Easy PV

Solar design made simple

# Helen Hepburn

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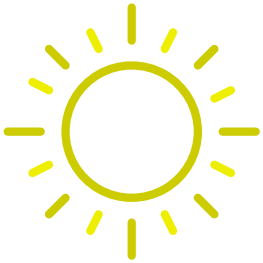
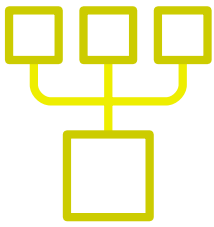
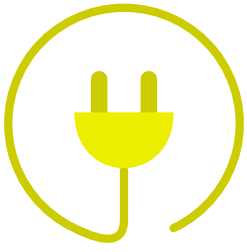
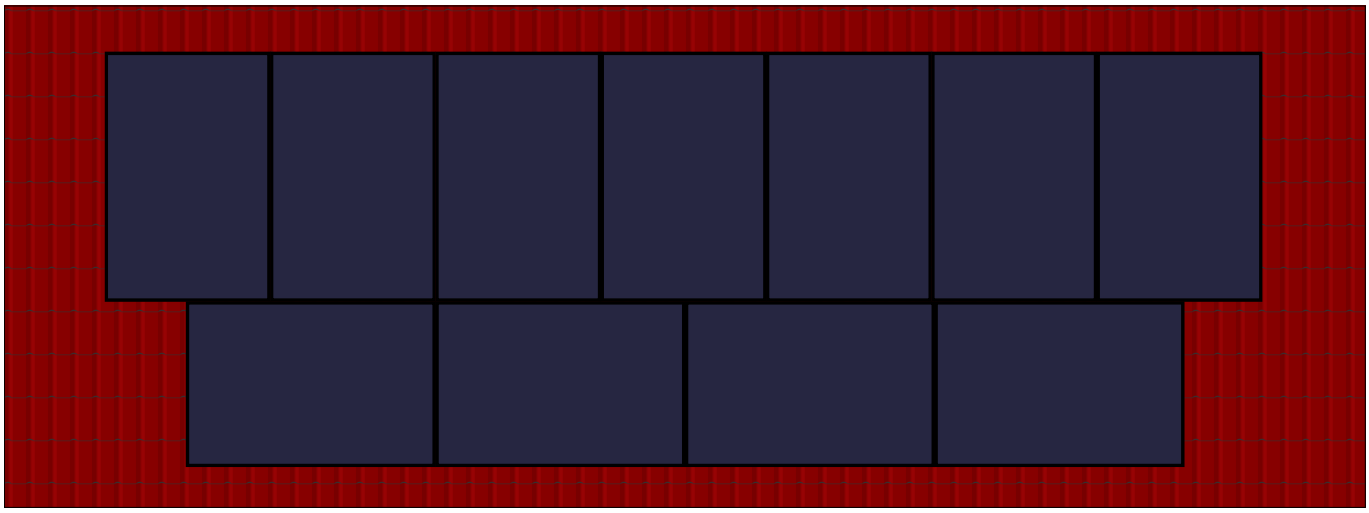


# Roof Layout

## West roof



# Structural calculations

## Weight loading calculations

For a traditional cut roof with rafters and purlins we recommend also using our rafter calculator to check the load-bearing capacity of the rafters. Even if the increase in loading is more than 15% the rafters may well be able to take the additional weight.

Please note that this method does not calculate the strength of the roof, and if a roof was badly constructed, does not meet existing building regulations, or is in poor condition then it may still not be appropriate to install an array.

### West roof

| | |
|---|---|
| Dead load from roof covering | 0.45 kN/m$^2$ |
| Imposed load | 0.75 kN/m$^2$ |
| **Total loading without solar array** | **1.2 kN/m$^2$** |
| | |
| Weight of solar panels and mounting | 276.5 kg |
| Area covered by solar array | 21.5 m$^2$ |
| Loading imposed by solar array | 0.13 kN/m$^2$ |
| **Total loading with solar array** | **1.3 kN/m$^2$** |

**Increase in loading due to solar array:** 10.8%

An increase of less than 15% in the load imposed on a roof is not considered to be a significant change (The Building Regulations 2010, Approved Document A).

# Span tables calculations

## West roof

| | |
|---|---|
| Total dead load of solar array, mounting and roof covering | 0.58 kN/m$^2$ |
| Roof pitch | 32 |
| Rafter depth | 100 |
| Rafter breadth | 47 |
| **Maximum unsupported span** | **1.8** |
| **Maximum permitted span** | **2.47** |

For a dead load of between 0.50 and 0.75kN/m$^2$ and a roof pitch of 30 to 45 degrees, with roof timbers of 47 x 100 mm at 400 centers, the maximum permitted unsupported span according to Trada span tables is 2.47m.

The maximum unsupported length of the roof timbers is within the permitted span.

# Wind loading calculations

The maximum force acting on a solar array from wind loading is given by the following formula in BRE Digest 489:

$$F = q_p \times C_{p\,net} \times C_a \times C_t \times A_{ref}$$

## West roof

| | |
|---|---|
| $Q_p$ | 1038 Pa |
| in | From Fig 34 in Guide to the Installation of Photovoltaic Systems for a building 10 m high, windzone 2, in country terrain, at a distance of greater than 20km from the sea |

| $C_{p\,net}$ | Roof Centre | Roof edge |
|---|---|---|
| Uplift | -1.3 | -2.2 |
| Pressure | 1 | 1.1 |

| | |
|---|---|
| $C_a$ | 1 |
| At an altitude of 12m | |

| | |
|---|---|
| $C_t$ | 1 |
| When there is no significant topography | |

| | |
|---|---|
| $A_{ref}$ | 21.48m$^2$ |

| **F** | Roof Centre | Roof edge |
|---|---|---|
| **Uplift** | **-28985N** | **-49052N** |
| **Pressure** | **22296N** | **24526N** |

With 32 roof hooks we should allow for an uplift force per hook in the central zone of **906N**, rising to **1533N** at the edges. If 2 screws are used per roof hook, this equates to **453N**per fixing in the central zone, and **766N** at the edges.

Concrete tile roof hooks are fixed with screws that pass through the 5mm plate of the roof hook and are then buried fully into the rafter beneath. So there is approximately 65 mm of thread in the timber. The pull-out force in C16 timber is given by tables and formulae in BS5268 Part 2:

$$17.3 \times 1.25 \times 65 = \mathbf{1406N}$$

The pullout force on the fixings is more than the expected wind loading, even when the fixings are close to the edge of the roof. ✓