

SINOLTECH FLEX PV CASE STUDY AND SYSTEM DESIGN



SINOLTECH COOPERATION WITH HANERGY:

SINOLTECH becomes authorized cooperater of Hanergy in year 2015. Representing brand “Global Solar”, “Miasole” and “Solibro” CIGS Modules in overseas market. Now our ODM factory is located in Zibo, Shandong province, ranging in capacity from an annual output of 30MW of up to annual output of 300 MW in 2020.

SINOLTECH is professional in designing custom-made projects with Flex PV BIPV solution. Our experienced engineering and training team is available from pre-design, installation, after sale maintenance, providing whole process tracking services. We are also available to help with upgrades and troubleshooting should any problems occur.

Our professional product knowledge, quick customer response, responsible after sale service will make your whole purchase process worry-free!

About Us

Introduction:

As a leading designer and supplier for high quality Solar Lighting products ever since 2013, SINOLTECH always focus on customer needs. Sinoltech has obtained 2 patents on Flex PV prebonded solar street post and Cylinder PV vertical solar street light, in order to integrate solar into building, realizing the aesthetics and harmony between Solar and Street Furniture.

Corporate Culture:

01. Quality ensured
02. Keep improving
03. Efficiency matters
04. Open Horizon



SINOLTECH Advantages:

01. Strict Quality Control System

Our strict quality inspection standard ensures systematic quality inspection process, reduces error rate to the minimum.

02. Profession in Technical Support

Our technical team consists of over 30 senior engineers in electronics, intelligent software and lighting design.

Strong technical support team ensures professional pre-sale and after-sale services, and provides solid technical base for cooperation.

03. Efficient communication

Experienced sales team provides most efficient sales services higher than the overall industrial standard. Solution is made upon customers' demand. Meeting the multiple demands from different applications.

04. Design and Innovation

SINOLTECH never stops innovation. We have achieved the national patents on "Flex PV integrated Street Post" and "Cylinder PV support Vertical Street Light". We are always focusing on BIPV, integrating solar with building to achieve the best energy saving and architectural aesthetics, and we will keep on doing this in future.



The Leader In Flexible, Powerful, Lightweight and Shatterproof Thin-Film Solar

MiaSolé is the producer of powerful, lightweight, shatterproof and flexible solar cells. The innovative solar cell is based on the highest efficiency thin-film technology available today, and its flexible cell architecture makes it ideal for a wide variety of solutions ranging from off-grid transportation solutions to commercial roofing solar panels to flexible mobile devices.


Why flexible Solar:


Flexible lightweight shatterproof solar cells and modules can go where rigid breakable glass modules can't. This makes it possible to add solar energy generation to curved surfaces, vehicles, structures such as carports and storage facilities, floating reservoir covers, landfill membrane covers, low load capacity roofs, as well as mobile devices and many other applications.


How do we do it?


We begin with high-grade stainless steel foil and use an advanced semiconductor deposition process, PVD, to produce the most controlled, stable, and powerful flexible stainless steel CIGS cell in the world. Once the cell structure is deposited on the foil, special transparent conductive oxides are applied, and a specialized plastic-cell interconnect meshwire system is laminated to the cell, which is in turn protected by special water barrier plastics. The transparent water barrier is key to the longevity of MiaSolé FLEX modules. The special plastic back sheet has an internal aluminum film to prevent water transmission from eroding the powerful stainless steel CIGS cells.

Flexible Solar Benefits


 **Lightweight:** Less than 2.4 kg/m² (<0.5 lb/ft²). Because MiaSolé flex modules are so much lighter than heavy rigid silicon panels mounted with racks, they are the best solution for building structures with low dead load and environmental load limitations (such as snow). The modules are also ideal for other structures, such as autos, trucks, and RVs, that are not constructed to support the weight of traditional solar panels.


 **Powerful:** MiaSolé FLEX modules are the highest efficiency flexible thin-film CIGS modules in production today, providing the highest power density per kilogram in a commercially available solar module. Our aperture efficiencies are as high as 17%, providing over four times the power generation per kilogram of silicon. In the future, efficiencies of up to 20% are expected.

 **Easy to Install:** MiaSolé FLEX modules use peel-and-stick application. This eliminates penetrations into the structure, reducing the chance of leaks. Peel-and-stick application also allows for installation on surfaces such as autos, trucks, and RVs where racks would not be feasible, and lowers the balance-of-systems (BOS) costs and complexity when mounting FLEX modules on rooftops.

 **Flexible:** MiaSolé FLEX modules conform to curved surfaces, enabling solar power generation on surfaces not suited to traditional rigid silicon panels.

 **Shatterproof:** FLEX modules are shatterproof, and won't break if struck by debris.

 **Resistant to Natural Disasters:** MiaSolé modules are thin (2.5mm) and adhere directly to surfaces, providing excellent wind and seismic resistance.

 **Reliable:** MiaSolé modules' unique redundant interconnect design enables industry-leading reliability.

Solution of Flex PV on transportation

The application of apply flexible solar panel onto transportation solution is comprised of solar solar modules and a charge controller that ensures you receive the maximum benefit from your solar investment.

Advantage:

The auxiliary power from Flex PV system allows you to:

01. Reduce Fuel Consumption. Use solar energy instead of gas to power auxiliary systems
02. Reduce Maintenance Costs. Running the truck engine less results in decreased intervals for scheduled maintenance.
03. Reduce Emissions. Using clean solar power instead of fuel reduces emissions to help truckers comply with environmental regulations
04. Provide Stand-by Power. Use solar energy for standby power without running the engine.
05. Provide Power to Truck De-icing Systems. De-ice the truck with solar energy instead of fuel

Power many systems:

01. Safety Lighting. Supply power for safety lights on light duty road construction and service vehicles..
02. Liftgate. Supply auxiliary power to liftgate batteries ensuring gate operation through the full delivery cycle and a decrease of tractor or reefer charging, resulting in reduced fuel consumption and extended battery life.
03. No-idle HVAC. Eliminate fuel consumption associated with diesel-powered APUs.
Reduce additional load on engine alternator resulting in decreased fuel consumption and lower engine maintenance cost.
04. Refrigeration. Supply power to keep cold-plate storage systems charged or to run evaporator fans while in operation, resulting in extended daily range, reduced fuel consumption, and lower engine maintenance cost.

Components:

- FLEX solar modules
- Charge Controller
- Cables

Why Choose Flex Solar Modules?

The FLEX Series module is a CIGS-based flexible thin-film solar module that is thin, flexible, shatterproof and provides one of the highest efficiencies on the market today, at up to 17%.

The kits include a range of sizes and powers of FLEX modules to accomodate various cab sizes and help you acheive your goals. FLEX modules provide the following benefits for transportation:

01. Adhere directly to the roof with no roof penetrations, eliminating the risk of leaks
02. Thin modules offer superior wind resistance
03. Shatterproof and durable
04. Low installed weight at less than 2.0 kg/m² (<0.5 lb/ft²)
05. Bypass diodes reduce PV system shading losses
06. Record efficiency levels

Customizable

FLEX modules are available in a variety of lengths and widths, providing a customized solution for your cab, trailer or box truck.



Recommend Kit Configuration:

	75W Trickle Charger	150W Lift-Gate	170W APU	225W APU	500W APU
Modules	1 FLEX-03NS 75W	2 FLEX-03NS 75W	1 FLEX-03WS 170W	3 FLEX-03NS 75W	1 FLEX-03W 500W
Charge Controller	8 Amp	10 Amp	15 Amp	20 Amp	60 Amp
Cables	As Required				

Custom Solutions Available

Case Study of Flex PV on transportation



Location	Norway
Installation size	1.2kW per Bus
Application Area	Bus Roof
Installation	2018

Location	Taiwan, China
Installation Size	1.5kW/Truck
Application Area	Truck Roof
Installation	2015



Location	India
Installation Size	5kW
Application Area	Train Roof
Installation	2016

Solution of Flex PV on carport

The installation of solar (photovoltaic or PV) carports on both private- and public-owned parking lots provides a new and cost-effective opportunity for generating clean, renewable energy without consuming additional land resources. Solar PV carports can provide far more power generation area compared to the more limited rooftop surface commonly used for many solar installations.

Parking lots, in general, have more solar potential and less shading issues than rooftop solar and can be easier to install than rooftop solar installations and be less disruptive to the facility. Two additional advantages to mounting solar on carports versus roof-mounted solar arrays include no roof penetrations, which increase exposure to potential water leaks, and the ability to avoid additional roof inspection or engineering and repair costs regarding the age, service life and integrity of the building's roof.

