

## Short-Course

# Solar PV System Installation and Maintenance

## NTQF Level III

### Learning Guide -15

<b>Unit of Competence</b>	<b>Install off-grid solar PV system</b>
<b>Module Title</b>	<b>Installing off-grid solar PV system</b>
<b>LG Code</b>	<b>EIS PIM3 M10 120 LO3 LG-15</b>
<b>TTLM Code</b>	<b>EIS PIM3 TTLM 0120 v1</b>

### LO 3:- Carry out site preparation -15

<b>Instruction Sheet</b>	<b>Learning Guide: -15</b>
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This learning guide is developed to provide you the necessary information, knowledge, skills and attitude regarding the following content coverage and topics:

- Explaining requirements for selecting and preparing of suitable installation site
- Locating and marking cable routs
- Locating and marking mounting points
- Clearing site from rubble and obstruction

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:-

- Explain requirements for selecting and preparing of suitable installation site
- Locate and mark cable routs
- Locate and mark mounting points
- Clear site from rubble and obstruction

### **Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below:
3. Read the information written in the information Sheet 1 (page: 70), Sheet 2 (page: 75), Sheet 3 (page: 80), Sheet 4 (page: 89),
4. Accomplish the Self-Check 1 (page: 74), Self-Check 2 (page: 79), Self-Check 3 (page: 88), Self-Check 4 (page: 90)

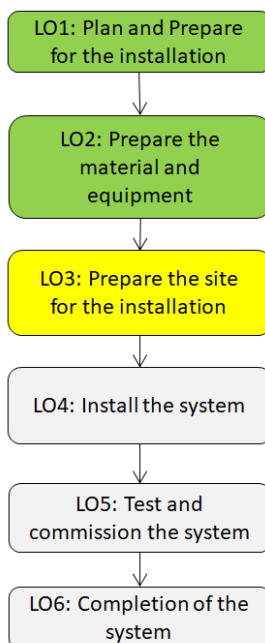
## LO3. Carry out site preparation -38

Information Sheet 1	Explaining requirements for selecting and preparing of suitable installation site
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### 1 Explaining requirements for selecting and preparing of suitable installation site

#### 1.1 Introduction

The next step is to prepare the site for the installation. See Figure 35 for a high level overview of the process that will be followed in Module 10. LO3 (in Yellow) deals with the preparation of the site before the installation commences.



**Figure 35: Installation Process**

It is important to prepare the site properly before the installation can commence. This can be done by an advance team before the installation team arrives. The type of installation and the size of installation will determine the extent of the site preparation.

#### 1.2 Site preparation

The following aspects of site preparation should be considered, depending on the size and type of system:

- Clearing site of rubble, rocks and vegetation;
- Installing water run-offs;
- Fencing of the array area;

- Laying foundation footings;
- Digging trenches;
- Access roads;
- Setting up secure storage for components and materials e.g. a container;
- Arranging for electricity (generator) and water (e.g. a tank) on site;
- Setting up ablution facilities;
- Setting up a site office;
- Setting up accommodation for the installation team;
- Setting up cooking facilities;
- Setting up scaffolding;
- Roof repairs and/or painting before installation.

Although most of the above is more relevant to big projects, some of it may be applicable to smaller systems as well.



Figure 36: Site preparation (<https://amandlaconstruction.co.za/>)



Figure 37: Ground Mount installation, Foundation example

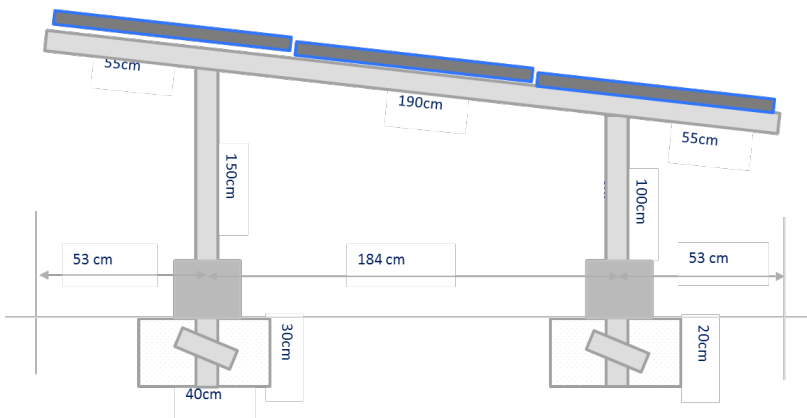


Figure 38: Foundation Diagram



Figure 39: Foundation work, SEF



<b>Self-Check - 1</b>	<b>Written Test</b>
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Answer all the questions listed below. Use the Answer sheet provided in the next page:

