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**THE GRO BIOSOLAR
BEST PRACTICE
DESIGN GUIDE**

July 2024

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INTRODUCTION

This **Best Practice Design Guidance** has been produced through the GRO Technical Committee and specifically by the GRO BioSolar Working Group, a WG consisting of GRO Manufacturer, Supplier and Contractor members with expertise in the field of Solar and Green roof systems.

1 | BENEFITS

There are considerable benefits to be derived from combining green roofs and solar photovoltaic (PV) panels on what is commonly referred to as a BioSolar roof. The green roof will help to manage surface water run-off from the roof as well as capture CO₂ and the evaporative cooling of the vegetation can increase the efficiency of the PV panels.

Purpose-made support frame systems for PV panels on green roofs have been developed and these are designed to be integral to the green roof and secured in place by the superimposed load of the build-up itself rather than being fixed to the roof structure. These systems avoid the requirement for fixings for the supports having to penetrate the roof waterproofing and structure and also allow for the green roof to continue beneath the PV panels thereby maximising the vegetated area. This is referred to as a “Bio Solar roof”. These systems can typically be used on roofs with a pitch of up to 5 degrees and often provide options for different degrees of panel inclination.

The above should not be confused with PV support frames that are designed to be ballasted with paving slabs or stones and which are not able to adequately support vegetation beneath the PV panel.

When designing a BioSolar roof, or any green roof, provision must be made for safe access and maintenance of all elements of the roof.

2 | SYSTEM DESIGN

The support frame system should be designed and tested in accordance with the relevant sections of the following standards depending on the metal used to create the framing system.

1. BS EN 1991 1-4:2005 and BS EN 1999 1-1 :2007 Eurocode 9 “Design of Aluminium Structures”; or
2. BS EN 1993 Eurocode 3 “Design of Steel Structures”.

It is very important when considering the specification of a BioSolar roof that bespoke design advice is sought from a BioSolar PV support supplier. It is also highly beneficial for there to be good early communication and coordination between all project stakeholders.

The following should be obtained from the design process:-

- Layout plan for PV panel supports and panels showing positions of solar supports on the roof area/s and spacing between panel rows.
- Wind loading report, using local weather data, for each roof involved to inform the ballast loading required for the solar PV supports. Calculations to be in accordance with BRE Digest 489 and specifically BS EN 1991-1-4 “Actions on Structures”.
- Specific plan showing differing ballast loadings if a zonal arrangement is required.

3 | KEY DESIGN CONSIDERATIONS

3.1 BASES

The base of each support should be located over a stable surface such as a waterproofed surface, Water Flow Reducing Layer (WFRL over inverted insulation board), suitable void former or directly over a drainage board layer of sufficient compressive strength. They are designed to be integral within the green roof build-up and BioSolar support bases should not be installed over substrate or aggregate layers. Specific manufacturer's installation recommendations for the chosen system should always be followed.

3.2 STRUCTURAL WIND LIFT

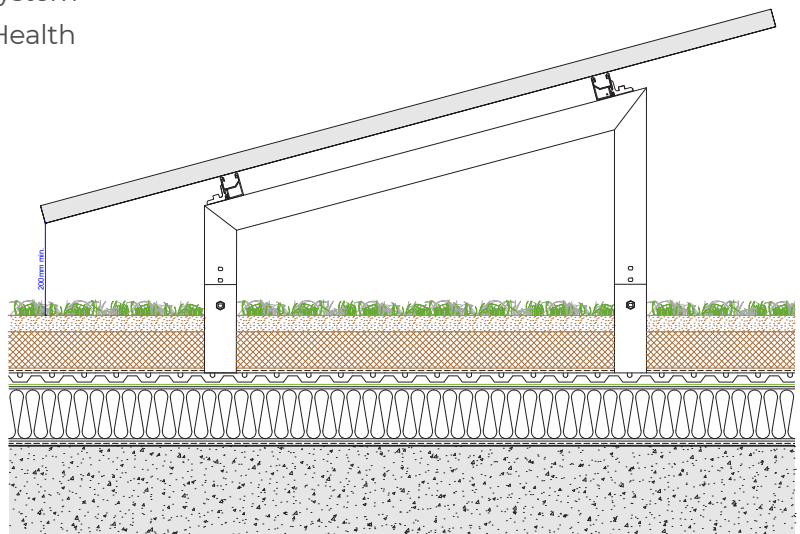
3.2 Structural wind load calculations should be carried out to **BS EN 1991-1-4: 2005 – Eurocode 1- Actions on Structures Part 1-4** with calculations in accordance with **BRE Digest 489** to ensure that sufficient substrate depth is laid so that that the dry weight of the green roof buildup will provide the required ballast loading requirement for the solar PV supports.

All ballast loading should be determined by these project-specific wind loading calculations and the saturated weight of the green roof buildup should not be utilised. On an Inverted roof system, a minimum of 80kg/m² dry weight should be utilised to prevent flotation of the insulation.

