Description

Title of Invention

PHOTOVOLTAIC SOLAR PANEL ROOFING SYSTEM CONSTRUCTED AS MAIN ROOF OR SECONDARY ROOF FOR PUBLIC/ PRIVATE HOUSING, COMMERCIAL BUILDING AND SATUTATORY BUILDING

Technical Field

[0001] The present invention relates to photovoltaic solar panel/ PV solar panel mounted on roof tops but with the usage of PV solar panel to:- acts as a main roof/ a secondary roofing system, providing waterproofing, enhance thermal insulation comfort through reducing sun heat transmitting from roof top into building and generate electricity for usage.

Background Art

[0002] Conventionally, PV solar panel (size: 1640x992x40mm thk) consisting of Mono-Crystalline/ Poly-Crystalline cells is either mounted on ground level or roof top via mounting brackets easily found in the industry. PV solar panel has not been used as main roof/ a secondary roofing system that could pass the water tightness test. Our system shall satisfy water tightness test.

Summary of Invention

[0003] Specifically, as shown in Drawing No.: ZC-01, the overall PV solar panel framing plan mounted on concrete flat roof slab with the typical adjustable prop support, RHS 100x40x4 HDG main frame, RHS 60x40x4 HDG @ 600 c/c secondary frame, 0.24mm thk colourbond corrugated roof sheet fixed at bottom side of secondary frames. PV solar panel (size: 1640x992x40mm thk) is used to form secondary roofing on entire concrete flat roof; no waterproofing on existing or new concrete flat roof is required.

[0004] Drawing No.: ZC-01. If there is any shadow from the adjacent building or objects casted partially on our photovoltaic roofing system, blank PV solar panel (size: 1640x992x40mm thk) without solar cells shall be used for those areas without sunlight, other areas with sun light shall use normal PV solar panel (size: 1640x992x40mm thk) with cells, the entire roofing coverage shall consist only of PV solar panel (size: 1640x992x40mm thk). Any PV solar panel where its surface does not receive sufficient sunlight due to shadow being casted shall use PV solar panel (size: 1640x992x40mm thk) without solar cell and its function is only a “dummy” to create a whole uniform flat roofing system together with normal PV solar panel all integrated together with 15 degree slope profile. All “dummy” PV solar panel shall not be linked with the normal PV solar panel circuit to generate power.

[0005] Drawing No.: ZC-02 (Sectional View) shows photovoltaic roofing system on an existing concrete flat roof top. This design can be used for those 6300 blocks of HDB flats built before 1988 where re-waterproofing is done at every 10 to 13 years cycle. PV solar panel is laid on entire roof and in 15 degree slope, allowing rain water to free fall. For any private housing, commercial buildings or statutory buildings where re-waterproofing to its existing roofing is required, our photovoltaic roofing system design is also applicable to these areas. No re-roofing is necessary since our PV solar panel system can act as waterproofing to prevent rain water from seeping into the existing roof if existing waterproof roofing system is due for re-roofing. In the event if our PV solar panel system is used, the existing waterproofing system on the roof slab and ferro cement slab (for thermal insulation purpose) shall remain while we built our PV solar panel system over the entire roof. The purpose of building the PV solar panel system over existing ferro cement slab is to further enhance the thermal insulation comfort within the building.

[0006] Drawing No.: ZC-02 (Detail A), the entire PV solar panel roofing system is supported via adjustable prop support consisting of CHS 60.3 OD x 4 HDG mounted on existing RC slab where there is column or beam at underside of RC slab so as to transfer the whole PV solar panel roofing system weight onto these structures. The method on anchoring adjustable prop support is shown in detail A. As the whole photovoltaic roofing system would add on additional dead load on the roofing structures, all adjustable prop support shall anchored directly on existing RC roof beams.

The height of the proposed secondary roofing varies depending on the condition of the existing housing or buildings. Adjustable prop support is used to adapt any secondary roofing height requirement.