N°	Questions and answers
1	<b>Why do you need to check age of the roof before the installation?</b>
2	<b>What type of preparations should be done before installing? (4)</b>

Satisfactory	4 points
Unsatisfactory	Below 3 points

**Answer Sheet**

Score = _____  Rating: _____
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Name \_\_\_\_\_

Date \_\_\_\_\_



## 2 Locating and marking cable routes

### 2.1 Introduction

Depending on the site, cables can run:

- Underground in trenches;
- Overhead;
- Through the roof and walls of a building.

### 2.2 The cable run

The route that the cables take should be selected based on the following criteria:

- As short as possible to prevent voltage drop and costs;
- The cable should be properly protected:
  - If underground without conduit, the soil should be compacted to prevent rodent damage;
  - Where it enters a roof, the cable should be protected against shaving damage
  - For roof entry, the roof entry point should be waterproof
  - Cables should be supported properly and not hanging loose.



Figure 40: Underground cable (<https://www.catcon.com.au/>)



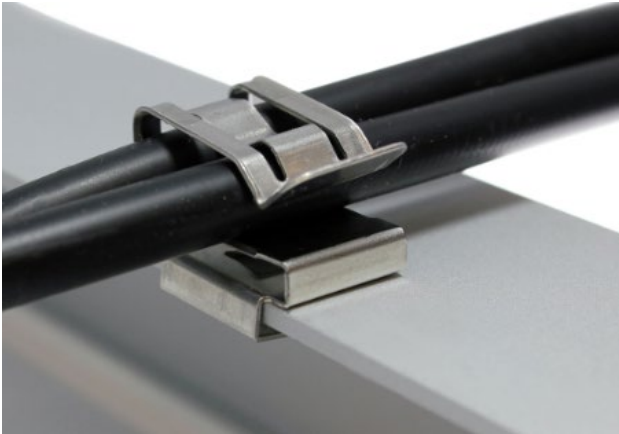


Figure 41: Supported cable (<https://www.solarpowerworldonline.com/>)



Figure 42: PV cable in conduit (<https://www.jadelearning.com/>)

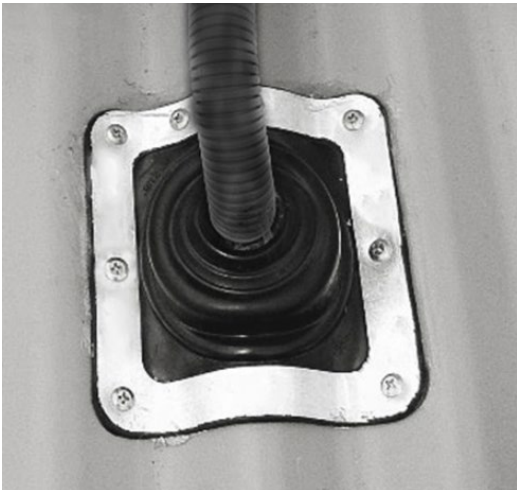


Figure 43: Solar cable roof entry (decktite)

### 2.3 Wire Marking Systems

The best way to prevent switched cables and related accidents is to mark each cable individually. In a good marking system, each cable can be identified at a glance; you should be able to tell immediately what type of connection that cable is for, and

where it leads. One of the best ways to reach this goal is to combine colour coding and written details.

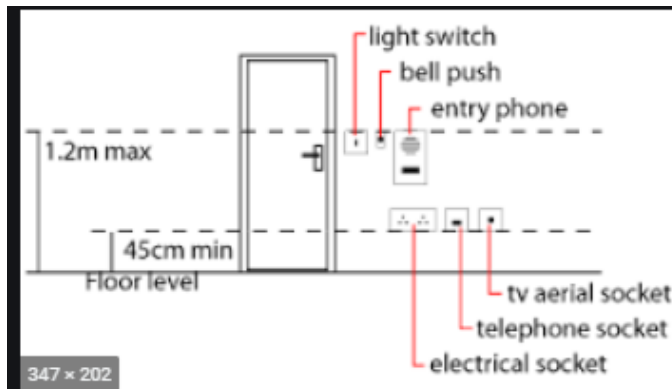


**Figure 44: Wire Marking**

## 2.4 Colour Coding for Wire Marking

Wire colour coding systems offer immediate recognition, but several different standards apply to similar wiring in different situations. The colour code that you know may not match the one in use in a different facility or even on a different piece of equipment. If your wire marking system uses colour codes, you should keep a description of the system posted near the wires that are affected.