Solar PV parking canopies offer the parking lot owner and the environment considerable value:

- 01.Highly desirable shade for parked cars, providing increased owner comfort and a lower carbon footprint when the car is started and cooled
- 02.Rain, snow and hail protection
- 03.Protection from hail damage
- 04.Reduced UV exposure
- 05.Reduced parking lot temperatures and heat island effect
- 06.Low-cost renewable power generation
- 07.Low power distribution and energy transmission cost for the utilities.
- 08.Improved municipal energy independences
- 09.Large power generation area when compared to traditional roofs
- 010.Fewer engineering and inspection challenges than traditional rooftop solar installations
- 011.Fewer shading issues than traditional roofs



Lightweight Flexible Solar vs. Glass:

Traditionally most solar carports use conventional heavy glass crystalline solar modules installed on rails over large heavy gauge structural steel building components requiring large support columns with deep concrete piers or large ballast blocks. Even carports designed and built using architectural metal panels require additional heavy gauge structural steel, railing and roof clamps, all adding weight and cost to the solar carport.

Sinoltech Miasole thin film flexible modules offer the same high efficiency power output as standard crystalline modules while weighing less than 0.7 lb/sf vs the 3-5 lbs. /sf for crystalline modules.

The lighter weight of the flexible solar modules means less structural steel is required in the carport design, which means less cost and faster construction time. Solar carports constructed with the flexible solar module can use light-gauge roll-formed steel, which allows the support columns to be placed further apart, creating a more open design.

Good wind and seismic performance engineering is important to carport design. With traditional glass modules, there is concern about the stresses of wind and seismic movement. In addition, purlins can sag when support columns are placed far apart, impacting glass module and rail attachment. Architectural metal panels with flexible solar modules provide stiffer support surfaces, can span wider distances, and are engineered for good wind and seismic performance while using lighter structural support.

Case Study of Flex PV on carport

Installing Solar Modules onto Existing Carports

Many facility owners have existing carports without solar. Owners often want to retrofit these existing carports, only to realize that the original design and construction will not support the additional weight of convention crystalline modules. Until now, the only option was to tear down the existing carport structure and to design and rebuild the carport to support conventional solar.

SINOLTECH Miasole flexible and lightweight thin-film solar modules can be installed over existing carports constructed with architectural metal panels and some square rib corrugated metal panels without affecting the current weight limitation design. On carports with non-compatible metal panel profiles, these metal panels can be removed and replaced with new architectural metal panels without having to modify the existing support structure at a cost lower than full replacement. SINOLTECH flexible solar modules can be installed on site, requiring fewer installers and equipment, speeding up both new construction and retrofit installations, all at a lower cost.

Miasole Flex PV Benefits:

01. Lightweight: less than 2.0 kg/m² (<0.5 lb/ft³)—Ideal for today's cost-optimized carport structures
02. Easy to install—simply peel-and-stick
03. No need for ballast or penetrations into the carport roof
04. Resistant to wind and seismic events - won't detach or shatter if struck by debris
05. Flexible modules conform to unique architecture
06. Blends into the carport; does not protrude above the carport structure
07. Left and vandalism resistant



Installation size	1.5kW
Application Area	Carport Roof

Installation size	25kW
Application Area	Carport Roof
Installation	2017, Qatar



Installation size	6.3kWh
Application Area	Carport Roof
Installation	2015, CA

Installation size	19kWh
Application Area	Carport Roof
Installation	2015, GA

Case Study of Flex PV on carport

A New Approach to Converting Existing Carports to Solar Carports with Flexible PV Modules

By Michael Gumm, Application Technologist, MiaSolé

Rooftop solar has become commonplace on commercial buildings and homes. While often times a residential home has sufficient roof top area to power the home 100% with solar, this is not always true with multi-story commercial buildings, apartments, and condominiums. The properties often do not have the necessary roof space to offset their energy needs with solar. This situation can also apply to low-rise buildings with high electrical usage (i.e. factories, big box stores and warehouses).

Carports have become a standard feature on many commercial and multi-family properties, and even those buildings without carports have parking lots with space for them. Carports provide users the benefit of shading cars and protecting cars and people from rain and snow. Carports keep cars cool, reducing the power required to air condition them when they're started, and reduce sun damage to the car finish. From an environmental standpoint, carports help mitigate the heat island effect in which large concrete and asphalt parking lots absorb heat during the day and release the heat at night. This additional heat can drastically change local weather patterns, especially in metropolitan areas.

In recent years, building owners have been installing new carports with solar PV modules. These solar carports have all the benefits of traditional carports with the added advantage of producing clean renewable solar energy while reducing the need to add rooftop solar to buildings.

In many places, existing carports were designed and built with minimal steel support structures and the metal roof and deck panels are already spanning the maximum distance between supports to keep cost down. Most were built to meet the minimum local wind and live-load code requirements. With the cost of solar installations falling, utility energy costs rising, and increased interest in improving the environment while reducing a building's carbon footprint, building owners are interested in retrofitting their existing carports with solar modules.

Unfortunately, many of these existing carport structures cannot support the additional four to six pounds-per-square-foot weight of standard crystalline PV modules and associated racking and rails. The only solution available to the owner is to structurally upgrade the carport or tear it down and replace it with a carport designed for the extra weight of solar. Even if the existing carport structure can support the weight, retrofitting the carport with solar can be technically challenging and expensive. MiaSolé has developed two solar application solutions to solve the live-load limitations of many existing carports. MiaSolé manufactures a flexible lightweight high-efficiency (16+ %) CIGS-based flexible PV module weighing less than 9 ounces per square foot in two format sizes: the narrow format FLEX-N series designed for traditional architectural standing seam metal roof panels, and the wide format FLEX-W series. Both applied to the carport roof with a simple peel-and-stick adhesive.

Two roofers can easier apply the FLEX W series to the existing carport metal panels:

- The existing carport is power washed to remove any dirt and debris from the metal roof surface.
- Any loose metal panel fasteners are tightened and missing fasteners replaced.
- The areas where the FLEX modules are to be installed are cleaned again with rubbing alcohol.
- The FLEX modules are laid down across the corrugated ribs, and the adhesive strips are aligned with the ribs.
- On one end, the roofer lifts up the module, peels back the adhesive release film, lays the module back down on the 7.2 panel ribs and presses down to bond the module to the ribs.
- The second roofer on the other end repeats the same process.
- Both roofers finish bonding the module by rolling the adhesive areas with a silicone roller to ensure complete adhesion to the metal panel.

MiaSolé FLEX series PV modules make it possible to economically convert existing carports with live-load limitations into new solar carports without having to make any major structural modifications. Even on new solar carports, the MiaSolé FLEX series modules can reduce labor and construction cost by reducing the need for heavy steel support structures and allowing longer metal panels with fewer support purlins.

The simple peel-and-stick adhesive system reduces labor cost while speeding up installation time. Unlike conventional rigid crystalline panels, the flexible MiaSolé FLEX modules work over curved roof structures for solar carports, solar walkways, and solar awnings.



Solution of Flex PV on Commercial Rooftop

High Performance Thin Film Solar in a Lightweight and Flexible Form Factor

The FLEX solar panel product is the ideal solar solution for metal and low-slope commercial roofs. These panels are lightweight and can be directly bonded to both **metal** and **membrane system roofs** - eliminating the need for solar racking, reducing weight load and significantly lowering project costs. For metal roofs, the FLEX series PV modules can be installed over a wide range of standard architectural metal roof panels, including flat and striated panel pans ranging from 16 to 36 inches wide. As an example, the FLEX Series modules can be directly applied to square rib corrugated panels to create solar parking canopies.

For today's advanced membrane roof systems, the FLEX modules bond directly onto the membrane, eliminating the need for solar racking, concrete ballasts, and roof penetrations. Integration of the low profile, thin film modules onto the membrane roof surface protects against seismic movement and high winds. The FLEX PV modules simplify project logistics and reduce labor costs and installation times. The final installed solar solution is lightweight, making it ideal for low weight bearing building structures.

Features and Benefits:

1. Factory Applied Self-Adhesive – Simple Peel-and-Stick Application
2. High power output under low light conditions
3. Lightweight
4. High Wind Zone Performance
5. Low Labor and Balance of System (BOS) Costs
6. Optional: Factory Laminated on Metal Panel for Rapid Installation
7. Optional: Field Applied Modules — On-site Roll Forming — Retrofit
8. Direct Bonding on Membrane Roofs from Some Roof Manufacturers
9. Optional: Secondary Membrane Panel Option for Older Membrane Roofs

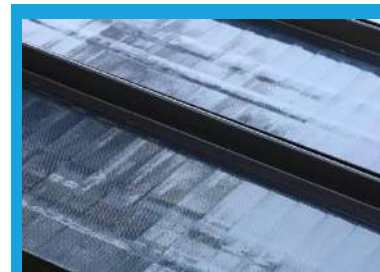
--Metal Roofing Systems with High Efficiency Thin-Film Solar Panel

High Performance, Flexible, Lightweight Thin-film Solar modules are the ideal solar solution for metal roofs. The modules are lightweight and can be directly bonded to the roof-eliminating racking, reducing weight load, and significantly lowering labor and project costs. SINOLTECH FLEX Solar modules can be installed over a wide range of standard architectural and specific exposed fastener metal roof panels. For example, the FLEX Series modules can be directly applied to industry-standard 7.2 trapezoid rib corrugated panels to create solar parking and RV canopies.

