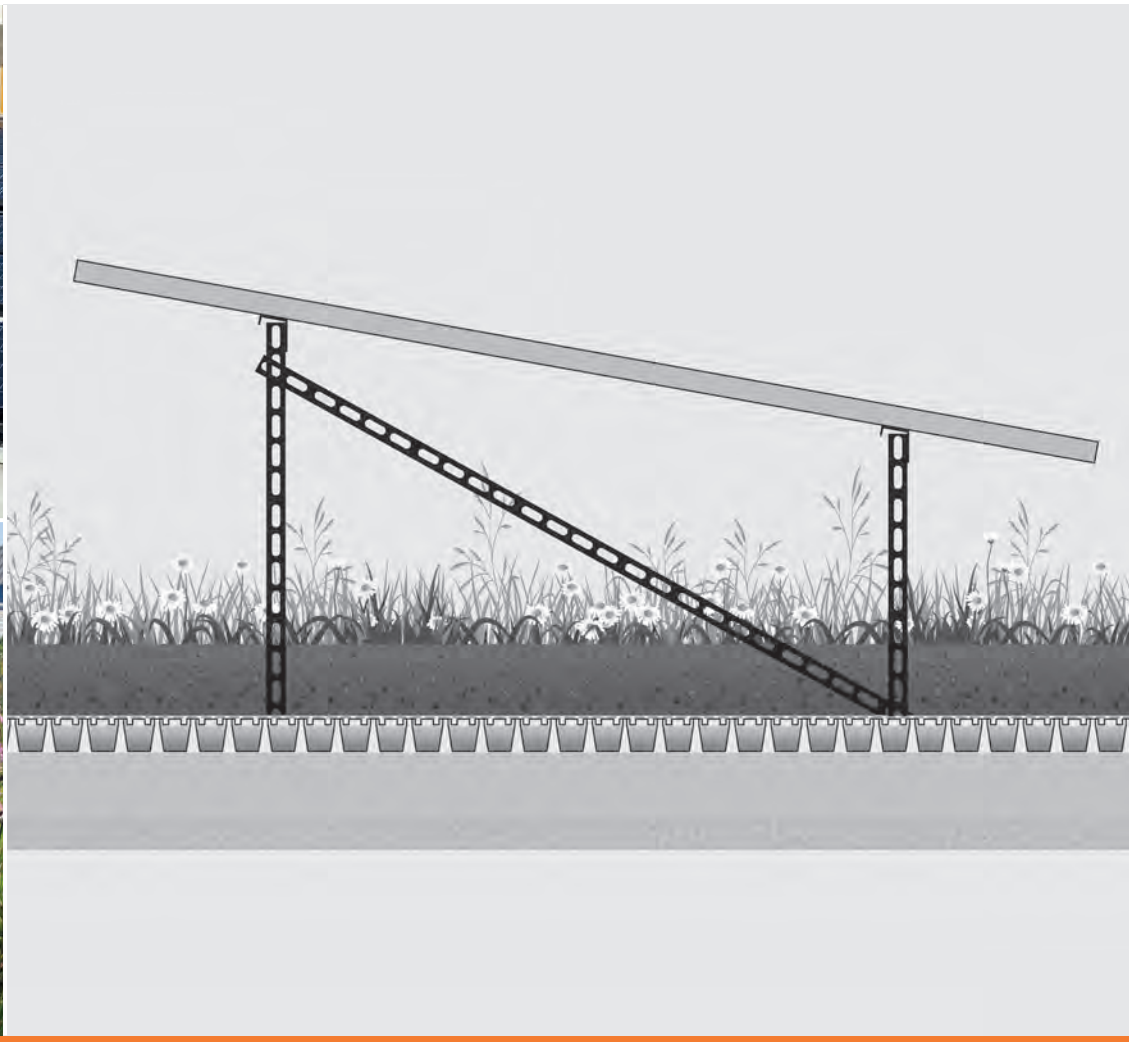
BAUDER
making roofs secure.

Design Considerations Guide

BauderSOLAR solutions



Design Considerations for BauderSOLAR PV Arrays on Flat Roofs

This document is intended to support our clients to make informed decisions when specifying solar photovoltaic (PV) systems for Bauder waterproofed roofs and does not replace the need for client expertise. All solar PV installations should be designed on a project-by-project basis. For further, in-depth guidance on electrical standards, solar panel standards, installation guidance and maintenance, the following can be consulted:

- IET Code of Practice for Grid-connected Solar Photovoltaic Systems
- MCS 005 - Product Certification Scheme Requirements: Solar Photovoltaic Modules
- MIS 3002 - The Solar PV Standard
- Solar Energy UK Rooftop O&M Best Practice Guidelines

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1 Sizing a Solar Photovoltaic Array

The sizing of a PV array can be determined by several elements that are often driven by the overall client objectives. Common motivating factors include meeting sustainability targets, achieving financial returns, and providing energy security.

