 37 is used when there are high wind uplift loads, but may be omitted when only light wind uplift loads are present. The load distributing member 37 distributes the clamping force exerted by the clamping bar 38 and helps prevent metal fatigue at the point where the clamping bar 38 would otherwise engage the bottom panel 14.

[0019] The base member 32 comprises a base plate 34 having a threaded rod 36 extending upwardly therefrom. The threaded rod 36 can be welded to the base plate 34, or secured to the base plate 34 by a threaded connection. The base member 32 is securely fastened to the roof structure using screws, anchors, or other suitable fastening means. The load distributing member 37 and clamping bar 38 each comprise a channel made of aluminum or other strong but lightweight material. The load distributing member 37, when used, is arranged so the channel opens upward. The clamping bar 38 is arranged so that the channel opens downward. The load distributing member 37 and clamping bar 38 are lowered onto the threaded rod 36 of the base member 32 so that the threaded rod passes through aligned openings 40 in the load distributing member 37 and clamping bar 38 respectively. The load distributing member 37 and clamping bar 38 are secured in place by a clamping nut 42 that threads onto the end of the threaded rod 36 and tightens against the top surface of the clamping bar 38.

[0020] FIG. 4 illustrates how the clamping system 30 is used to secure the support frames 12 to a roof structure. The support frames 12 for two or more solar panels 100 are aligned in row. The base members 32 are positioned between adjacent support frames 12 and secured to the roof structure as previously described. The load distributing members 37 and clamping bars 38 are placed so that they extend parallel to the front and rear vertical walls 16, 18 and overlap two adjacent support frames 12. When the clamping nut 42 is tightened, the load distributing member 37 and clamping bar 38 are pressed firmly downward against the bottom plate 14 of the support frames 12. The force generated by the clamping bars 38 on the support frames is capable of resisting very high uplift loads.

[0021] FIGS. 5A-5D illustrate the installation of the base member 32. After determining the location of the base member 32, the base member 32 is secured to the roofing structure by self-tapping screws that screw into the metal decking of the roof structure. (FIG. 5A). After the base member 32 is installed, a fibrous backing material 44 is placed over the base plate 34 (FIG. 5B). A waterproof patch 46 compatible with the existing waterproof membrane on the roof structure is placed over the backing material 44. (FIG. 5C). A sealing collar 48 is placed over the threaded rod 36. A self-sealing nut 50 is then threaded onto the threaded rod 36 and tightened to press the sealing collar firmly against the waterproof membrane (FIG. 5D). The outer periphery of the waterproof patch can then be secured to the existing waterproof membrane of the roof by conventional means, such as waterproof adhesives, fusing, etc.

[0022] FIG. 6 illustrates a cross-section of a typical roof structure showing the base member 32 and a portion of the support panel 12. The roof structure includes a corrugated metal deck 102, a vapor barrier 103, an insulation layer 104, a waterproof membrane 105, and a finishing layer 106. The base member 32 is installed on top of the waterproof membrane 105 and is secured to the metal deck 102 by screws that penetrate through the roof structure. The waterproof patch 46 covers the base plate 34 of the base member 32 and is bonded at its outer edges to the waterproof membrane 105. Sealing collar 48 and nut 50 prevent infiltration of water around the threaded rod 36. The support frame 12 is held down by the clamping bar 38 and clamping nut 42.

[0023] The exemplary embodiment provides one example of how the present invention may be used. However, the present invention is not intended to be limited in any way to the specific details of the exemplary embodiment and variations from the exemplary embodiment will be readily apparent to those of skill in the art.

What is claimed is:

1. A support frame for supporting a solar panel on a roof, said support frame comprising:
an elongated channel member including a bottom panel, a front vertical panel extending upward from a front edge of the bottom panel, and a rear vertical panel extending upward from rear edge of the bottom panel; front and rear support panels for engaging a bottom surface of the solar panel extending respectively from upper ends of said front and rear vertical panels; and wherein said front and rear support panels are coplanar and lie in the same inclined plane.

2. The support frame of claim 1 wherein the front and rear vertical panels are different heights.

3. The support frame of claim 2 wherein the rear vertical panel is higher than the front vertical panel.

4. The support frame of claim 3 wherein the front and rear support panels extend outwardly from the front and rear vertical panels.

5. The support frame of claim 4 wherein the front support panel forms an acute angle with the front vertical panel and the rear support panel forms an obtuse angle with the rear vertical panel.

6. The support frame of claim 1 further comprising a flange extending at a right angle from said front support panel for engaging a bottom edge of said solar panel and preventing the solar panel from sliding.

7. The support frame of claim 1 wherein the elongated channel, the front support panel, and the rear support panel are formed from a single sheet of material.

8. The support frame of claim 1 wherein the front and rear vertical panels are made from solid, non-perforated sheets for deflecting wind.
9. A clamping assembly for securing a support frame for a solar panel to a roof structure, said clamping assembly comprising:
   a base member including a base plate to be secured to the roof structure and a threaded rod extending upwardly from the base member;
   an elongated clamping bar to extend over a portion of said support frame to apply a clamping force to the support frame, said clamping bar have an opening through which the threaded rod extends, and
   a clamping nut to thread onto an end of the threaded rod and to tighten against said clamping bar to generate said clamping force.
10. The clamping assembly of claim 9 wherein said clamping bar comprises a U-shaped channel opening downwards
11. The clamping assembly of claim 10 further comprising a load distributing member for interposing between said clamping bar and said support frame to distribute clamping forces over said support frame.
12. The clamping assembly of claim 11 wherein the load distributing member comprises a U-shaped channel opening upwards.
13. A mounting system for mounting one or more solar panels to a roof structure, said mounting system comprising:
   a generally U-shaped support frame for supporting at least one solar panel in an inclined position above a roof structure:
   a clamping mechanism to secure the support frame to the roof structure, said clamping assembly comprising:
   a base member including a base plate adapted to be secured to the roof structure and a threaded rod extending upwardly from the base member;
   an elongated clamping bar to extend over a portion of said support frame to apply a clamping force to the support frame, said clamping bar have an opening through which the threaded rod extends, and
   a clamping nut to thread onto an end of the threaded rod and to tighten against said clamping bar to generate said clamping force.
14. The mounting system of claim 13 wherein the front and rear vertical panels are different heights.
15. The mounting system of claim 14 wherein the rear vertical panel is higher than the frontal vertical panel.
16. The mounting system of claim 15 wherein the front and rear support panels extend outwardly from the front and rear vertical panels.
17. The mounting system of claim 16 wherein the front support panel forms an acute angle with the front vertical panel and the rear support panel forms an obtuse angle with the rear vertical panel.
18. The mounting system of claim 13 further comprising a flange extending at a right angle from said front support panel for engaging a bottom edge of said solar panel and preventing the solar panel from sliding.
19. The mounting system of claim 13 wherein the elongated channel, the front support panel, and the rear support panel are formed from a single sheet of material.
20. The mounting system of claim 13 wherein the front and rear vertical panels are made from solid, non-perforated sheet material for deflecting wind.
21. The mounting system of claim 13 wherein said clamping bar comprises a U-shaped channel opening downwards
22. The mounting system of claim 21 further comprising a load distributing member for interposing between said clamping bar and said support frame to distribute clamping forces over said support frame.
23. The mounting system of claim 22 wherein the load distributing member comprises a U-shaped channel opening upwards.