Features and Benefits:

1. Factory Applied Self-Adhesive-Simple Peel-and-Stick Application
2. Operating Efficiency is high
3. Lightweight-2.9 kg/m² (0.6 lb/ft²)
4. Provides Four Times the Wattage per Kilogram as Silicon
5. High Wind Zone Performance
6. Lowest Rooftop Solar Installation Cost
7. Optional: Factory-laminated on Metal Panels for Rapid Installation
8. Optional: Field-applied Modules and On-site Roll forming to Retrofit

Existing Roofs



Steep-slope Standing Seam



Residential Applications



Solar Parking Canopies

Solution of Flex PV on Commercial Rooftop

--Solar Engineered for Today's Membrane Roof Systems

High Performance Solar Roofing in a Lightweight Format

The flexible solar modules are designed for low-slope commercial roofs-perfect for today's advanced membrane roof systems. The FLEX modules(FLEX-W Series) bond directly onto the membrane roof system, eliminating the need for solar racking, concrete ballasts, and roof penetrations. Integration of the low-profile, thin-film modules onto the membrane roof surface protects against seismic movement and high winds. The FLEX modules simplify project logistics and reduce labor costs and installation times. The final installed solar solution is lightweight, making it ideal for low-weight-bearing building structures.

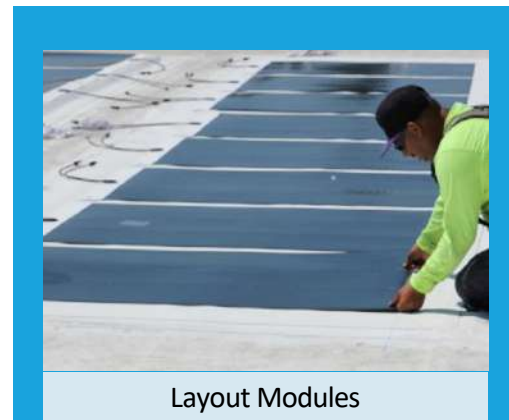
Features and Benefits:

1. Factory-applied Self-Adhesive-Simple Peel-and-Stick Application
2. Aperature Efficiency is high
3. Lightweight—2.4 kg/m² (0.5 lb/ft²)
4. Provides Four Times the Wattage per Kilogram as Silicon
5. High Wind Zone Performance
6. Low Labor and Balance-of-System (BOS) Costs
7. Direct Bonding on Certain Roof Membranes
8. Secondary Membrane Panel Option for Older Membrane Roofs

TECHNICAL INFORMATION

Recommend Series	FLEX-03W
Model No,	FLEX-03W 500W.520W
Length	2583 mm (101.8 in)
Module Thickness	2.5 mm (0.1 in)
Weight	6.6 kg (14.6 lb) with adhesive
Weight/Area	2.0 kg/m ² (0.4 lb/ft ²) with adhesive
Junction Box Type	IP68
Cable Connections	Compatible MC4
Cell Type	Copper Indium Gallium Selenide (CIGS)
Bend Radius	250mm in minimum
Warranty*	5 year workmanship; 10/25 year power output
Package information	5 modules per crate, 40 modules per pallet, 320 modules per 20' ISO container, 640 modules per 40' ISO containe

- * Low weight
- * No ballast or racking
- * No module grounding
- * Non-penetrating
- * Building-integrated PV module
- * Designed for high wind and seismic zones



Layout Modules



Clean & Prep Membrane Roof



Peel & Stick Modules to Membrane

Case Study of Flex PV on Commercial Rooftop



Application	Evalon Membrane Roof
Installation size	150 kWp
Installation	2018, Netherlands

Application	Metal Roof
Installation size	50 kWp
Installation	2015, Netherlands



Application	Corrugated Metal Roof
Installation size	6 kWp
Installation	2015, Australia

Application	Metal Roof
Installation size	17.5 kWp
Installation	2016, UK

Case Study of Flex PV on Commercial Rooftop



Application	TPO Roof
Installation size	15 kWp
Installation	2014, USA



Application	TPO Roof
Installation size	1 kWp
Installation	2014, USA



Application	Stand seam Metal Roof
Installation size	1.5 kWp
Installation	2015, UK



Application	Metal Roof
Installation size	27.4 kWp
Installation	2016, Finland

Back adhesive brand:
HelioBond_PVA_600BT_R7
Fully Sticky



Flexible PV for Residential Rooftop

High Performance Thin Film Solar for Residential Rooftops

The Thin Film Flex Series solar modules are designed for building integrated solar applications over a wide range of residential standing seam metal roof panels. SINOLTECH's FLEX series solar panels can be applied onsite and are available factory laminated onto metal roof panels to reduce onsite labor cost. Unlike conventional glass modules and rack systems that cover the metal roof, the SINOLTECH flex series solar modules bond directly onto the metal roof panel and blend in with architectural standing seam panels preserving the visual look and design of the architectural metal roof panels. Without heavy and expensive solar racking, roof penetrations are eliminated and the reduction in weight load significantly lowers project costs and stress on the roof and home. In addition, since the roof and the solar system are now one BIPV (Building-integrated Photovoltaic) product, project logistics are greatly simplified, and installation labor costs and time are reduced. Integration of the low profile, BIPV roof modules onto a residential roof surface protects against seismic movement and high winds.

The final installed solar solution is lightweight, maintains normal roof warranty, and is ideal for low weight bearing building structures.

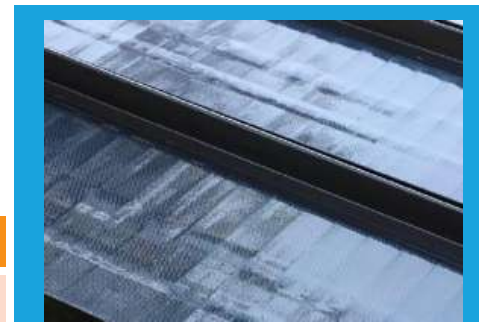
Features and Benefits:

- Factory Applied Self-Adhesive-Simple Peel & Stick Application
- Efficiency Rating +17.5%
- Lightweight - 0.7 lb/ft²
- High Wind Zone Performance
- Low Labor and Balance of System (BOS) Costs

TECHNICAL INFORMATION

Recommend Series	FLEX-03N	FLEX-03NL
Model No,	110W-130W	260W-290W
Length	2583 mm (101.8 in)	5905 mm (232.5 in)
Module Thickness	2.5 mm (0.1 in)	2.5 mm (0.1 in)
Module Thickness	2.5 mm (0.1 in)	2.5 mm (0.1 in)
Weight w/adhesive	2.3 kg (5.0 lb)	4.9 kg (10.8 lb)
Weight/Area	2.6 kg/m ² (0.5 lb/ft ²)	2.4 kg/m ² (0.5 lb/ft ²)
Cable Connections	Compatible MC4	Compatible MC4
Cell Type	Copper Indium Gallium Selenide (CIGS)	
Bend Radius	250mm in minimum	
Warranty*	5 year workmanship; 10/25 year power output	

- *Integrated profile for aesthetic appeal
- *Low installation cost
- *Four times lighter than silicon solar panel solutions
- *Superior resistance to wind



Steep-slope Standing Seam



Residential Applications



Solar Parking Canopies

Case Study of Flex PV on Residential Rooftop



Application	Metal Roof
Installation size	9.7 kWp
Installation	2019, USA



Application	Standing Seam Roof
Installation size	2 kWp
Installation	2015, USA



Application	Metal Roof
Installation size	2 kWp
Installation	2013, Australia



Application	TPO Roof
Installation size	24 kWp
Installation	2015, Costa Rica



Application	Metal Roof
Installation size	12 kWp
Installation	2017, USA



Application	Bituminous waterproofing membrane
Installation size	5.92 kWp
Installation	2016, Italy

Case Study of Flex PV on Residential Rooftop



Application	Standing Seam Roof
Installation size	5 kWp
Installation	2017, Finland

Flexible PV for Marine Application

Marine

The low-profile SINOLTECH FLEX solar modules offer superior performance in high-wind environments, making them an ideal solution to provide solar power on boats.