In the majority of instances, the system size will be determined by the following considerations:

Meeting planning or Part L requirements

For new build projects, the principal factor that will determine the size of an array will be meeting the building's energy performance or Part L requirements. The size of the array will be determined by the Simplified Building Energy Model (SBEM), Standard Assessment Procedure (SAP) or building energy model.

Available roof space

This will often be the client's biggest limiting factor, particularly for new build applications where the solar array is competing for roof space with other M&E equipment.

Consideration should be given to:

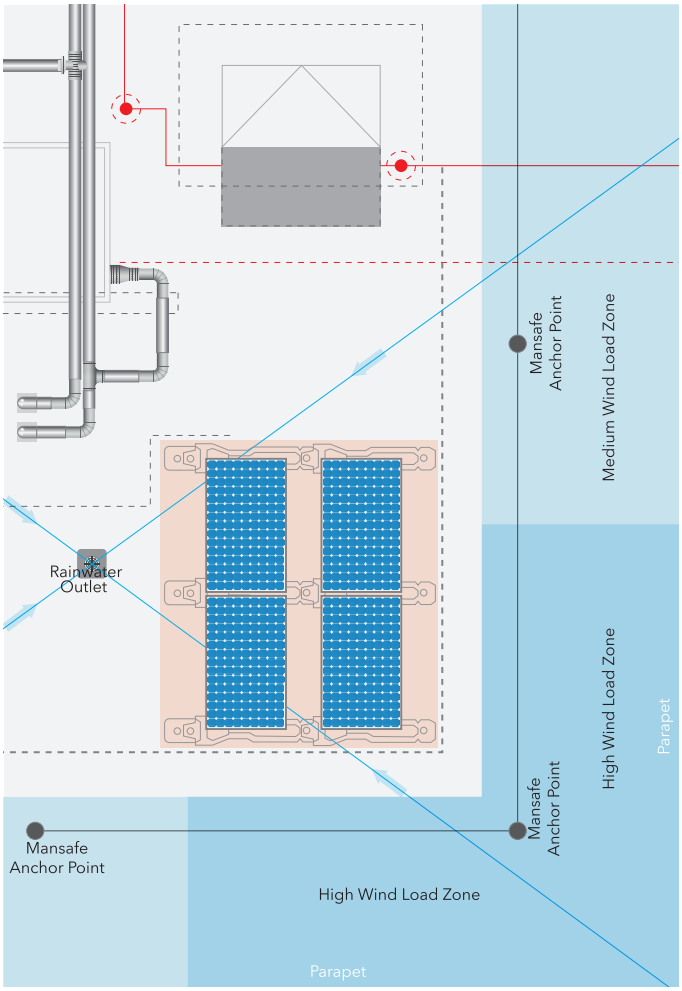
- Avoiding shading items such as plant screens, edge protection, trees and adjacent buildings
- Safe access for maintenance
- Adequate fire breaks between solar panels and rooftop plant, rooflights, upstands and other vulnerable elements
- Wind load zones

Budget

Often a project's capital budget or the building's financial plan may determine scheme size rather than optimal return on investment for the size of available roof space.

The building's energy consumption

The optimal return on investment will occur if the system is sized to maximise self-consumption rather than exporting back to the grid. Buildings that are used predominantly during the day such as offices, schools and factories are well suited to maximise self-consumption from a solar PV array and therefore maximise return on investment.



2 Roof Conditions and Layout

Roof warranties

As a general rule, the flat roof waterproofing system should have an expected useful lifespan of no less than the solar installation. This applies not only to the waterproofing layer, but to the entire build-up of the roof.

When installing solar to a flat roof, consideration should be made to the impact on roof warranties. The best time to install a solar PV system will be in conjunction with the roof waterproofing. This helps designers to ensure that the solar PV system does not have any negative impact on the roof system, allow fire mitigation measures to be included (see section 4) and ensure that roof warranties are not invalidated.

If the solar PV system is to be retrofitted to an existing roof, then the provider of the roofing system warranty should be consulted to ensure that measures are taken to protect the waterproofing system and prevent roof warranties from being invalidated.

Safe access

Safe access will be required for maintenance of both the roof and solar array. For refurbishment applications it should be established whether the existing safe access system meets the needs of additional traffic and equipment required to maintain the solar PV array. If not, the access system may need updating or a permanent edge protection may be required.