Follow design diagram for locating and marking cable routes.



**Figure 45: Cable routes Diagram**

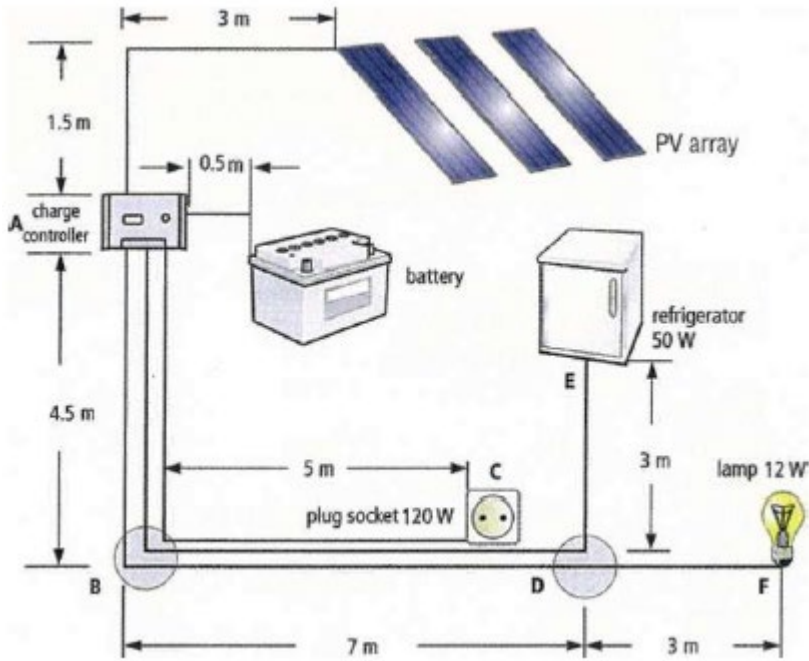


Figure 46: Cable Dimension (DGS/2010/Chapter 8)

## 2.5 PV Cable

Although it may be easier to just use a single colour PV cable, using two colours e.g. Red for positive and Black for negative will make fault tracing much simpler and may prevent wrong connections.



Figure 47: Helukabel PV1-F cable in different colours

<b>Self-Check - 1</b>	<b>Written Test</b>
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Answer all the questions listed below. Use the Answer sheet provided in the next page:

<b>N°</b>	<b>Questions and answers</b>
<b>1</b>	<b>Why is it important to measure cable length?</b>

Satisfactory	2 points
Unsatisfactory	Below 1 points

**Answer Sheet**

Score = \_\_\_\_\_

Rating: \_\_\_\_\_

Name \_\_\_\_\_

Date \_\_\_\_\_

### 3 Locating and marking mounting points.

#### 3.1 Introduction

The next step is to locate and mark the mounting points for the various components i.e. the modules, combiner box, charge controller or hybrid inverter, batteries, off-grid inverter and DB board.