The low-profile unobtrusive design also maintains the aesthetic appeal of the boat. The panels are so lightweight that they do not require retrofitting the boat structure for support, and they can be easily mounted and removed.

The high efficiency rating of > 17% enables the highest energy production possible in a flexible panel, crucial on a boat with little free space.



Application	On Boat
Installation size	500 Wp
Installation	2015



Application	Metal Roof
Installation size	6.7 kWp
Installation	2016

Flexible PV for Landfill Covers

Landfill Cover

Solar Landfill Cover Benefits:

1. Landfills are located on large, open areas with no commercial or agriculture use or value perfect for solar installations.
2. Closing and sealing landfills with a synthetic TPO membrane cover reduces costs compared to conventional standard methods.
3. Flexible modules can be bonded directly to the membrane cover, providing power generation capability.
4. Membrane covers and flexible modules are a perfect combination for sloped landfill sites where conventional solar arrays cannot be installed due to slope and live-load limitations.
5. Large power-generation area and fewer shading issues when compared to rooftop solar.
6. Excellent complement to landfill gas technology to increase overall energy output.

FLEX modules provide the following benefits when used on landfill covers:

- Easy to install: simply peel-and-stick module onto the membrane used to contain, cover and close the landfill
- Non-penetration installation protects the environment
- Flexible: conforms to the contours of the landfill and accommodates differential settlement
- Resistant to theft and vandalism
- Wind and seismic resistant
- Shatter-proof: won't break if struck by debris

TECHNICAL INFORMATION

Recommend Series	FLEX-03W
Model No,	490W-520W
Length	2583 mm (101.8 in)
Width	348 mm (13.7 in)
Width	1292 mm (50.9 in)
Module Thickness	2.5 mm (0.1 in)
Weight w/adhesive	6.6 kg (14.6 lb)
Weight/Area	2.0 kg/m ² (0.4 lb/ft ²)
Cable Connections	Compatible MC4
Cell Type	Copper Indium Gallium Selenide (CIGS)
Bend Radius	250mm in minimum
Warranty*	5 year workmanship; 10/25 year power output



Flexible PV for Reservoir Covers

Lightweight Solar Modules for Reservoir Covers

Installing solar modules on reservoir covers allows reservoir owners and municipalities to generate power using the water surface area without consuming valuable land area for a solar array. Due to reduced evaporation, a 3-acre storage pond covered with a solar reservoir cover could save over four million gallons of water each year. In addition, solar reservoir covers ensure less water contamination and algae growth, minimizing water treatment costs.

Solar reservoir covers offer a large power-generation area and less shading issues when compared to rooftop solar. The cooling effect of the water also improves solar module performance. And for reservoir-based hydro power plants, solar power provides an ideal supplement to hydro-based power generation.

Solar Reservoir Cover Benefits:

1. Generate power using the water surface area without consuming valuable land area for a solar array
2. Reduced evaporation due to the solar covering a 3-acre storage pond covered with solar panels could save over four million gallons of water each year.
3. Less water contamination and algae growth, minimizing water treatment and associated labor costs
4. Large power generation area when compared to rooftop solar Modules are naturally cooled by the water for better performance
5. Fewer shading issues than rooftop solar
6. For reservoir-based hydro power plants, solar power can supplement hydro-based generation during the day when sunlight is available.

Flex solar module benefits:

Lightweight: less than 2.4 kg/m² (<0.5 lb/ft²) -Ideal for floating structures

Easy to install-simply peel-and-stick onto reservoir membrane

Resistant to wind,

Shatter-proof, won't break if struck by debris



Flexible PV for NON-ROOF SOLUTIONS

LED Lighting

For lighting applications, this means that the power generated by a flex panel is sufficient to power an LED streetlight for up to eight days, meaning even in times of inclement weather the light will be powered.

The Flex panels curve around the light pole structure, eliminating the need for a separate rack. Not only does this reduce the chance of vandalism and theft, but it preserves the aesthetic appeal of the light. In addition, the manner in which the FLEX panels lay on top of the cylindrical shape of the pole increases wind resistance. A traditional solar light with rectangular panel can only withstand 70 to 90 mph winds while a light powered by a flexible panel can withstand 150+ mph.

Because solar-powered lighting is self-contained, it is off-grid and can be used in remote installations and is unaffected by power outages.

Customer Challenge-

1. Provide outdoor lighting that preserves resources, has no moving parts and is virtually maintenance-free
2. Panels need to:
 - Generate sufficient power
 - Easily fit onto existing poles
 - Withstand the outdoor environment
 - Look good

Solution with flexible solar panels-

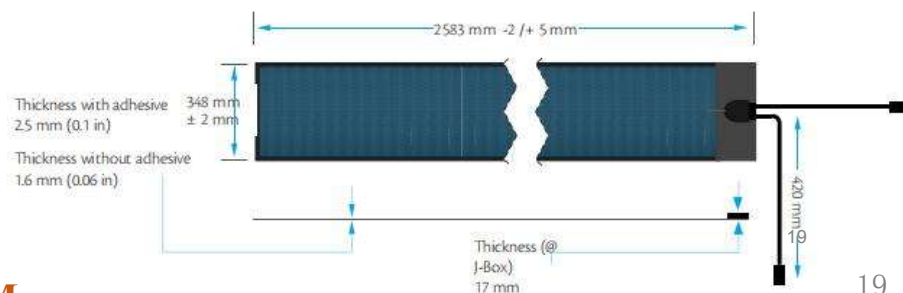
1. Flexible panels curve around light pole, preserving the look of the light
2. Lights can withstand 150+ mph winds and have low risk of theft and vandalism
3. Powerful enough to charge battery to power light for eight days



Benefits:

01. An ultimate lighting option to reduce operating costs for municipalities, while providing an environmentally friendly option.
02. Available option to operate off the grid, so a power outage won't leave residents in the dark.
03. Temper resistant
04. Flood and hurricane resistant
05. Eliminate carbon footprint

Recommended Model: FLEX-03N





Solar LED Streetlights in Extreme Weather for Gulf South



Solar LED Streetlights in Miami and Pompano Beach



Solar LED Streetlights in North Caroline and Virginia



Solar LED Streetlights in Canada

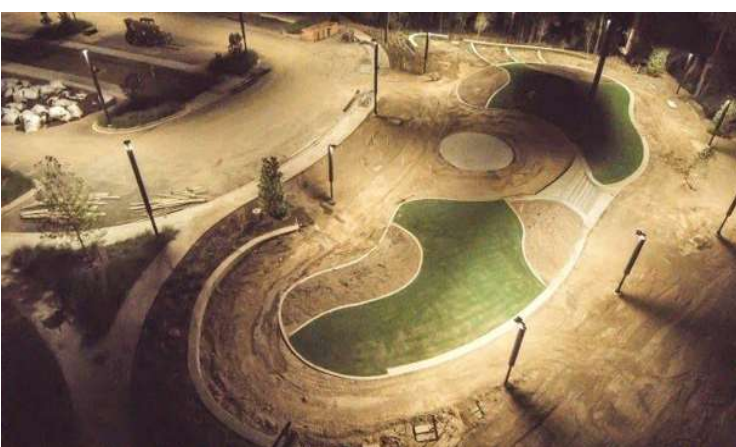
Case Study of Flex PV on LED Streetlight Pole



Solar LED Streetlights in Dubai, UAE



Solar LED Streetlights in Dubai, UAE



Solar LED Streetlights in Park of USA



Solar LED Streetlights in Community of Canada

Flexible PV for Greenhouse Solution

Greenhouses

Greenhouses are climate controlled environmental structures. With the integration of photovoltaic panels, LED lighting, heating and monitoring systems can be powered off-grid. This allows growers to fulfill green mandates and sustainability goals through carbon reduction and local sourcing. Adding photovoltaic panels to greenhouses also dramatically reduces lifetime building and energy costs.