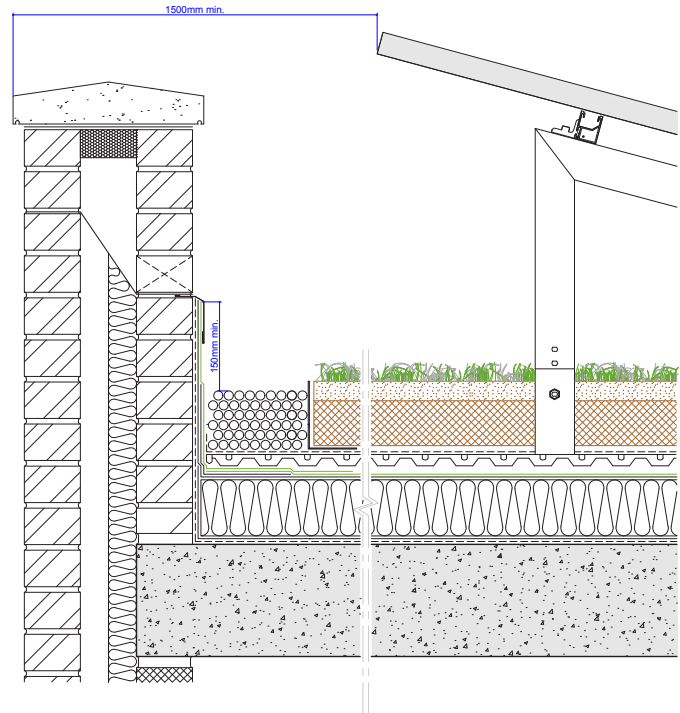
3.3 DESIGN GUIDANCE

The solar panels should be positioned to allow sufficient space between each row to allow for safe and practical maintenance of both the PV panels and the green roof. Minimum spacings should be sought from the BioSolar system supplier and take into consideration Health and Safety Executive guidelines.

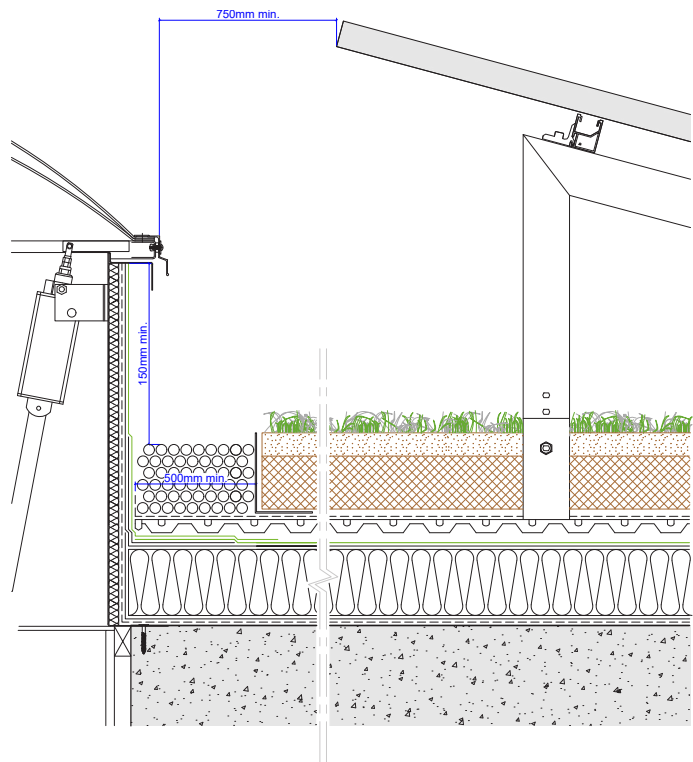
- A minimum distance of 200mm should be provided between the low point of each solar panel and substrate surface.



