



| Connecting Strength

K2 Base Report

Prime Point

Project address	Kirkby Bank Rd, Liverpool L33
Customer	Construction and Property
Company	CEF Ltd
Author	National Renewables
Issue date & version	27/01/2025 K2 Base Version 3.2.23.1



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About us

K2 Systems. Innovative mounting system from a strong team.

Since 2004 we have been developing pioneering and highly functional mounting system solutions for photovoltaic installations around the world. Our systems are designed in our own product development department where we continually optimize and adapt mounting systems to the ever-changing market.

A knowledgeable and friendly team

Just like a mountain climbing team, K2 Systems is built on mutual trust. This applies to our customer service as well as within the company itself, because we believe a trusting partnership leads to successful photovoltaic projects.

Our employees place total focus on the needs and wishes of our customer. This is true in all company departments.

10 locations and worldwide sales network

In our international team, everyone works together to provide customers with competent, comprehensive and entirely personalized service.

This is especially true in the constant training our employees undergo with regards to product optimization, quality assurance, or innovations in construction techniques.

Quality management and certificates

K2 Systems stands for Connecting Strength, the highest quality, and precision-crafted and customized components. Our customers and business partners deeply appreciate all of these factors. Three independent authorities have tested, confirmed, and certified our skills and components. External authorities are not the only ones to have put K2 Systems to the test. Our internal quality control ensures that all our products are subject to a constant review process.

These measures all ensure the outstanding quality standards that exemplify products from K2 Systems, and which we maintain through largely exclusive "Made in Germany" or "Made in Europe" practices.



Product guarantee

K2 Systems offers a 12-year product warranty on all products in its integrated range. The use of high quality materials and a three-level quality inspection ensure these standards.

In a nutshell

As roof-top specialists, we offer effective and economical solutions for roofs all around the world and provide professional, fast and reliable support for our customers in the solar industry.

The static report is not including module and building verification.



Project overview

Roofs

Roof	System	Module	Height	Quantity	Total power
Roof 1  Trapezoidal	MiniRail MK2	JAM54D40-450/LB 1,762×1,134×30 mm 450 Wp	10.60 m	66	29.7 kWp
Roof 2  Trapezoidal	MiniRail MK2	JAM54D40-450/LB 1,762×1,134×30 mm 450 Wp	10.60 m	22	9.9 kWp
Total				88	39.60 kWp

Project information

Address	Kirkby Bank Rd, Liverpool L33
Customer	Construction and Property
Author	National Renewables

Load settings

Design method	BS EN
Failure consequence class (CC)	CC1
Design working life	25 years
Terrain category	Town Terrain
Basic wind speed	23.0 m/s
Distance to shoreline	20.00 km
Distance inside town terrain	3.00 km
Snow load zone	3
Snow load on ground level	0.50 kN/m ²

Material values

Aluminium EM-AW 6063 (EP, ET, ER/B) T66

Elastic module	E = 70.000 N/mm ²
Shear module	G = 26.923 N/mm ²
Density	g = 2.700 kg/m ³
Thermal coefficient	α _T = 2.3e ⁻⁵
Yielding strength	f _{o,k} = 200 N/mm ²
Ultimate strength	f _{u,k} = 245 N/mm ²

THE PROJECT IS VERIFIED.

The selected mounting system can be installed as planned



Project overview



Thank you for choosing a K2 mounting system.