Application	On Greenhouse Roof
Installation size	9W per sf
Installation	2016

Flexible PV for Bus Stop Shelter(Street furniture)



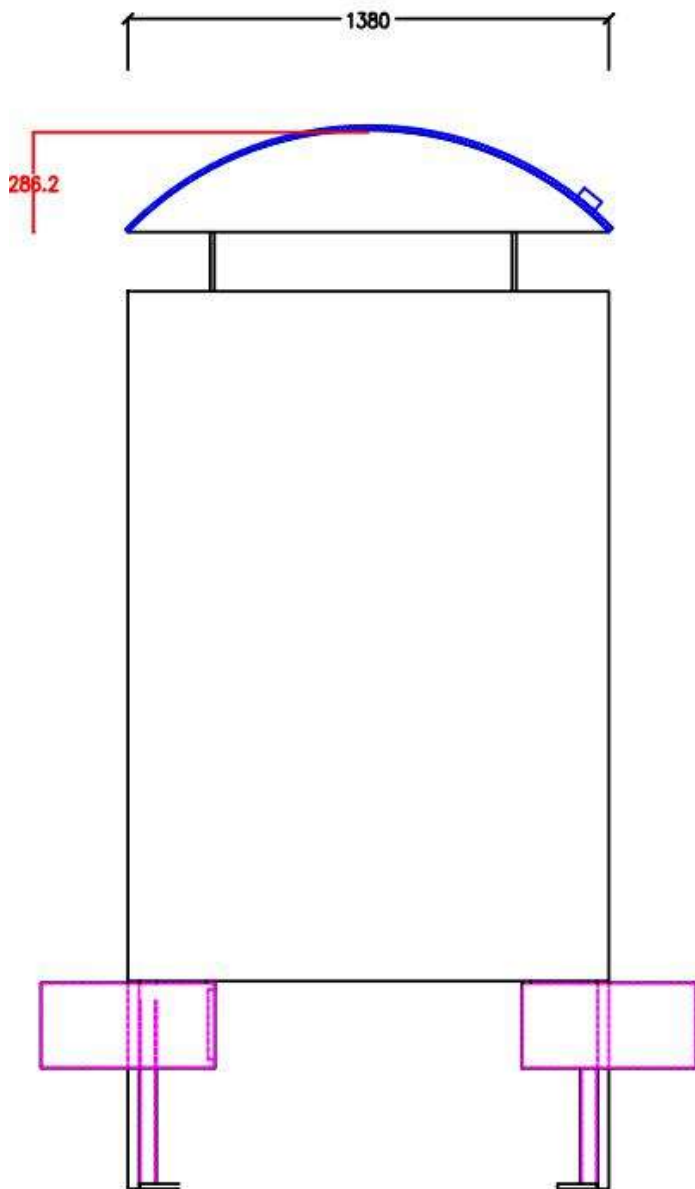
5G Smart Intelligent Bus Stop Solar Roofing System in CHINA



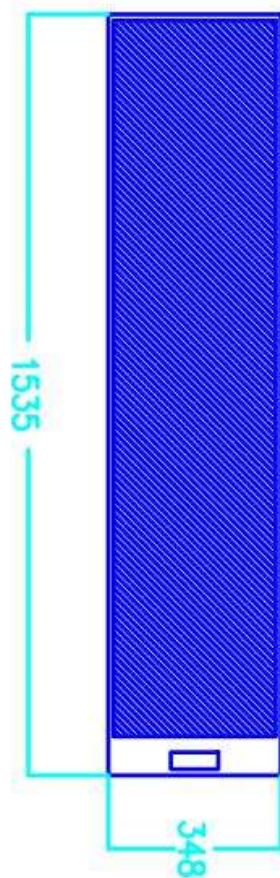
Custom-made FLEX PV Solution

Flexible Solar PV For Lighting Box Roof(Street furniture)