[0007] Drawing No.: ZC-03 (Detail B), adjustable “U” head jack on threaded rod is mounted on CHS 60.3 OD x 4 HDG. The 4mm thk x 160W x 75H “U” MS plate @ 15 degree slope with 4mm thk triangular stiffener welded to the threaded rod is mounted on adjustable “U” head jack. The main horizontal support for the entire system is RHS 100x40x4 HDG main frame, which is fixed onto 4mm thk x 160W x 75H “U” MS plate @ 15 degree slope via 2 nos of M12 bolt HDG.

[0008] Drawing No.: ZC-03 (Detail B), to achieve 100% water tightness for this entire roofing system, 0.24mm thk colourbond corrugated roof sheet (to act as protective roofing sheet) is being used and shall be mounted at underside of secondary frame consisting of RHS 60x40x4 HDG @ 600 C.C. This system is applicable for those HDB flats, private housing, commercial buildings or statutory buildings where waterproofing re-roofing is necessary at every 10 to 13 years cycle. However, for those buildings where no waterproofing re-roofing is necessary, 0.24mm thk colourbond corrugated roof sheet (to act as protective roofing sheet) shall not be required but the whole photovoltaic roofing system built up shall remain the same. The secondary frame (RHS 60x40x4 HDG @ 600 C.C), is mounted on main frame (RHS 100x40x4 HDG) via 6mm thk x 60W x 60H cleat @ 600 C.C MS plate HDG.

In order to prevent corrosion between mild steel structure and aluminium structure, 0.8mm thk PTFE membrane is laid over secondary frame (to act as metal separator between mild steel secondary beam and aluminium guard rail).

[0009] Drawing No.: ZC-03 (Detail B), a special system (Guard Rail) is used to bind all PV solar panel in a uniform horizontal level with 15 degree slope. PV solar panel is inserted into the guard rail and slotted to position until each panel is packed horizontally at edge to edge and forming a roof coverage area. There are 2 special guard rails in our design; namely the guard rail (half) and guard rail (full) refer to Drawing No.: ZC-07.

[0010] Drawing No.: ZC-04 (Section –XX), shows a typical section of how the PV solar panel is being slotted into the guard rail (refer to Drawing No.: ZC-07, guard rail (full), guard rail (half), rear face fascia and front face fascia).

[0011] Drawing No.: ZC-04 (Section –XX), all guard rails is used to hold both length of the PV solar panel on each side and fastened with M5 self tapping screw whereas on both width of the PV solar panel, a stationary flat is inserted to close the gap between both PV solar panel.

In order to form water tightness between the gaps of the PV solar panel, high sun heat resistance silicon is being used to fill up all gaps around guide rails and stationary flat.

[0012] Drawing No.: ZC-05 (Typical Detail of Adjustable Prop Support), adjustable prop is used due to vary building roof profile, such as there may be other M&E services on the existing or new roof top. The adjustable prop enables the whole secondary roof (PV solar panel) to rise to any desired height. The adjustable prop is applicable to the construction of secondary roofing.

[0013] If the photovoltaic solar roofing system is to be used as main roofing, then the adjustable prop shall be replaced with fixed height concrete column or RHS MS hollow section or “I” beam.

[0014] Drawing No.: ZC-06 (Plans, Section And Blow Up Details), the whole design as shown in Plan, Section A, Section B, Detail A, Detail B, Detail C, Detail D and Detail E and its component shall form an integral part of our photovoltaic solar roofing system. Typically, the secondary roofing system shall have two (2) main components to form 100% water tightness throughout the life span of at least 20 years (before replacing solar panel at 25 years). The 2 components are high sun heat resistance silicon to seal the gaps of the guard rail and stationary flat, and 0.24mm thk colourbond corrugated roof sheet (to act as protective roofing sheet) is being used and mounted on underside of secondary frame consisting of RHS 60x40x4 HDG @ 600 C.C.

In the event after 10 years if the high sun heat resistance silicon fails, the protective roofing sheet can still acts as a secondary protection to collect and drain off rain waters.

If the existing building concrete flat roof is already waterproofed and no re-waterproofing is required during the whole building life cycle, then our photovoltaic solar roofing system could still be applicable except the removal of protective roofing sheets since waterproofing is not necessary. However, our PV solar panel system could still enhance thermal insulation within the building and at the same time harness the sunlight to generate some electrical power.