Prime Point

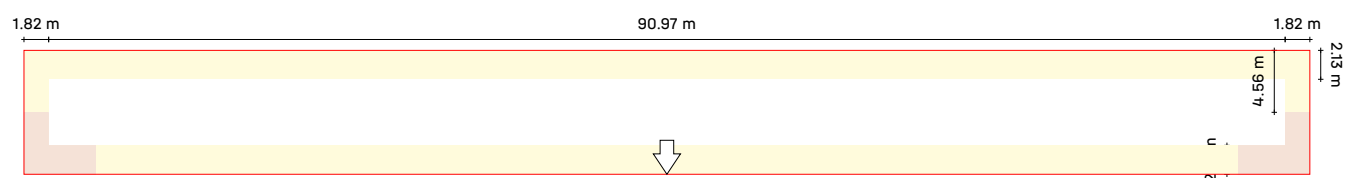


Project information

Address	Kirkby Bank Rd, Liverpool L33
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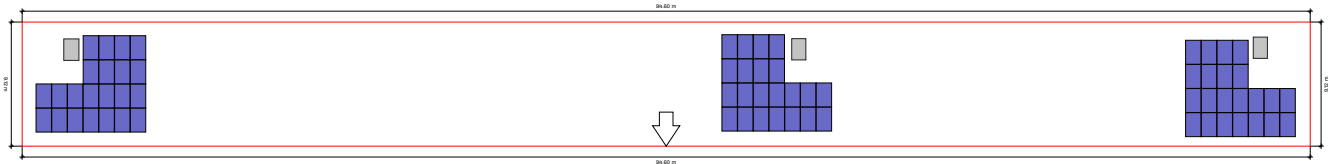