#### 3.2 Modules

##### 3.2.1 Module Installation Systems

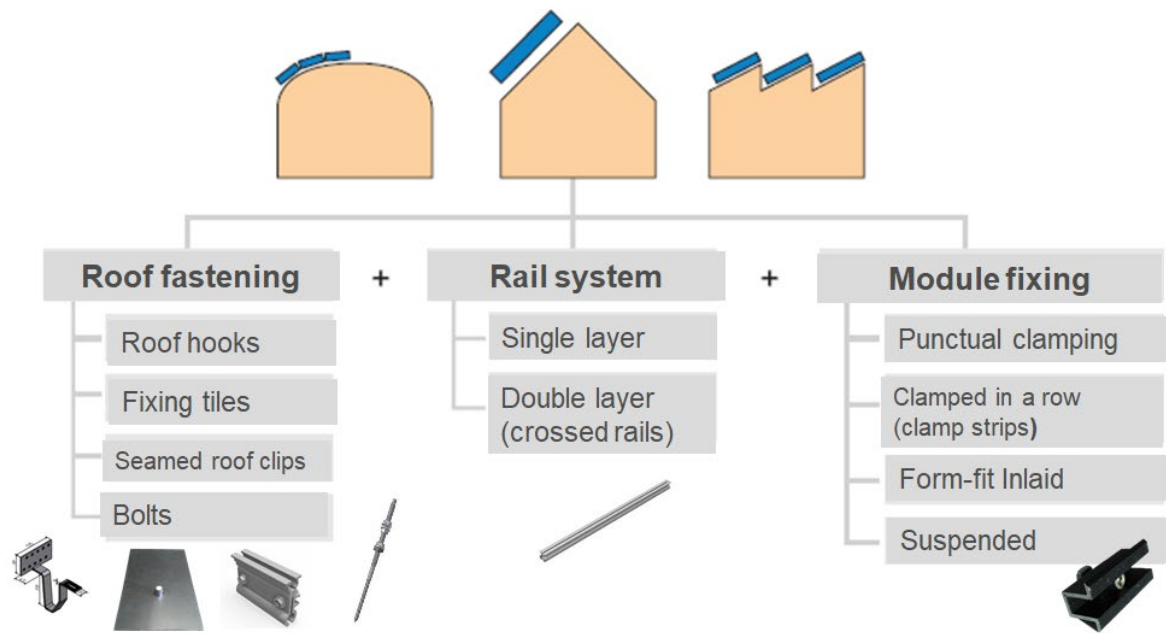
The installation of the modules will vary slightly depending on the type of roof or structure used. The general principle is that there is (Figure 48):

- Roof fastening
  - This is the bolt or hook that anchors the mounting frame to the roof or ground.
  - For tile roofs, roof hooks are used;
  - For corrugated roofs, anchor bolts are used;
  - For other metal roofs, roof clips are used;
- Rail system (mounting frame)
  - These rails are normally extruded aluminium or galvanised steel and are bolted onto the roof fastenings;
  - The rails forms a flat 'bed' for the modules to be placed on;
- Module fixing.
  - Modules are placed onto the rail system
  - Modules are fixed to the rails using module clamps

##### 3.2.2 Clamping Zones

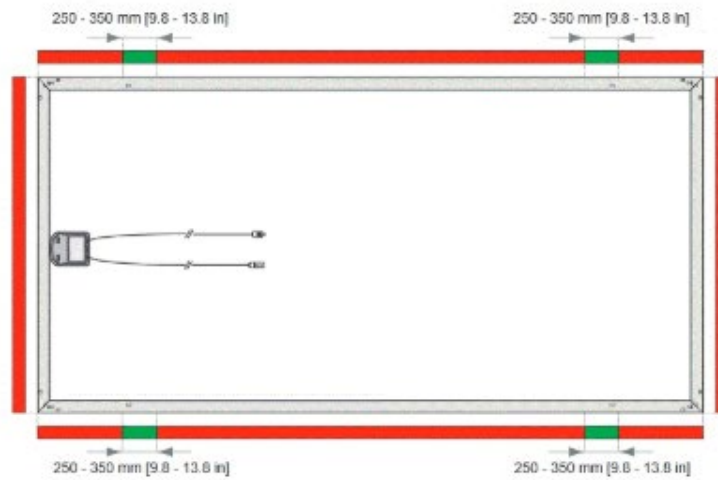
When measuring the area where modules will be mounted, the following needs to be considered:

- The rails needs to be spaced to fall within the clamping zones of the modules (Figure 49);
  - Consult the installation manual for clamping zones;
  - Clamping outside the clamping zone can void the warranty;
  - Clamping outside the clamping zones affect the max wind/snow loading of the modules.
- There is a maximum span for the rails between roof fasteners. Consult the rail installation sheet for the maximum span.
  - If the rafters are spaced too far apart, a stronger rail with larger span should be selected.



**Figure 48: Module mounting system**

- Clamping in the green zone (250 - 350 mm) is certified for downward loads of 5400 Pa (DL: 3600 Pa) & upward loads of 2400 Pa (DL: 1600 Pa).
- Clamping in the red zone is not permitted (0 - 250 mm, > 350 mm on long side, entire length of short side).