[0015] Gap or void between PV solar panel and 0.24mm thk colourbond corrugated roof sheet has the effect of creating thermal insulation by protecting the sun heat from transmitting into the concrete flat roof. If the photovoltaic solar roofing is used as main roofing, the building internal heat gain can also be reduced due to reduction in heat transmitted.

[0016] Drawing No.: ZC-07 (Plans, Section And Blow Up Details), the design of our component:- guard rail (half), guide rail (full), fixed plate, stationary flat, rear face fascia and front face fascia is critical in this photovoltaic solar roofing system. These special components bind the PV solar panel together horizontally with M5 self tapping screw and to slope at 15 degree. It enables rain water to flow smoothly on the PV solar panel surfaces and drain off free fall, no water stagnant as the whole

system is integrated to cover the whole roof thus resolving any existing uneven concrete roof top surface where rain water may pond.

[0017] Drawing No.: ZC-07 (Plans, Section And Blow Up Details), the guide rail (half) and guide rail (full) is used for PV solar panel (1640 x 992 x 40mm thk) to slot into position. Both guide rail (half) and guide rail (full) is being fastened via fixed plate fixed with self-fastening bolt onto secondary frame. “T” Stationary flat (992mm L) is then being inserted to both width of PV solar panel.

For both guard rail (half and full), there are holes for M5 self tapping screw. The PV solar panel is slotted into position followed by drill M5 holes on the PV solar panel aluminium frame as per prefabricated guard rail holes @ 820mm centre to centre. Each PV solar panel length, there are 2 nos of M5 self tapping screw to fasten the guard rail and length of PV Solar panel together on both sides. All PV Solar panel is being fastened on the guard rail via M5 self tapping screw.

[0018] Drawing No.: ZC-07 (Plans, Section And Blow Up Details), the Rear Face Fascia and Front Face Fascia (both overall length 996mm) is used to cover the width edge of the PV solar panel. From the perimeter of the whole roofing system, both sides lengthen is covered with guide rail (half), the other both side width is covered with Rear Face Fascia and Front Face Fascia. This enables the whole system perimeter to look uniform and at the same time clamp the four (4) sides of the roofing system/ perimeter of the roofing system to avoid any panels from falling loose.

There are M5 self tapping screw hole at 820mm centre to centre on guard rail (half) and guard rail (full), this enables to fix the slotted PV solar panel onto all guard rails with M5 self tapping screw. Similarly, there are also M5 self tapping screw hole at 820mm centre to centre on Rear Face Fascia and Front Face Fascia, this enables to cap the width of the PV solar panel.

Drawing No.: ZC-06, Detail A, indicates the Rear Face Fascia is capped at 20mm above the protective metal roofing sheet which allows rain water to drain off should there be a leakage of rain water into the gaps of the high sun heat resistant silicon after 10 years. Detail B, indicates the Front Face Fascia fully capped onto the PV solar panel and the protective metal roofing sheet.

[0019] Our roofing design, photovoltaic solar roofing system can maximise the usage of the whole roofing area to harness sunlight for electricity power. At the same time, it is forming a secondary roofing or main roofing where people could still do their normal activities within. Our Photovoltaic solar roofing system can be installed in HDB multi-storey car park/ Commercial building car park to generate solar power for electric car in the near future. Alternatively, this system could also be used as linkway or walk way shelter cover or any outdoor shelter area.

[0020] The photovoltaic solar roofing system with colourbond corrugated roof sheet attached on secondary beam could also act as ceiling for the proposed new building.

[0021] The whole installation procedure is in PDF format for reference.

Claims

1. The PV solar panel (size: 1640x992x40mm thk) consisting of Mono-Crystalline/ Poly-Crystalline cells is used to act as a main roof/ a secondary roofing system. The system creates the function of providing waterproofing, enhance thermal insulation comfort and generate electricity for usage.

2. The PV solar panel is arranged in horizontally slope at 15 degree to cover the entire roofing and high sun heat resistance silicon is being used to fill up all gaps around guide rails and stationary flat. This enables our roofing system to form 1st layer of water tightness against rain water.