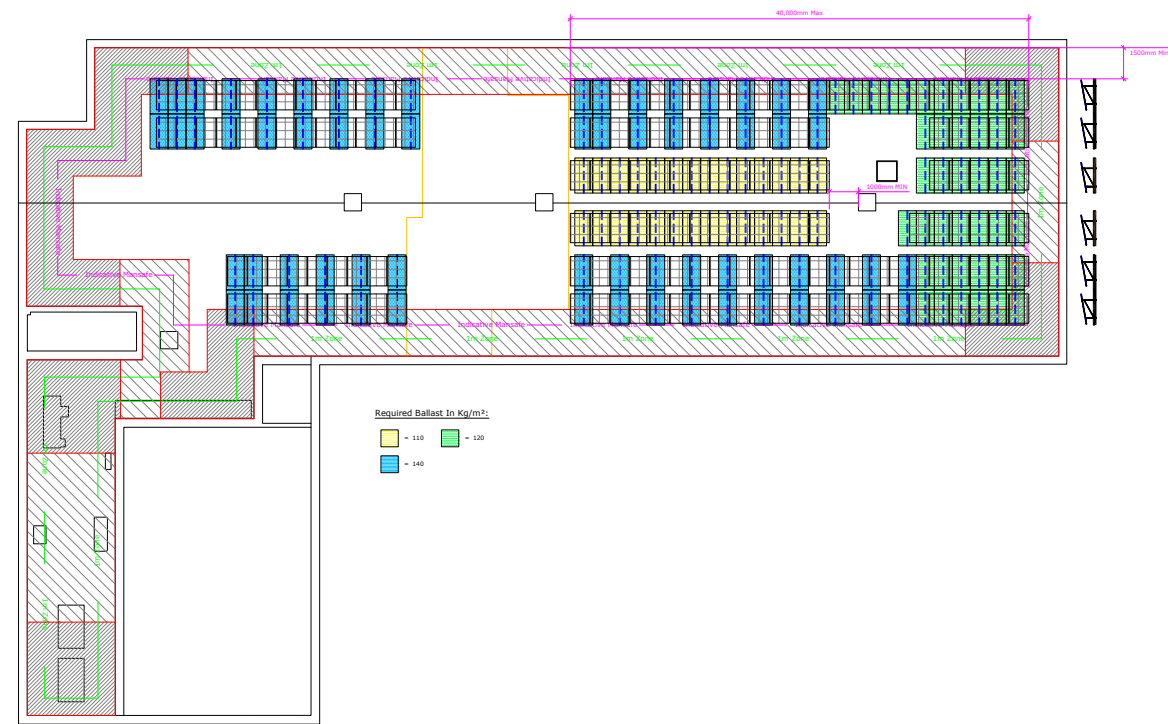
- A minimum distance of 1.5 metres should be provided between solar panels and outside edge of the roof perimeter, subject to meeting the requirements of the wind load calculations.



- A minimum distance of 750mm is recommended between solar panels and rooflights or atrium features. However, on roofs with limited space available, the PV support designer should establish if this distance can safely be reduced.



- There should be no encroachment of PV panels over fire breaks on the roof.
- The base board of the support should not be positioned within the pebble vegetation margin.
- Shading of solar panels from vegetation or other roof features should be avoided.



INDICATIVE BIOSOLAR LAYOUT PLAN
Image: Courtesy of Bauder Ltd

4 | FIRE CONSIDERATIONS

In general, the normal design features for green roofs to prevent fire spread will apply to BioSolar roofs in relation to vegetation margins, minimum substrate depths and correct substrate specification. These are all detailed in the GRO Green Roof Code.

Unless the upright section of solar panel supports penetrate the waterproofing membrane, they do not need to have a vegetation margin around them. In addition to the above on larger roofs a one-metre-wide fire break should be provided at intervals of 40 metres across the roof as detailed in the GRO Green Roof Code.

All electrical works associated with the installation and commissioning of the PV panels to be as required within MCS guidelines (MCS Certified | Giving you confidence in home-grown energy). All cabling associated with the PV system running along the substrate surface or within the green roof build-up should be contained within a closed conduit.

5 | MAINTENANCE

All green roofs will require regular maintenance and BioSolar roofs are no exception. Therefore, a long-term maintenance regime will form a key part of a successful BioSolar system. Specifically, the GRO Green Roof Code recommends that green roofs are correctly maintained to ensure that any build-up of organic matter does not represent a fire risk.

GRO recommend that all BioSolar roofs are maintained at least twice a year as a minimum requirement. The outcome of these maintenance visits should ensure the following:

- The vegetation is kept below a height where it shades any solar PV array.
- Minimum gap of 200mm between lower edge of PV panel and substrate surface to be maintained.
- Old biomass (old seed heads and dead vegetation) must be cut and removed from the roof annually, typically in the Autumn.

5 | MAINTENANCE (continued)

- All fire breaks should be checked on each maintenance visit and cleared of any vegetation or combustible material.

Additional activities may also include:

- Removal of invasive weed species.
- Removal of individual plants causing shading to the panels
- Ensuring depths of substrate remain correct as per the original wind loading requirements.
- Reseeding of bare areas in the vegetation as required.
- Cleaning and inspection of the solar PV panels.

A record of each visit and work completed should be provided to the building owner or entity responsible for the maintenance of the building. Maintenance of the solar PV system should be carried out in accordance with MCS and manufacturers guidelines. Where solar

PV systems require cleaning the materials used should be checked to ensure that they are not harmful to the green roof. Similarly, prior to the application of any fertiliser to the green roof the product should be checked to ensure it will not affect the performance of the solar mounting system or PV panels.

Failure to carry out regular maintenance will affect the performance of both the green roof and the power output of the solar PV array. It will also increase the potential fire risk of the installation.

6 | IRRIGATION

If an irrigation system is provided on the roof, it is important not to over-irrigate the vegetation under and directly around the PV panels to avoid excessive plant growth and potential shading issues.



Image: Bridgman & Bridgman and Bauder



Image: Bridgman & Bridgman and Optigreen



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