2PCS = 140Watt



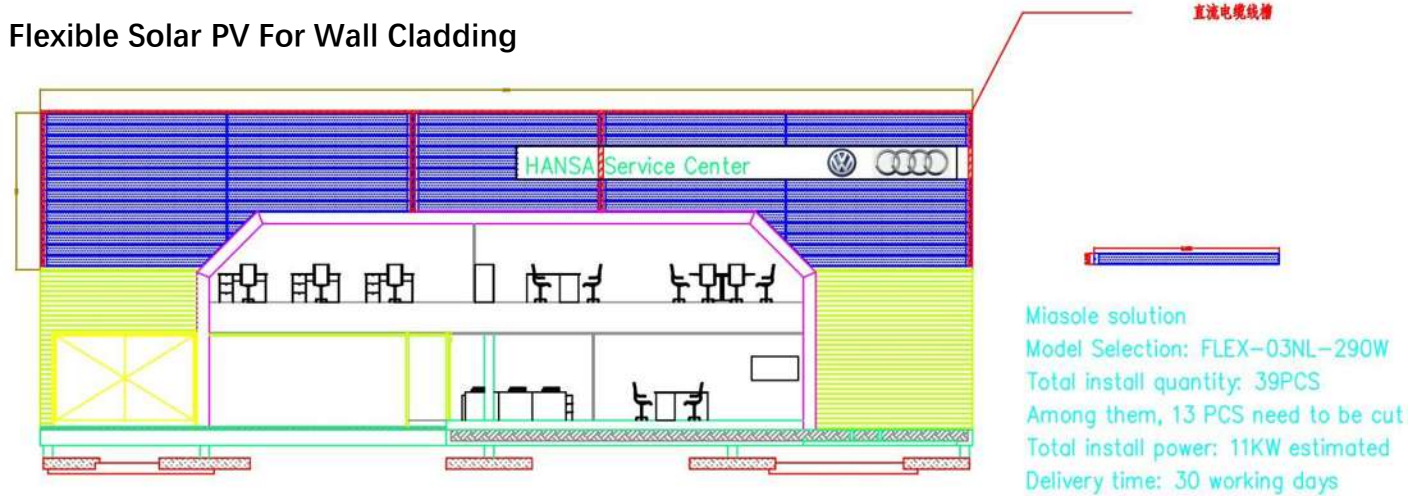
1PC = 70Watt



Model: 70W, FLEX-03NC
2PCS (total 140W) for each roof

Custom-made FLEX PV Solution

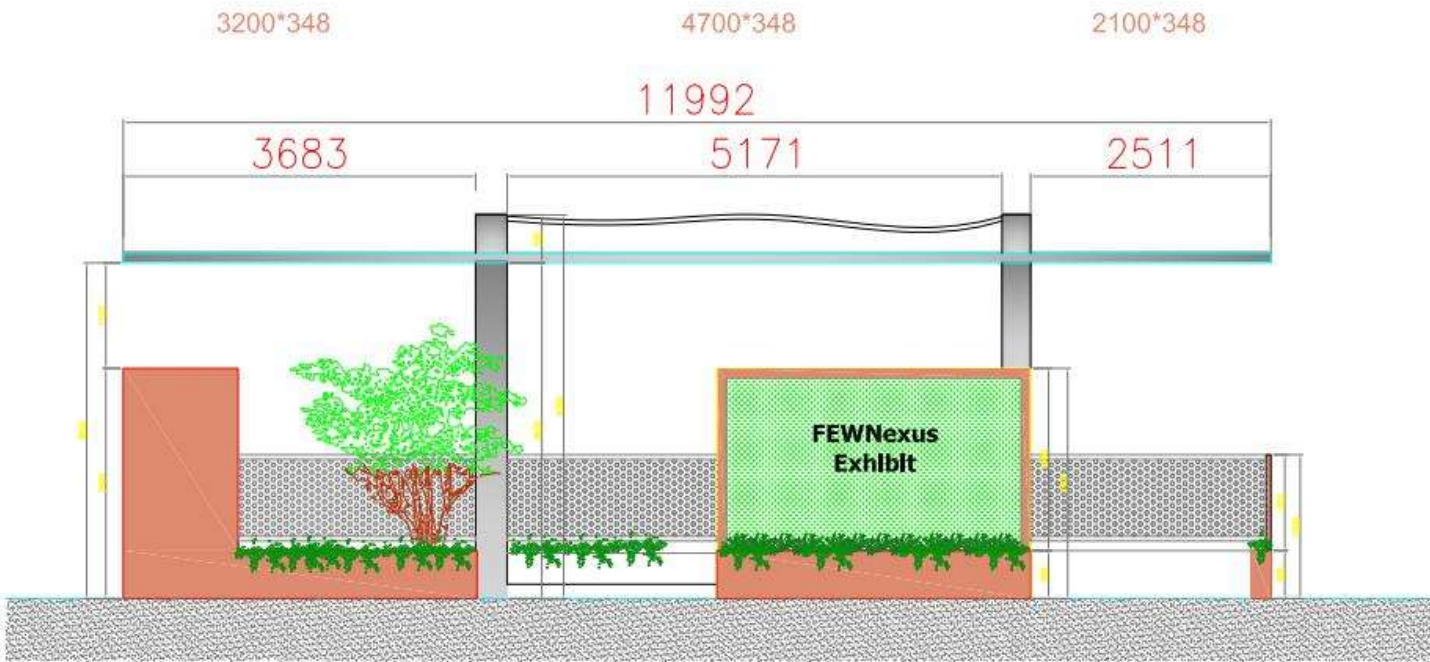
Flexible Solar PV For Wall Cladding



Model: 290W, FLEX-03NL
for BIPV Wall Cladding

Custom-made FLEX PV Solution

Flexible Solar PV For Canvas Roofing

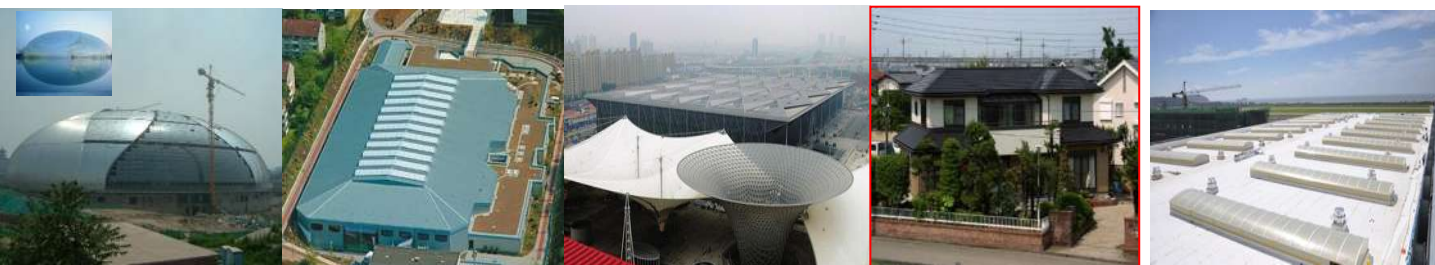


Custom length Flex PV for Canvas Roofing

Suitable Roofing Materials for Bonding Flex PV Panels

Flexible Solar PV For Canvas Roofing

Roof Type		Structure	Install Type	Applicable PV type	Comparison between Flex & Glass PV	If recommend flexible PV
Tile Roof		Concrete, wooden/Steel frame	Bracket	Glass PV FLEX PV	No advantage	NO
Concrete Roof		Reinforced concrete	Bracket and direct bond	Glass PV FLEX PV	If change to membrane materials, direct bond	NO
Metal Roof	Al-Mg-Mn Standing seam	Lightweight steel		Glass PV FLEX PV	Strongly recommend Flex PV Flex PV obtains advantage on constant load design	YES
	Short rib locked-edge			With building aesthetic		
	Steel standing seam type					
	Seam Lock steel					
	Dark buckle type					
Membrane Roof	TPO	Lightweight steel and reinforced concrete	Direct bond	FLEX	Strongly recommend Flex PV Flex PV obtains advantage on constant load design With building aesthetic	
	EPDM					
	PVC		None	None recommended	NO	



Al-Mg-Mn Standing seam

Short rib locked-edge

Steel standing seam panel

Dark buckle type

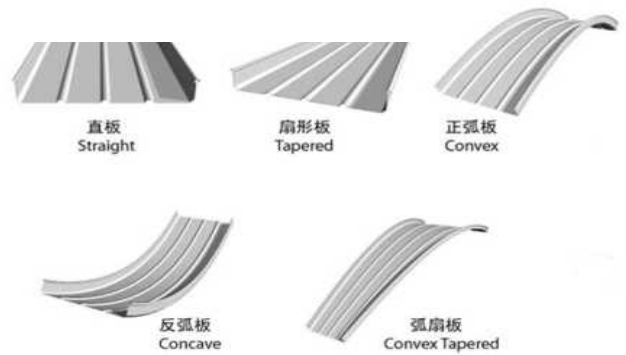
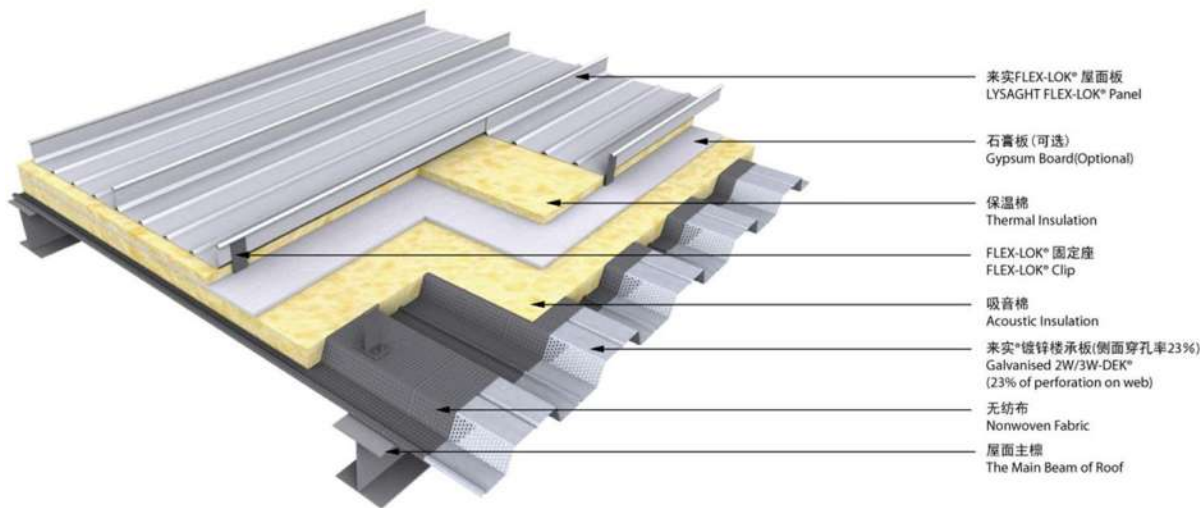
Membrane materials

Direct bonding or adopting bracket

Direct bonding

Suitable Roofing Materials for Bonding Flex PV Panels

Suitable Roofing Materials: Al-Mg-Mn Standing steam Metal Roof



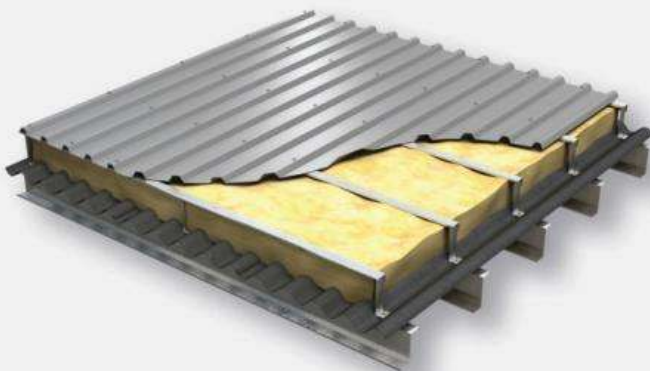
Recommended Brand



Panel Type

ASHGRID

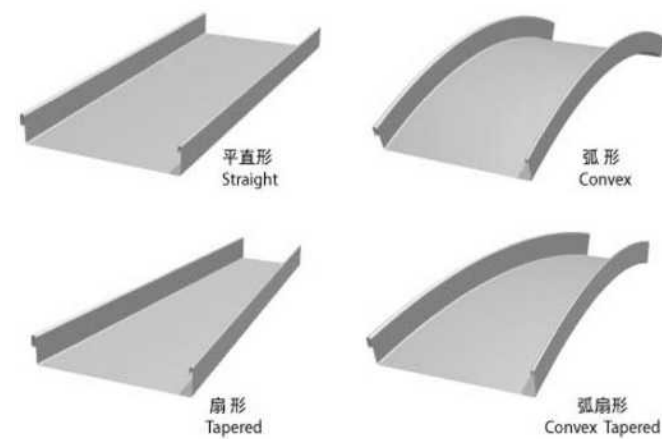
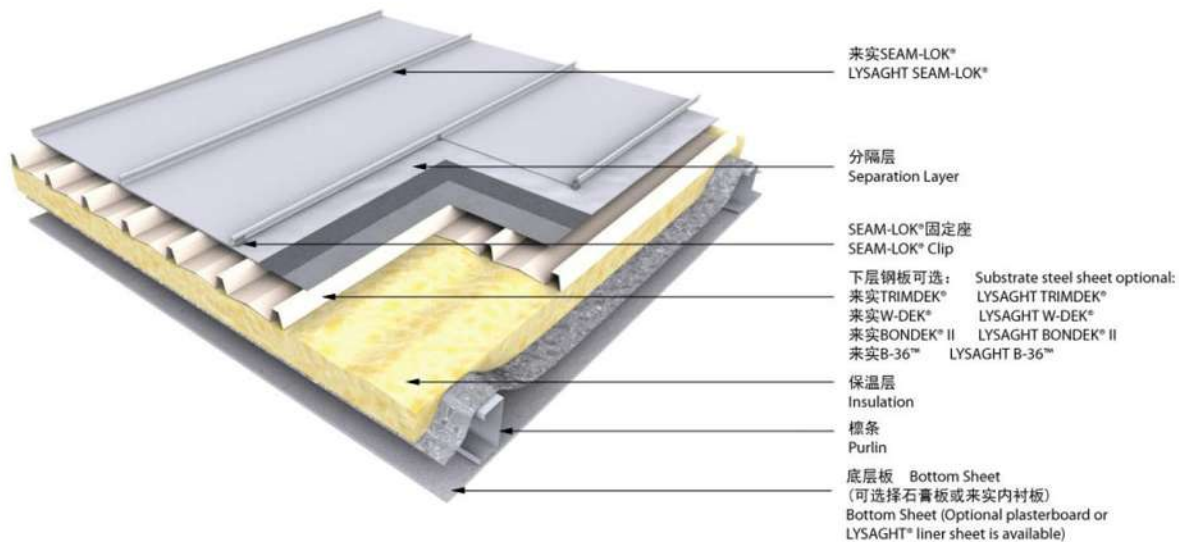
Over-Roofing Asbestos Roofs