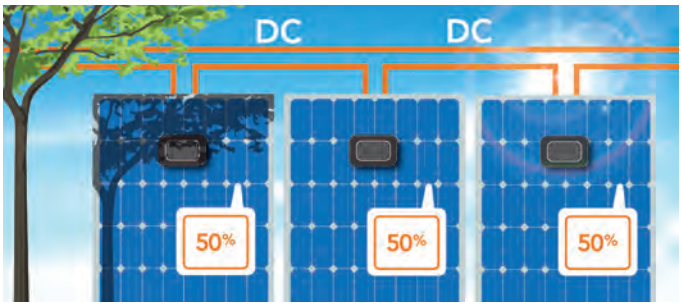
Shading

Partial shading of solar modules can have a significant impact on system performance. Shading can be caused by elements such as roof-mounted equipment, vents and SVPs, parapets, adjacent buildings, and trees. If partial shading occurs, modules should be relocated where possible. In cases where modules cannot be relocated elsewhere on the roof, solutions such as module-level power optimisation should be considered to reduce the impact of this shading.

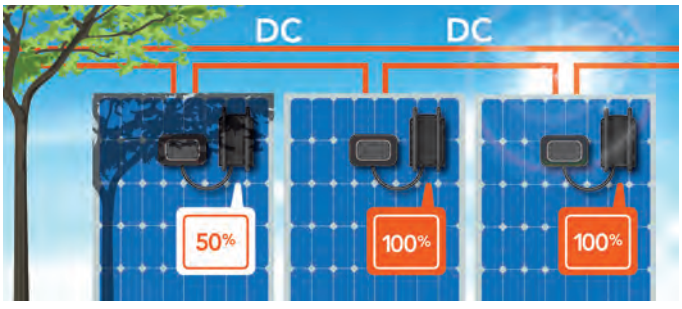
Module orientation

Various factors can affect the choice of module orientation when designing solar arrays for flat roofs. Often,maximising the number of panels, rather than specifically orientating them due south can often provide a better return on investment. Equally, many systems will be installed in an east-west orientation as this can maximise roof utilisation and increase self-consumption of site-generated electricity.

Impact of partial shading on the performance of a PV array



Traditional String Inverter



Inverter with Power Optimisation

3 Structural Considerations and Wind Loads

Wind load design

The impact of wind load on solar arrays can vary significantly depending on the following factors:

- Geographical location
- Height and shape of the building
- Location of modules on the roof
- Module orientation

A project-specific wind load calculation should be carried out for each project and/or array in accordance with BS EN 1991-1-4 wind actions on structures and/or BRE Digest DG489.

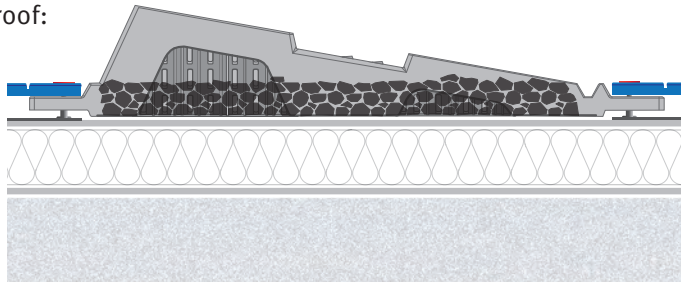
Structural considerations

Solar arrays will add additional weight to the roof structure and a structural engineer should be consulted prior to installation of the array.

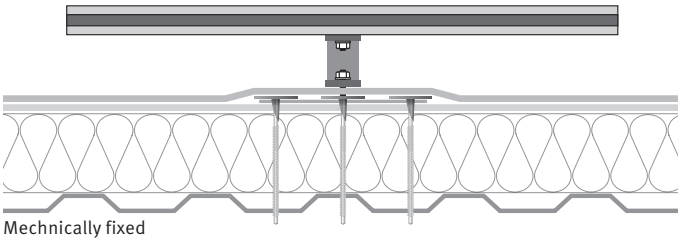
Fixing methods

There are two primary options for fixing a PV system to a flat roof: ballasted or mechanical. A ballasted system adds additional weight to anchor the array to the roof, whereas mechanical methods cover two key practises: either they penetrate the roof covering and are fixed to the deck or they bond to the roof membrane, leaving the waterproofing system intact.