Roofs | Roof 1



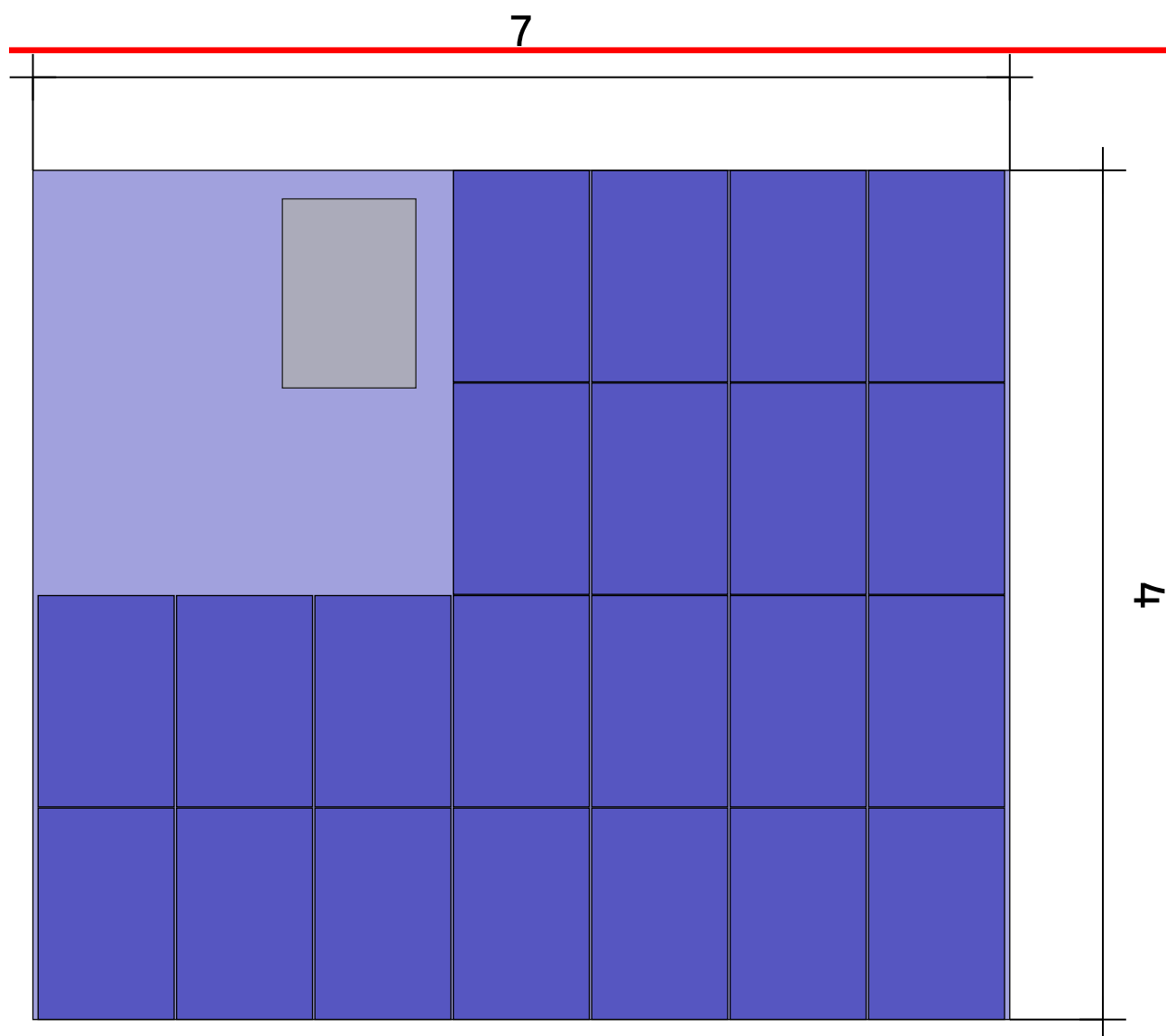


Roofs | Roof 1



Roof	System	Module	Height	Quantity	Total power
<u>Roof 1</u>  Trapezoidal	<u>MiniRail MK2</u>	JAM54D40-450/LB 1,762×1,134×30 mm 450 Wp	10.60 m	66	29.7 kWp

Roofs | Roof 1 | Module array 1



Roof ① Module array ①

Mounting System

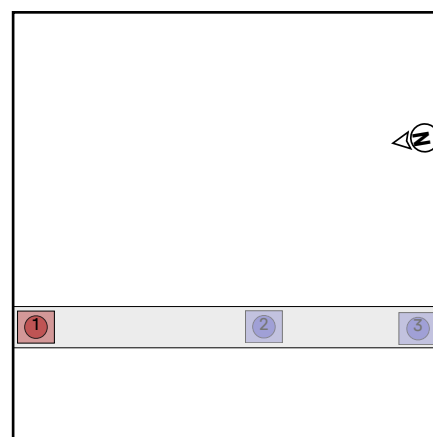
[MiniRail MK2](#)