Structure	270° Arc edge locking
Panel materials	Al-Mg-Mn alloy AA3004 H24/H44, stainless steel 304, 316,443,445
Surface processing	Primary color, Primary hammer, PVDF
Panel size	65*400(streight panel), 65*500(fan panel), custom leng
Panel thickness	0.9mm,1.0mm(Al), 0.45mm,0.5mm(steel)
Roof servicelife	> 50 years
Building type	Airport, train station,exhibition center, stadium, important warehouse, plant
Market stock	Large

Suitable Roofing Materials for Bonding Flex PV Panels

Suitable Roofing Materials: Short rib locked-edge



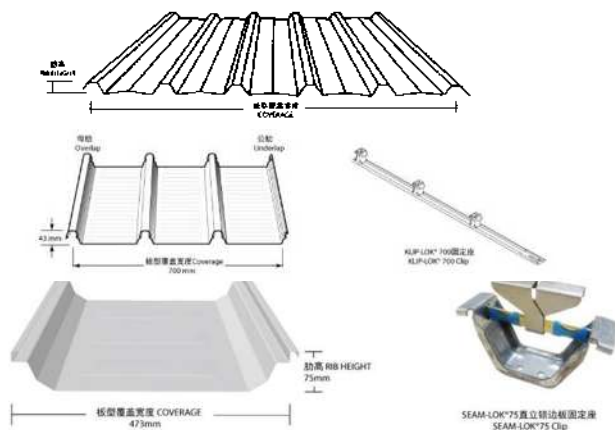
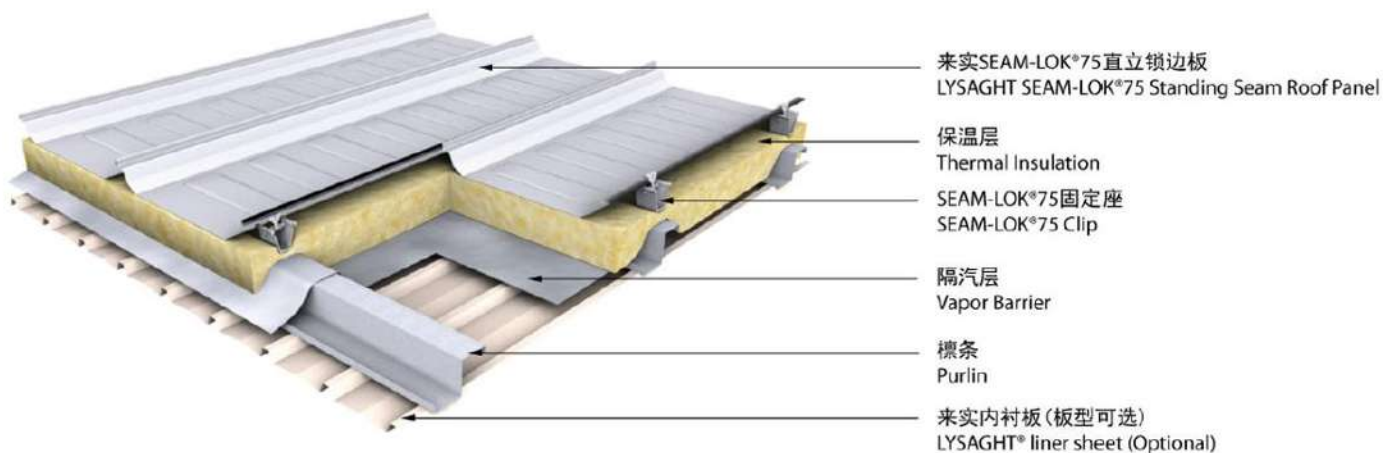
Panel Type

Structure	360° Arc edge locking
Panel materials	Al-Mg-Mn alloy AA3004, Alu-Zinc painted metal sheet, titanium zinc plate
Surface processing	PVDF, alu-zinc coated, zinc and zinc oxide coating
Panel size	32*310/410/510 25*420/520
Panel thickness	0.7mm, 0.8mm, 0.9mm, 1.0mm(Al), 0.6mm(steel)
Roof service life	> 50 years(Alu type), > 25 years(Alu-Zinc coated),
Building type	High-end architecture
Market stock	Medium



Suitable Roofing Materials for Bonding Flex PV Panels

Suitable Roofing Materials: Dark buckle type



Panel Type

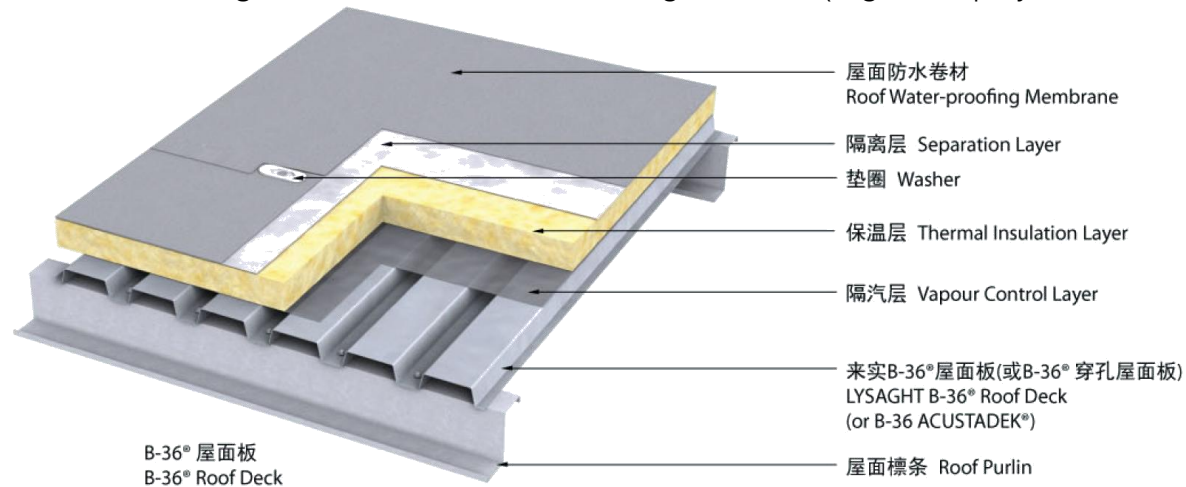
Structure	Dark buckle locking, edge locking
Panel materials	Steel panel Q235,Q345,Q550
Surface processing	PVDF,alu-zinc coated, PE
Panel size	Various
Panel thickness	0.4~1.0mm
Roof service life	5~35 years
Building type	Various
Market stock	Large



World Expo Theme Pavilion, Shanghai

Suitable Roofing Materials for Bonding Flex PV Panels

Suitable Roofing Materials: Membrane Roofing Materials (High tech polymer membranes)



Structure	Mechanical fixing+hot wind welding, back adhesive bonding+hot wind welding/bonding
Panel materials	TPO/EPDM
Surface color	White, Black, Gray
Panel size	2m~3.05m
Panel thickness	1.2mm, 1.5mm
Roof service life	> 35 years
Building type	Factory for tobacco, electronics, aerospaces, car manufacturing, warehouse and storage logistics
Market stock	Large



Flexible Rolling Materials



Flex PV Install 1: Direct Peeling and Sticking

Method 1: Direct bonding

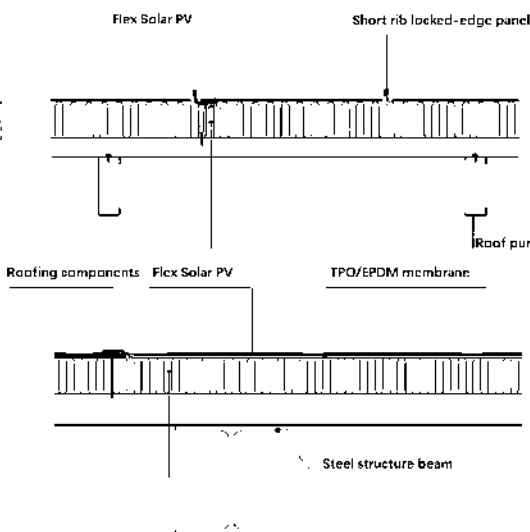
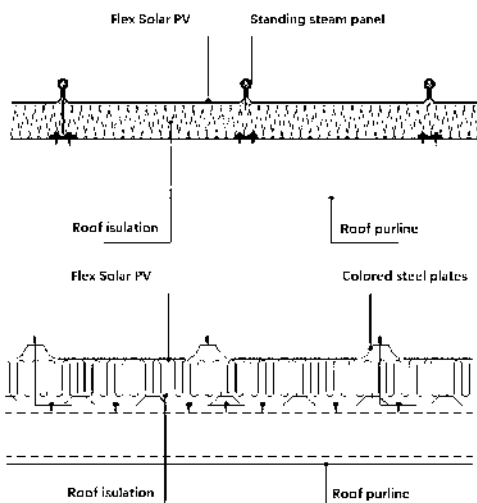
Project photo, Japan