**Figure 49: Module clamping zones REC 72 cell modules**










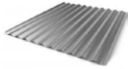

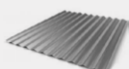






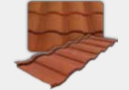




Description	Roof Type	Material	Mass	Bracket
Domestic Tile Roof Bracket In Land Standard Fix or Bottom Fix		Galvanised Steel	0.472kg	
Domestic Tile Roof Bracket Coastal Standard Fix or Bottom Fix		Stainless Steel / Hot Dipped	0.472kg	
IBR Roof Bracket (across the rib)		Aluminium Alloy 6063 T6 Class/ Type-21	0.096kg	
IBR Roof Bracket (along the rib)		Aluminium Alloy 6063 T6 Class/ Type-21	0.096kg	
Corrugated L-Bracket Comes complete with foam gasket		Aluminium Alloy 6063 T6 Class/ Type-21	0.053kg	
Corrugated C-Bracket Comes complete with foam gasket		Aluminium Alloy 6063 T6 Class/ Type-21	0.075kg	
Slate Tile Roof Bracket Double Thread Screw-Hanger Bolt M10/250mm or M12/300mm		Stainless Steel	0.485kg	
Asbestos roof - Hangerbolt solution available for wood substructure		Aluminium Alloy 6063 T6 Class/ Type-21	0.045kg	
Corrugated L-Bracket comes complete with foam gasket for metal substructure		Stainless Steel	0.485kg	
Nu Rib / Widedek Roof Standard L-Bracket Long L-Bracket		Aluminium Alloy 6063 T6 Class/ Type-21	0.045kg	
Harvey Tile Roof Bracket Standard L-Bracket Long L-Bracket		Aluminium Alloy 6063 T6 Class/ Type - 21	0.045kg	
Brown-built Roof Bracket With Slot or Stud No Penetration		Aluminium Alloy 6063 T6 Class/ Type-21	0.278kg	
Klip-Lok Roof Bracket with Slot or Stud		Aluminium Alloy 6063 T6 Class/ Type-21	0.315kg	

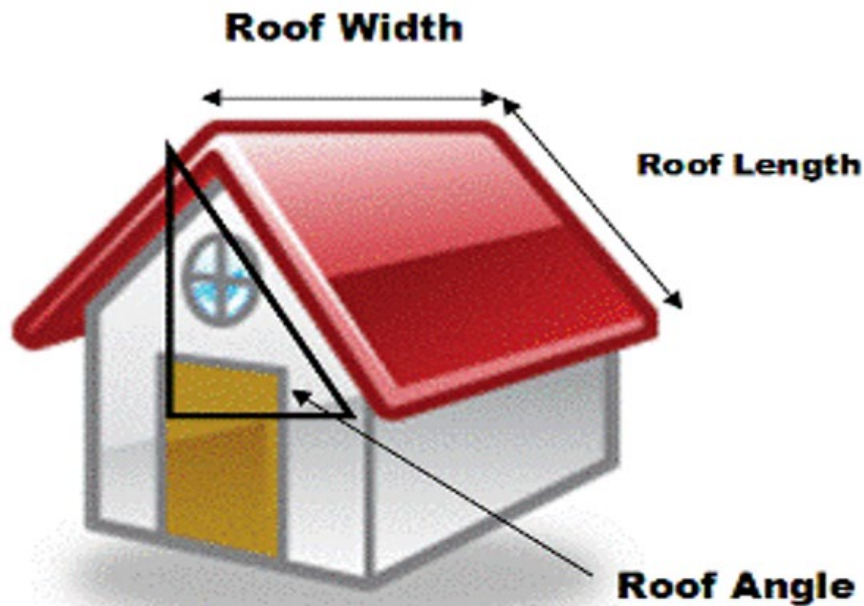
Figure 50: Common Roof Mounting Systems (source: <https://valsa.co.za/>)



### 3.2.3 Measuring the roof

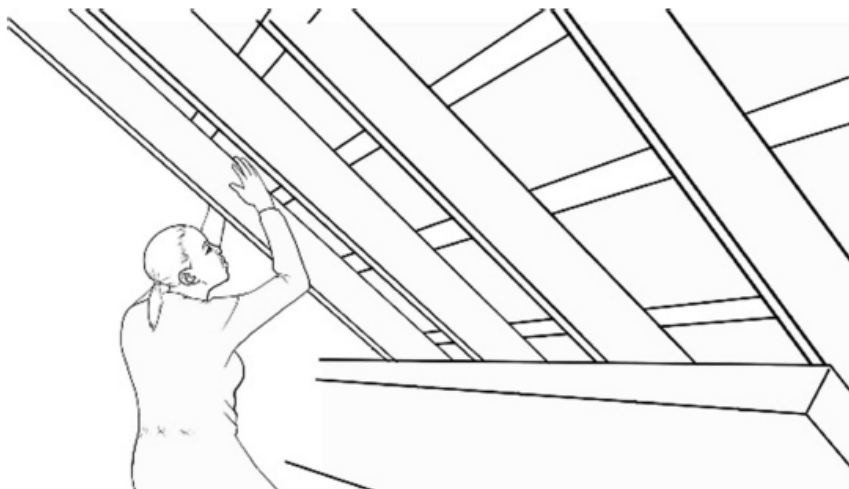
Measuring the roof entails the following:

- Measure and confirm available space for solar modules
- Remember to keep space for walking around the modules (at least 400mm).