Module

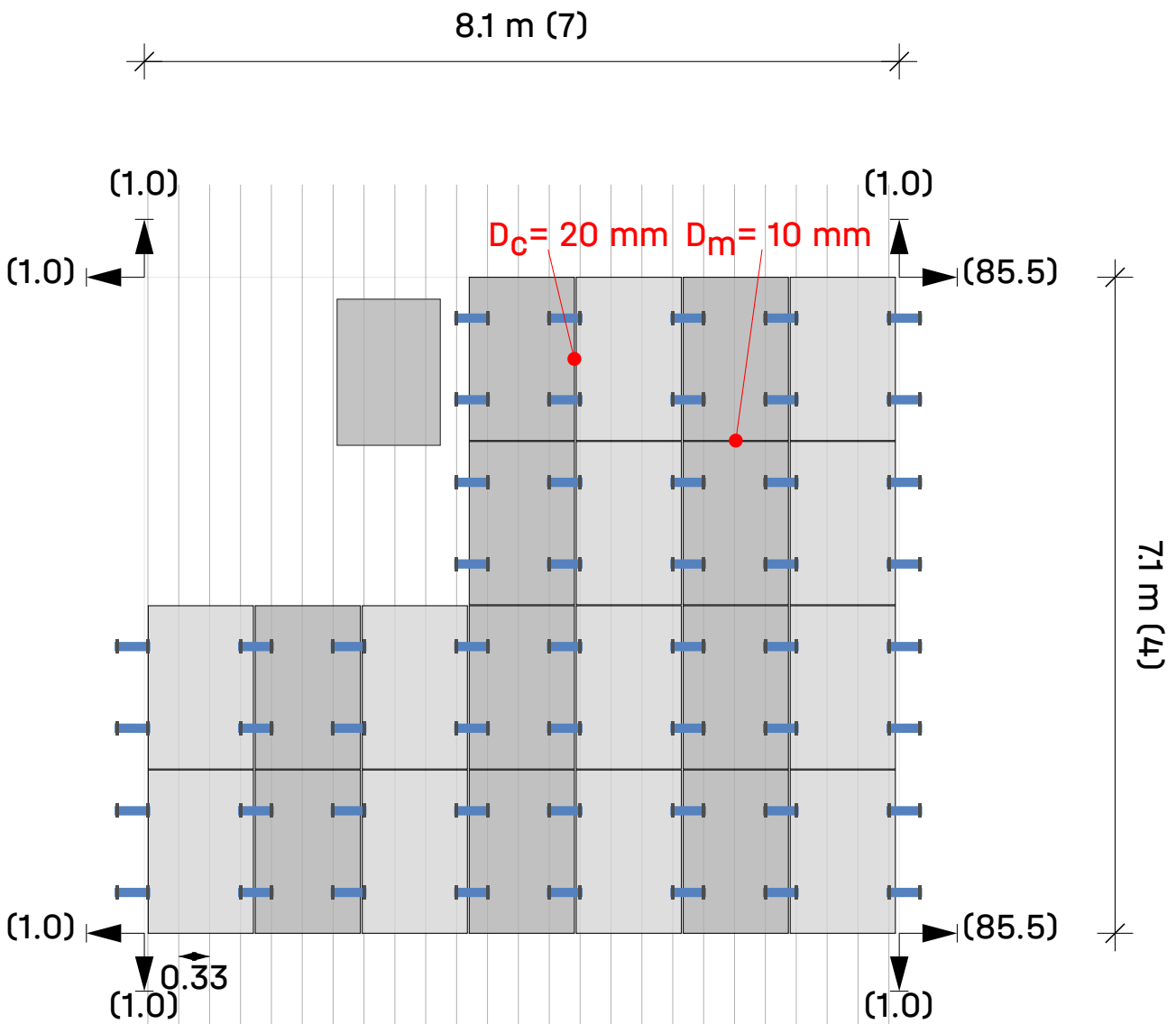
22(9.9 kWp) x
JAM54D40-450/LB

Row spacing

1.77 m



Roofs | Roof 1 | Module array 1 | Module blocks

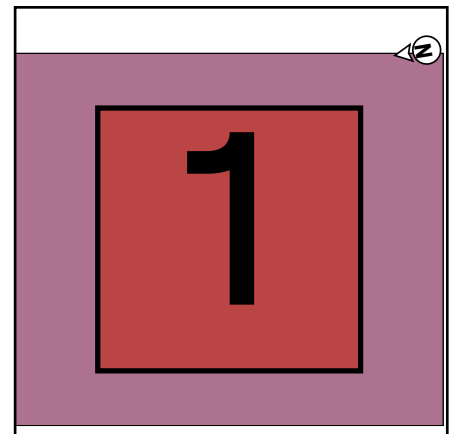


Roof ① Module array ① Module block 1

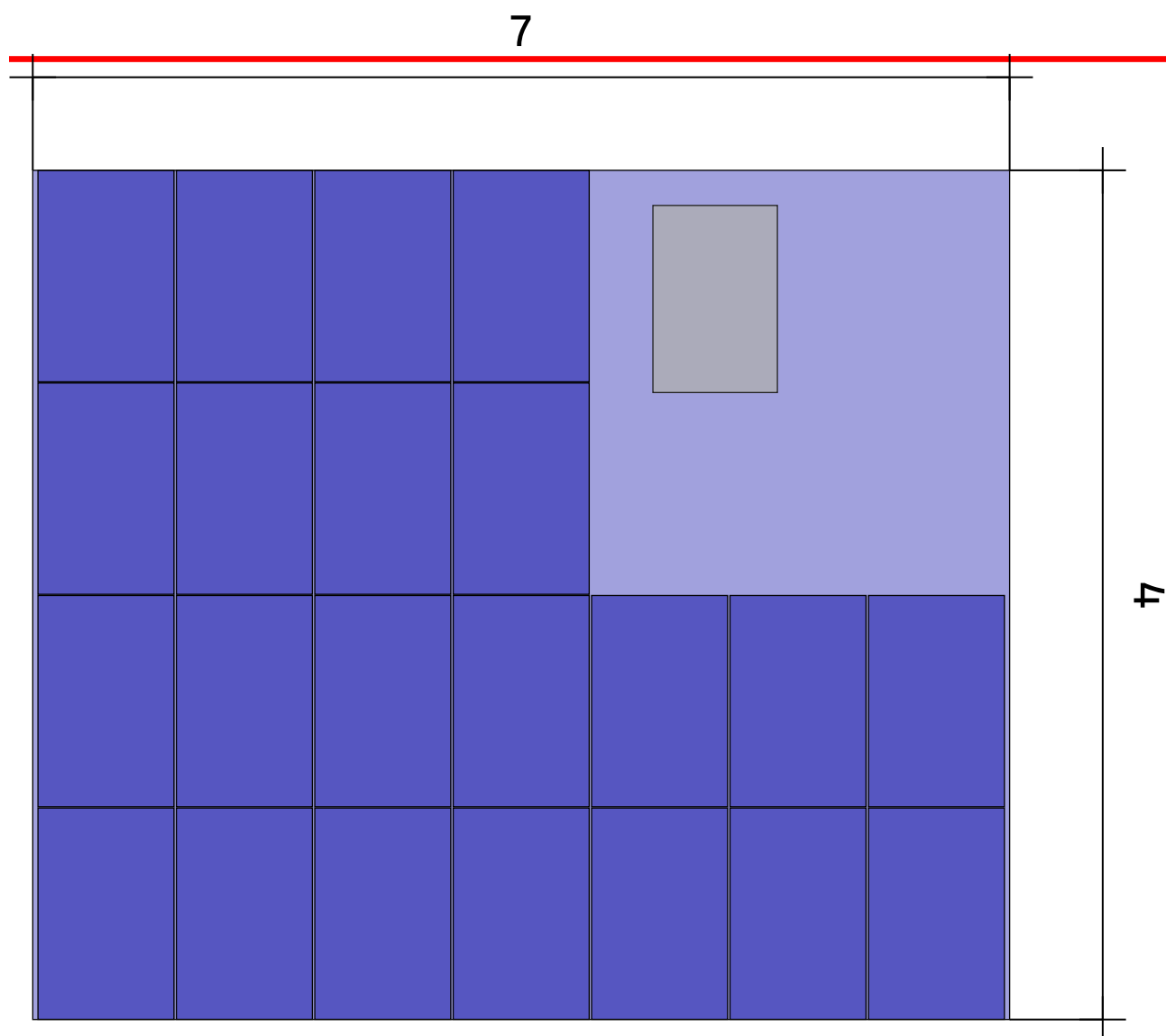
Modules $(7 \times 4) - 6 = 22$

Legend

- Fastener
- Distance to Roof Edge [m]
- D_c Distance for clamping between modules
- D_m Distance between modules



Roofs | Roof 1 | Module array 2



Roof ① Module array ②

Mounting System

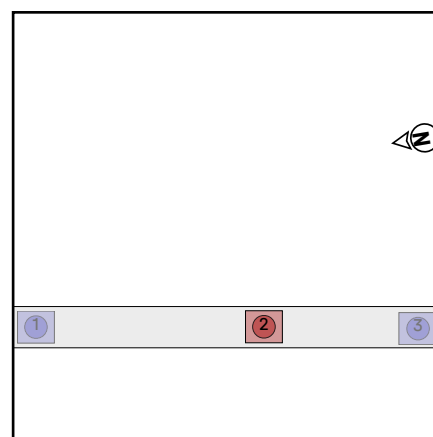
[MiniRail MK2](#)