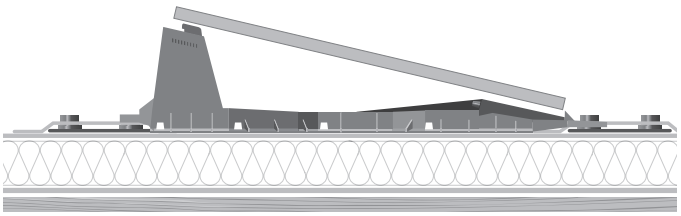
When installing ballasted solutions, the ballast should allow for a spread of load across the roof and avoid point-or line-loading. In all ballasted applications a suitable protection layer must be allowed for, and this should be agreed in advance with the waterproofing warranty supplier.



Ballasted



Mechnically fixed



Membrane welded

BauderSOLAR F systems

BauderSOLAR F mounting systems for flat roof photovoltaics are attached to the roof without penetration of the waterproofing system or roof deck. The system is designed to be used in conjunction with our single ply or bituminous membrane waterproofing solutions, and provides the following benefits:

- Penetration and ballast free installation method reduces risk
- High output to roof space ratio
- Range of solar PV panels to suit client needs and budget
- Lightweight system 12-14 kg/m^2, depending on the module selected
- Single source for design of waterproofing and solar PV array with clear accountability

4 Fire Prevention and Mitigation

Correctly-installed and maintained roof-mounted solar arrays are inherently low-risk. A 2018 report by The BRE National Solar Centre (NSC) found that there were fewer fires in the UK per unit installed caused by solar arrays than tumble dryers. That said, it is also the case that installing a solar array will both increase risk of a rooftop fire and change the fire performance of the roof system itself.

To manage this risk, designers should consider solutions that help fires from occurring and mitigation strategies that reduce the impact of a rooftop fire.

Prevention

There are various solutions a designer can consider that help reduce the chance of a solar array causing a rooftop fire. To help ensure their rooftop array is as safe as possible, two of the most important considerations for a designer are:

Contractor selection

Using an experienced, quality installer will ensure that the correct electrical standards are met and that due care is taken over design and installation.

Ongoing maintenance

Regular maintenance will prevent minor issues becoming significant ones whilst ensuring maximum yields.

DC connections

Site-made solar connectors are often the main cause of rooftop solar fires. To minimise this risk, Viridian Solar has developed the Arcbox, a connector enclosure which has been proven to prevent electrical arcs from becoming electrical fires.

We encourage all of our partner contractors to install Arcbox wherever there are site-made DC connections on the roof.

Mitigation

As well as preventing and limiting the cause of rooftop fires, it is also vital to ensure that installing a roof-mounted solar array does not create conditions where a rooftop fire would lead to unacceptable risk for the building or its occupants.

At the time of writing, there are currently no test standards or methodologies for flat-roof mounted solar arrays. Bauder has therefore developed guidance for installations of our BauderSOLAR.

Unless specifically requested by the client in writing, Bauder will only provide BauderSOLAR designs for schemes where one of the following is in place:

- A non-combustible deck, i.e metal or concrete
- Non-combustible layer above the waterproofing:
  - 50mm of stone ballast, or
  - 80mm BauderGREEN substrate
- Bauder DensDeck® Prime Cover Board installed between waterproofing membrane and insulation

We will also follow the below parameters within all our designs:

- Ensure there are fire breaks between the solar PV system and any rooflights, upstands, penetrations, and other M&E equipment or the perimeter of the roof. This should be 1.5m where possible with an absolute minimum of 1m
- Include a fire break in the solar array of minimum 1m every 40 metre run of panels
- Where a ballast layer is installed above the waterproofing as a non-combustible layer, this will be to a minimum of 1.5m external to the perimeter of the solar PV array