**Figure 51: available space on the roof**

- With the size of the roof and the space for walking around, confirm that the number of modules can fit.
  - Use the length and width of the modules from the datasheet;
  - Include 20mm space between modules for the clamps to fit;
- Locate rafters or trusses on the inside of the roof



- Locate and Measure the locations of the rafters in the attic or at the outside eave, and transfer measurements to the roof. The rafter spacing will determine the location of roof hooks.
- Measure the purlin distances
- Draw a sketch of the roof
- The roof hooks are fastened onto the rafters at purlin spacing.

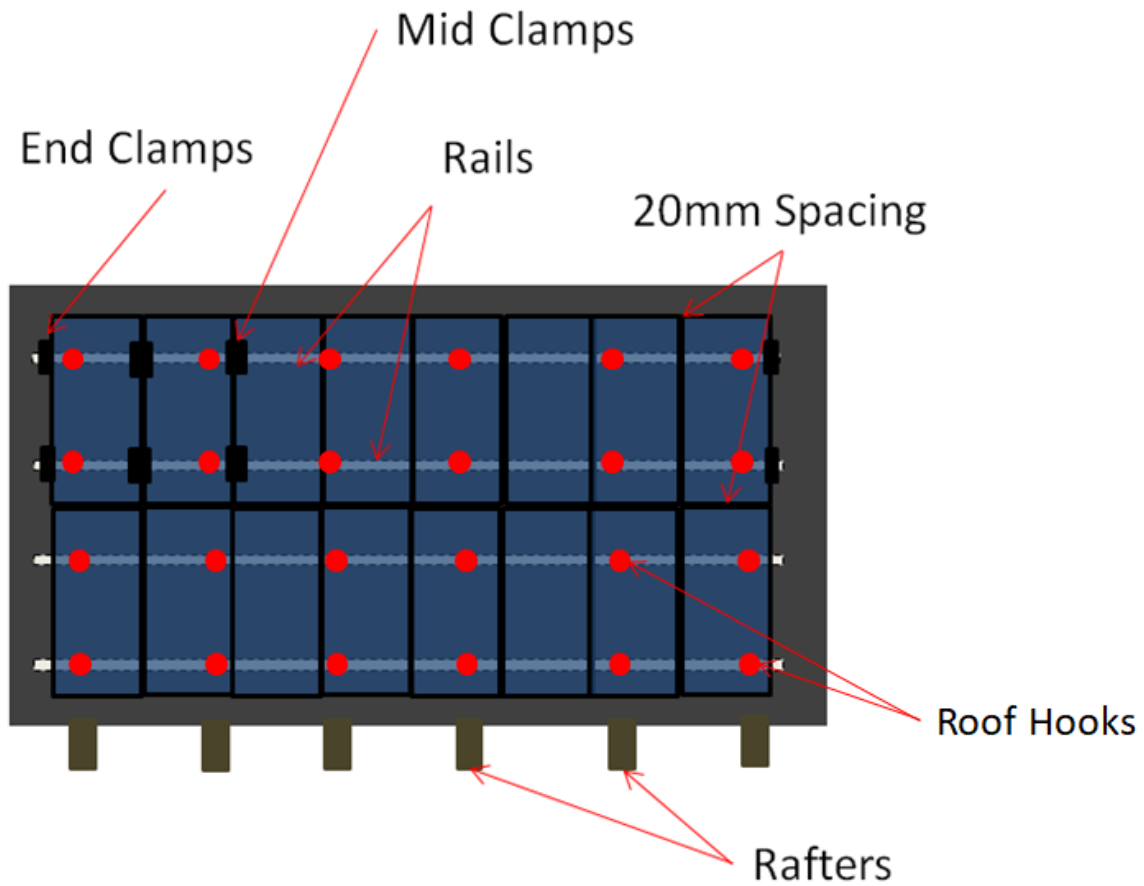
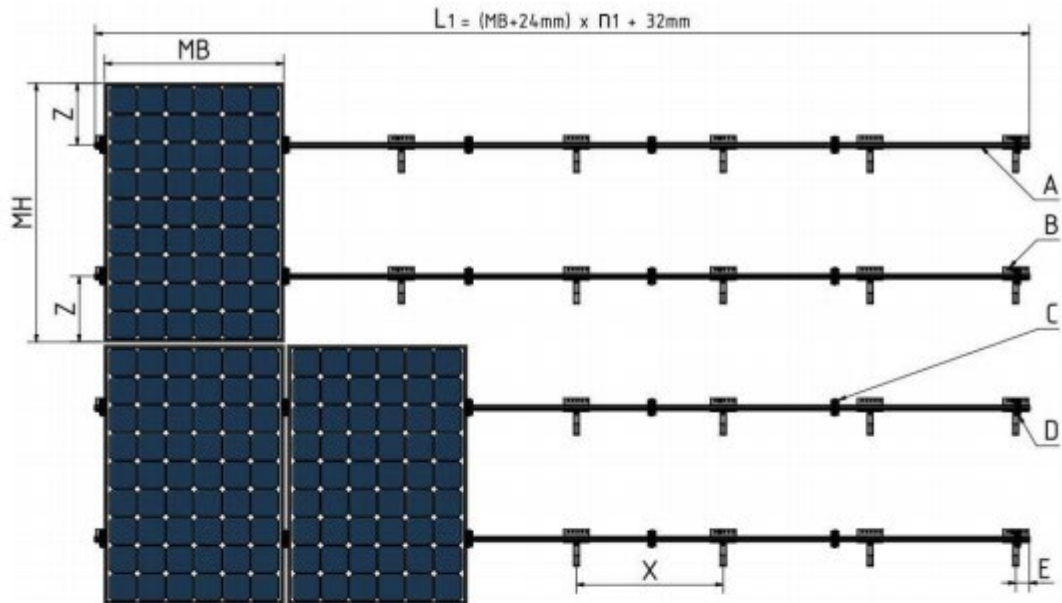