3. The 2nd layer of water tightness is through the usage of 0.24mm thk colourbond corrugated roof sheet or any other metal roofing sheets available in the market and is arranged and fixed horizontally at underside of the secondary frame so as to further enhance water tightness for the whole roofing system.

4. The gap between PV solar panels and 0.24mm thk colourbond corroguted roof sheet is about 100mm, this creates an air circulation space within to reduce heat transmitted from sun. The whole elevated PV solar panels also create a shelter for the entire roof to protect it from rain and shine.

5. The whole new or existing roofing system can be covered with PV solar panel. If there is any shadow from the adjacent building or objects casted partially on our photovoltaic roofing system, blank (“dummy”) PV solar panel without solar

cells shall be used for those areas without sunlight and shall not be linked into the circuit. Other areas with normal sunlight where there is no obstruction on the PV solar panels, these normal PV panels receiving sunlight shall be linked into the circuit to generate electricity.

6. This PV solar roofing system can act as fully integrated waterproofing system, and can be used to replace current HDB flats re-waterproofing/ re-roofing system.

7. If the current HDB flats or proposed new HDB flats does not require re-waterproofing/ re-roofing system, then our PV solar roofing system can still be applicable except to omit the 0.24mm thk colourbond corroguted roof sheet during installation.

8. The guide rail (half), guide rail (full), fixed plate, stationary flat, rear face fascia and front face fascia is used to bind individual PV solar panel together to form a PV solar panel roofing system. Our component design shall form an integral part of this design to hold the PV solar panel horizontally at slope 15 degree and enabling rain water to free fall and drain off from the PV solar panel surface.

9. The adjustable prop support consisting of CHS 60.3 OD x 4 HDG is specially designed to hold the whole PV solar roofing system horizontally at slope 15 degree. It enables the installer to adjust to the required height so that the PV solar panel can be elevated above the RC roof slab to avoid any existing

M&E services; and thus allows human movement under the PV solar system to gain access to any parts of the roof for maintenance.

10. Our whole system could also be used as main roofing, under such circumstance, the adjustable prop shall be replaced with fixed height concrete column or RHS MS hollow section or “I” beam.

11. The PV solar roofing system with colour corrugated roof sheet attached on secondary beam could also act as ceiling for the proposed new building using this system as main roofing.

Abstract

There are 9,300 existing HDB residential blocks currently, about 6,000 blocks built prior to 1998 have roofs that come with a waterproofing membrane applied to the main reinforced concrete roof deck and laid with another layer of secondary roof slab (ferro cement slab acting as thermal insulation), the remaining 3000-plus blocks built after 1998, only the secondary roof slab is installed to serve thermal insulation function. Those housing built after 1998 only needs minimum roofing maintenance as compare with the earlier batches of housing.

This photovoltaic solar roofing system may be a long term solution to improve current public roofing system. It is now timely, and considering the fact that initial investment cost of solar power has now dipped drastically and pricing is affordable for all. We are confident that ultimately solar power investment cost and electricity tariff rate will reach almost on parity, making mass implementation of this photovoltaic solar roofing system as secondary roof or main roof to be very attractive.

Our design of this roofing system is focus on resolving the current issue of 6,000 blocks of HDB flats having to do re-waterproofing carried out every 10 to 13 years. As for the remaining 3000-plus blocks, this roofing design is still applicable except without installing protective roofing sheet. This photovoltaic solar roofing system is applicable to any reinforced concrete flat roof of any buildings.

This system can also be constructed and served as main roofing for any proposed new housing building or commercial building. This system can create cost saving in

overall building construction cost. For the purpose of functioning as main roofing, the adjustable prop shall be replaced with fixed concrete column or steel column.

We have designed this photovoltaic roofing system to address all issue of re-waterproofing at every 10 to 13 years cycle, minimise maintenance cost within 25 years, low cost, achieve thermal insulation comfort, easy installation and replacement, can generate some electricity power for usage and feasible for mass implementation on public housing, private housing, commercial building and statutory building, Multi-storey Carpark, linkway, walk way shelter cover and any outdoor shelter area.

FIGURE FOR PUBLICATION

Drawing No.:ZC-01 (PV Solar Framing Plan For Concrete Flat Roof) show one complete installation of our system for reference and publication.