5 Biosolar Systems

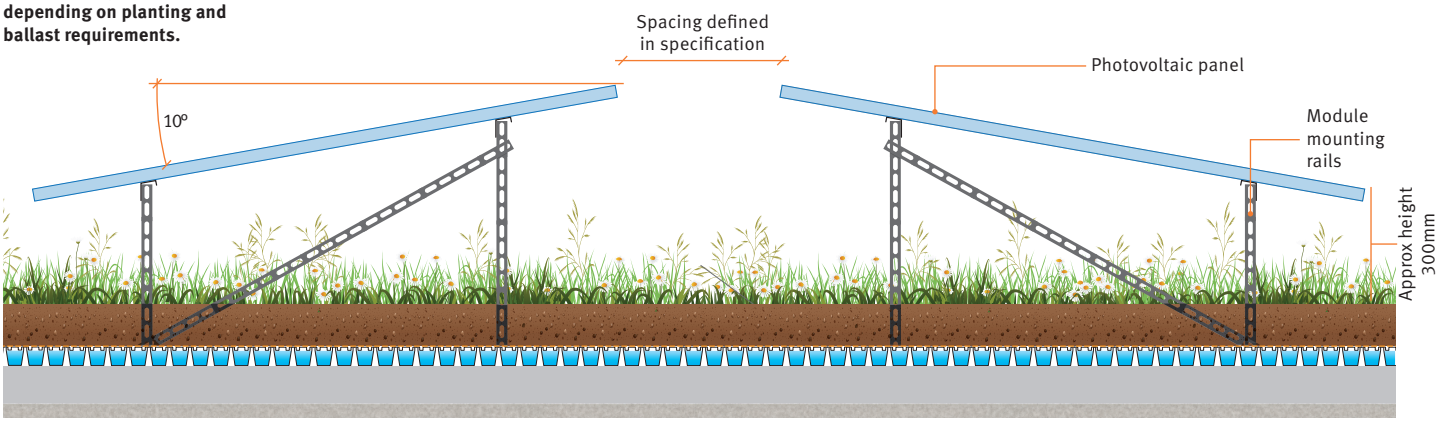
Biosolar roofs are an integrated solution for mounting photovoltaic solar panels on a green roof or a blue roof. This combination provides environmental benefits and has quickly become popular with specifiers looking to achieve both biodiversity net gain (BNG) and reduce the operational carbon of their buildings.

To realise the various benefits of a biosolar roof, systems must be designed to ensure that both the green roof and solar requirements are considered. When designed and installed correctly, a biosolar roof can enhance solar generation (due to the cooling effect of the vegetation) whilst also varying the habitat across the roof, aiding biodiversity.

A key component of any biosolar roof is the solar mounting solution. Systems such as our BauderSOLAR G LIGHT raise the panels above the growing medium allowing vegetation to thrive across the roof, whilst providing a secure mounting for solar panels to be installed.

For further information on biosolar design and best practice, the Green Roof Organisation's Biosolar Best Practice Design Guide can be consulted.
https://www.greenrooforganisation.org

Substrate depth variable depending on planting and ballast requirements.



6 Module Specification

The solar PV module industry is fast-paced and dynamic, with new module options being produced on an almost monthly basis.

Module size, output and price will change as new technologies come to the fore, continually pushing up efficiencies and return on investment. This is beneficial to consumers and combatting climate change, but can make it difficult to specify commercial solar systems, where the actual installation may be 12-18 months from the original specification. Price and efficiency are often the key elements that specifiers and clients consider. However it is also equally important to take into consideration the following:

- Durability
- Guarantee terms
- Responsible sourcing
- Availability
- Fire performance

Bauder takes pride in providing quality solutions with low environmental impact. Our mounting systems are universal and we partner with Solarwatt for all our design specifications. Further information on Solarwatt's products and service is available on their website.

SOLARWATT®
powering a better tomorrow

7 Contractor Selection

Although solar is a relatively simple solution to design and install, it is vital that contractors understand the various considerations covered in this document and have the experience, skills and expertise required in both the electrical and roofing elements of a rooftop solar PV system.

Bauder systems are exclusively installed by our approved roofing contractors and partner electrical contractors who are evaluated to ensure the company possesses the technical expertise required and organisational facilities to manage and maintain an efficient and well-run project.

They are separately approved for different systems to maximise and recognise their specialist areas of expertise.

We look to build strong relationships with our contractors by providing them with training, support and expert advice so they can deliver a high-quality installation. We keep them abreast of all our latest developments in products and installation techniques and run symposiums specifically to keep them updated.

8 Maintenance

Regular maintenance of solar arrays by qualified professionals is vital to ensure safe operation.

Adhere to guarantee requirements and enable maximum output from the array during its serviceable life.

Exact maintenance requirements will vary from system to system, and the following should be crried out for all solar arrays:

- Electrical inspection
- Mounting system inspection
- Cleaning of solar modules

Further information on maintenance of BauderSOLAR solutions can be found on our website
bauder.co.uk/technical-centre/installation-maintenance

Solar Energy UK has also produced a useful overview of general solar maintenance requirements. Refer to their website for more information.
solarenergyuk.org

9 Bauder Design Support

At Bauder, our service is free and covers all elements for a successful project delivery from initial concept or site survey, through to specification package with bespoke drawings and calculations, on site monitoring, and final sign-off and handover.

To ensure that our clients can make informed decisions from as early in the design process as possible, we are happy to provide a solar design package including, but not limited to:

- CAD roof layout
- Windload calculations
- Generation projections
- Return on investment calculations
- Bill of materials

In order to provide a design, our area technical managers will work with you to understand all the parameters for designing a BauderSOLAR array for your flat roof project.

Please contact us to arrange a meeting
www.bauder.co.uk/contact-us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Reducing use of materials

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