Figure 52: Roof Layout for a tile roof



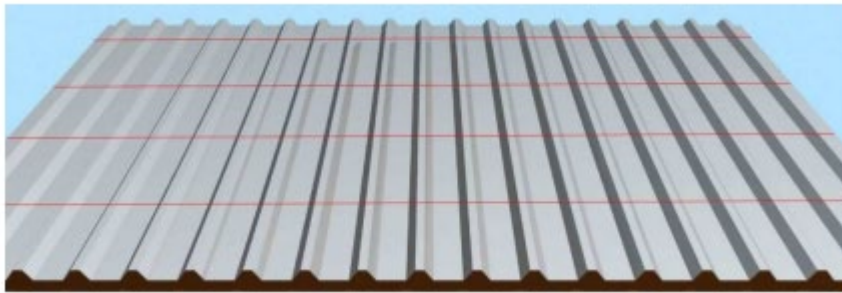
	Description
$L = (MB + 24 \text{ mm}) \times n + 32 \text{ mm}$	Carrier rail length = (MB + 24 mm) × number of modules per row + 32 mm
MB	Module width
MH	Module height
A	Type TF50/TF50m/TF60 carrier rail
B	Roof hooks
C	Middle clamp
D	Outside clamp
E	Max. 400mm
X	X – selected fixing interval (dimensioned using PV Manager software)
Z	Max. ¼ of the module height (please observe module manufacturer specifications)

**Figure 53: IBC Topfix mounting system**

### 3.2.4 General considerations

Some roofs are better suited for portrait mounting while others are better suited for landscape.