Metal Roof direct bonding



Roof Structure



Advantage:

01. Minimal consumption materials for system, light-weight, unit weight for fully bonding less than 3kg/m²
02. Perfect adaptability for curved surface
03. Minimal materials cost and installation cost
04. East to install and operate
05. Flex PV obtains absolute preponderance on membrane roofing materials

Flex PV Install 2: Adapting special designed clamps

Method 2: Lightweight clamps and brackets

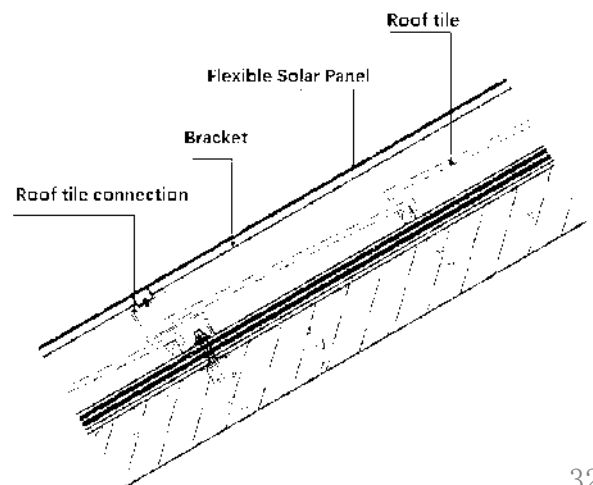
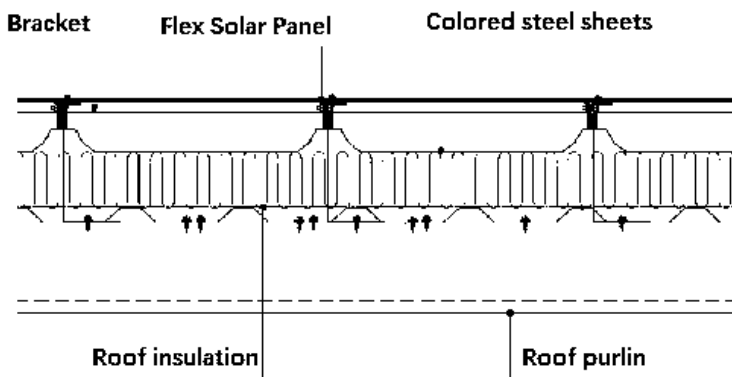
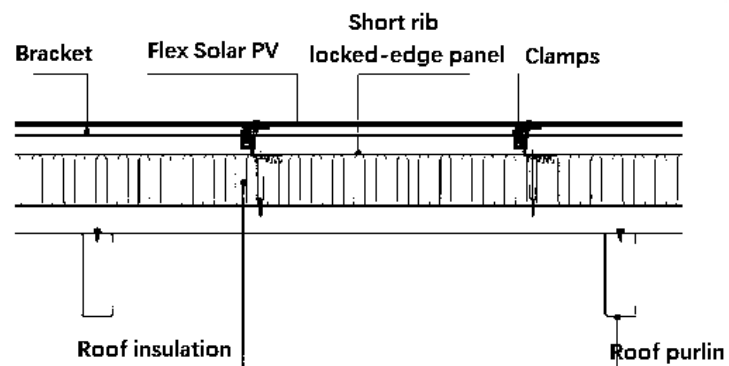
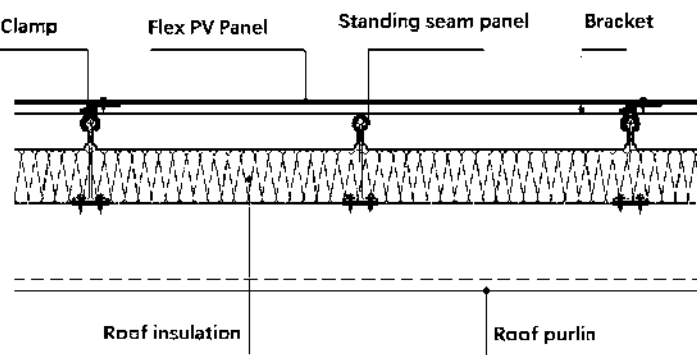
Project photo, Netherlands



Advantage:

01. Light structural weight, around 6kg.
02. Close sticking to roof surface, safe structure, very small effect on wind load.
03. No need to drill through roof structure, won't destroy the original waterproof design
04. Mature solution, easy to install, low cost.
05. Excellent adaptability onto curved surface, perfect appearance.

Roof Structure



Steps for direct bonding-Easy peeling and sticking

Step 1: Clean surface of roof materials



Step 2: Arrangement of PV Panels



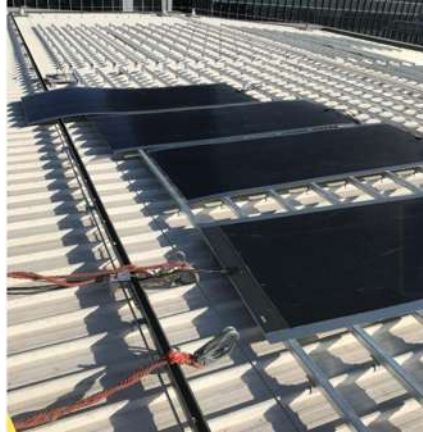
Step 3: Peeling off back adhesive tape



Step 4: Using roller to enhance fully bonding



Steps for Clamps Fixing



Step 1: install steel rails over roof

Step 2: Pre-bonding flex PV on metal sheet

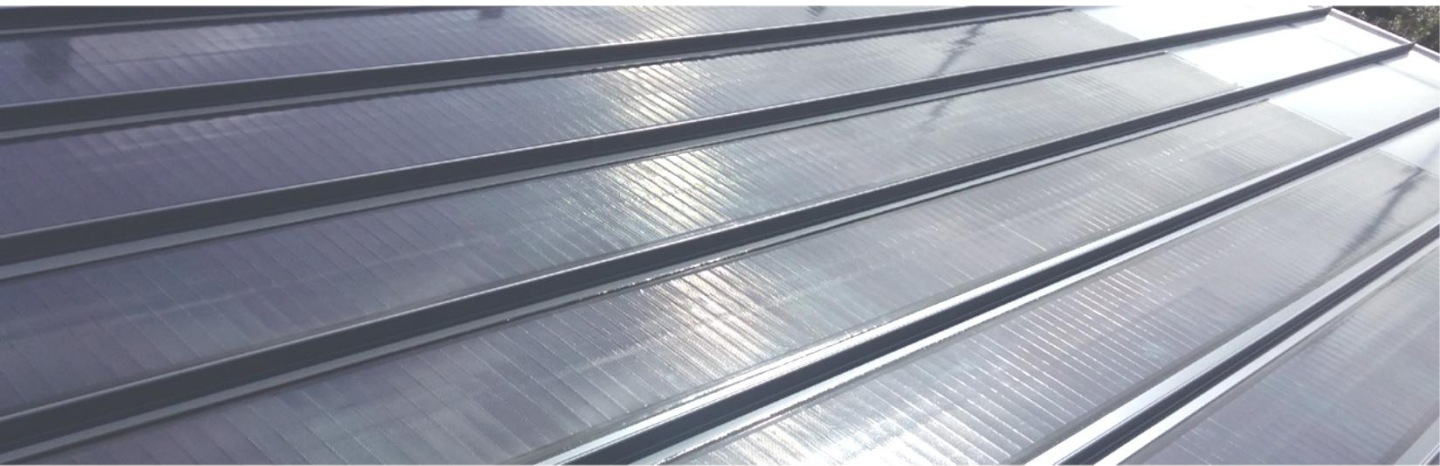
Step 3: Fix flex solar sheets onto rails



Step 4: Connect different Flex PV sheets

Step 4: On site installation photos

Step 5: Photos of clamps



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