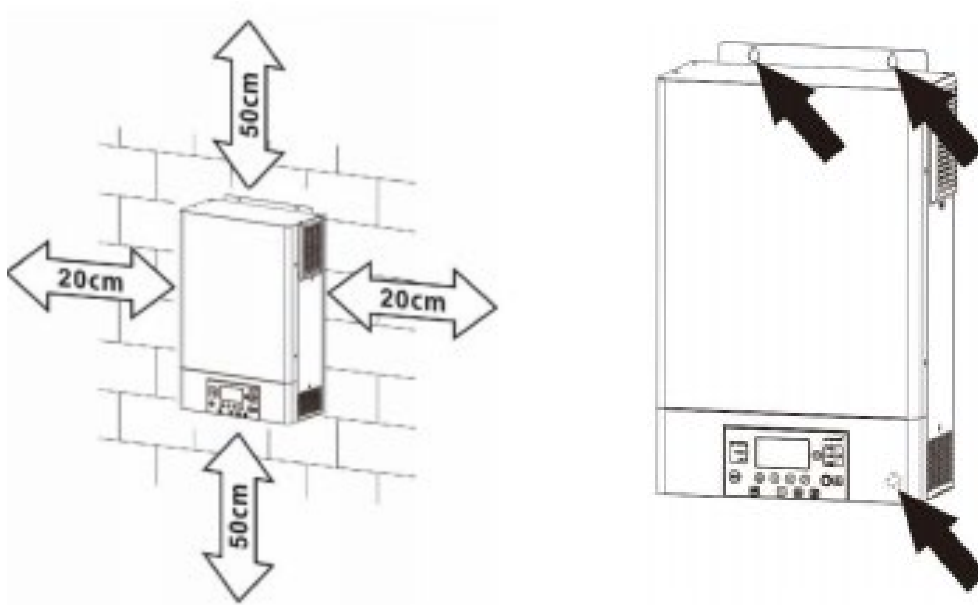
- For tile roofs, portrait mounting is normally easier as the rails are fixed to the rafters;
- For corrugated roofs, landscape mounting is easier as the rails are fixed to the purlins
- For IBR roofs and non-penetrating roofs like seam roofs where the roof clips are mounted directly on the metal, either portrait or landscape can be used. The space of the seams will dictate. If the space between seams is larger than the clamping zone length of the module, landscape mounting cannot guarantee that the modules will be in the clamping zones. Portrait mounting will give total control to space the rails to fit within the clamping zones.



**Figure 54: Marking fixing points on IBR roof (IBC Solar)**

### 3.3 Charge Controller and Inverter

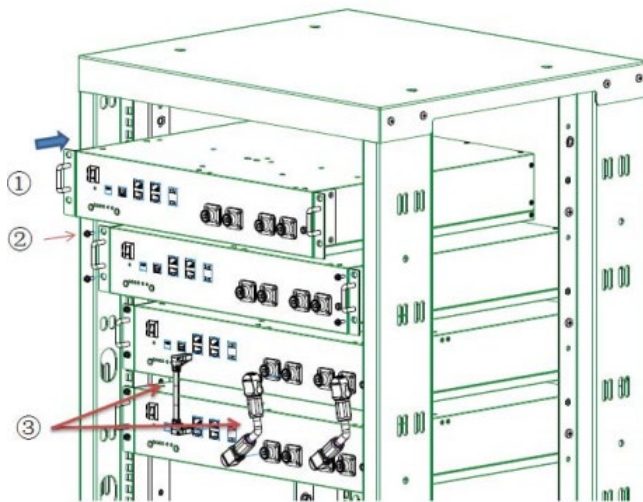
The installation manuals for the charge controller and the inverter (or hybrid inverter) will indicate the mounting holes positions. It will also indicate the space required around the unit to be kept open for air circulation



**Figure 55: Phocos Anygrid mounting holes and spacing**

### 3.4 Batteries

The size and type of batteries will determine the mounting points. This information can be found in the battery datasheet or installation manual. Some batteries have to stand upright; others can be placed on their sides etc.



**Figure 56: Extract from Pylontech battery installation manual**

<b>Self-Check - 2</b>	<b>Written Test</b>
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Answer all the questions listed below. Use the Answer sheet provided in the next page:

N°	Questions and answers
<b>1</b>	<b>What is wire marking and why it is needed?(4)</b>
<b>2</b>	<b>Why is clamping zones important? (2)</b>

Satisfactory	5 points
Unsatisfactory	Below 4 points

**Answer Sheet**

Score = _____
Rating: _____

Name

Date

#### 4 Clearing site from rubble & obstruction

Before starting with the installation of the PV system, the site needs to be prepared (see LO3 Information Sheet 1). Part of this preparation is to clean the site from obstructions, unwanted vegetation and rubble.

There may be no other choice than to trim or remove certain trees or other structures.



<b>Self-Check - 3</b>	<b>Written Test</b>
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Answer all the questions listed below. Use the Answer sheet provided in the next page:

N°	Questions and answers
1	<b>Why it is important to clean the installation site?</b>

Satisfactory	2 points
Unsatisfactory	Below 1 points

**Answer Sheet**

Score = \_\_\_\_\_

Rating: \_\_\_\_\_

Name

Date