Module

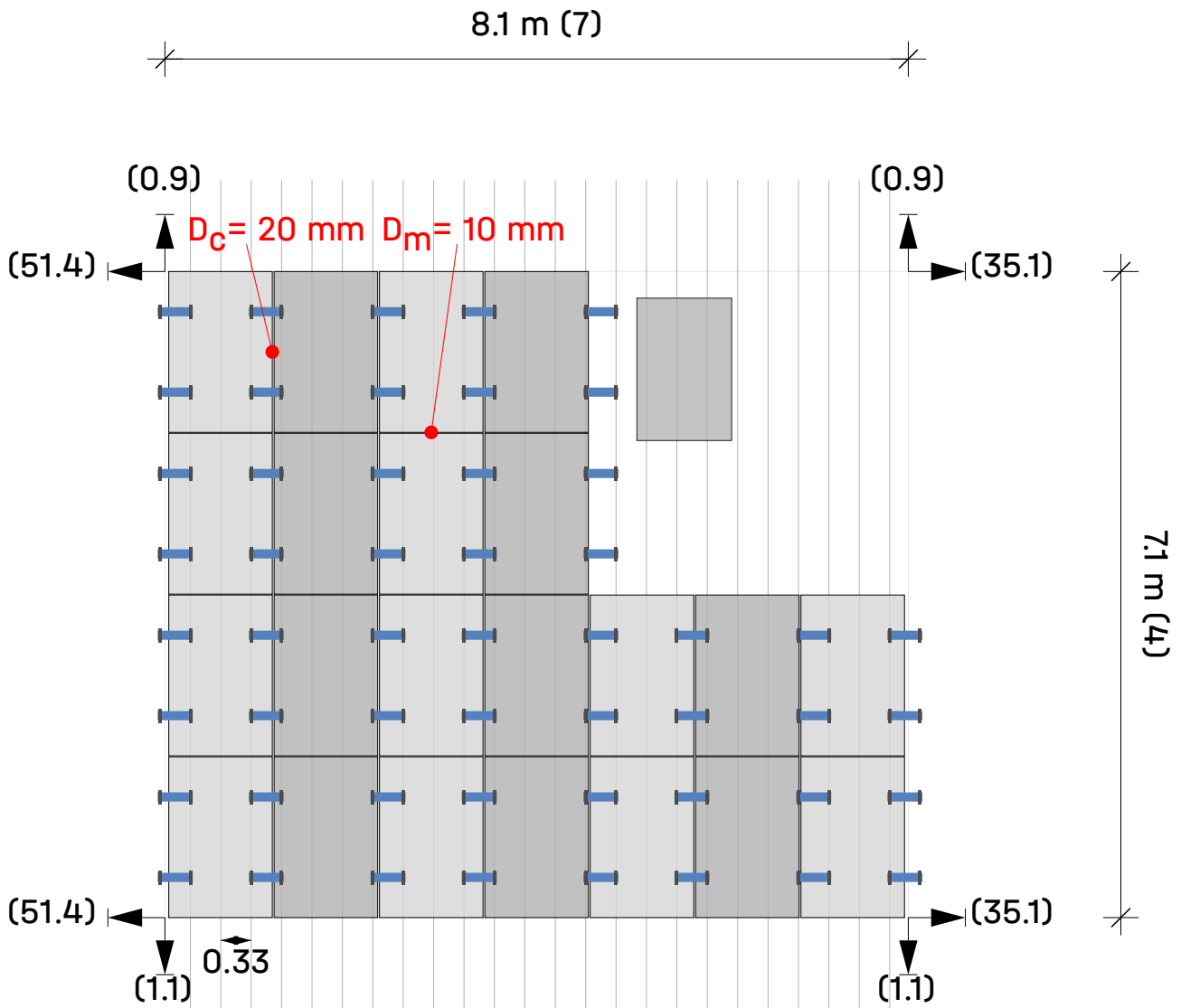
22(9.9 kWp) x
JAM54D40-450/LB

Row spacing

1.77 m



Roofs | Roof 1 | Module array 2 | Module blocks

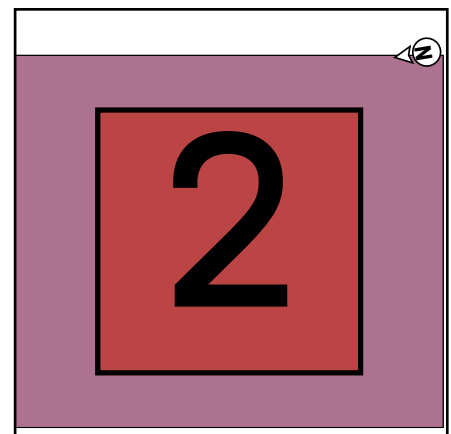


Roof ① Module array ② Module block ②

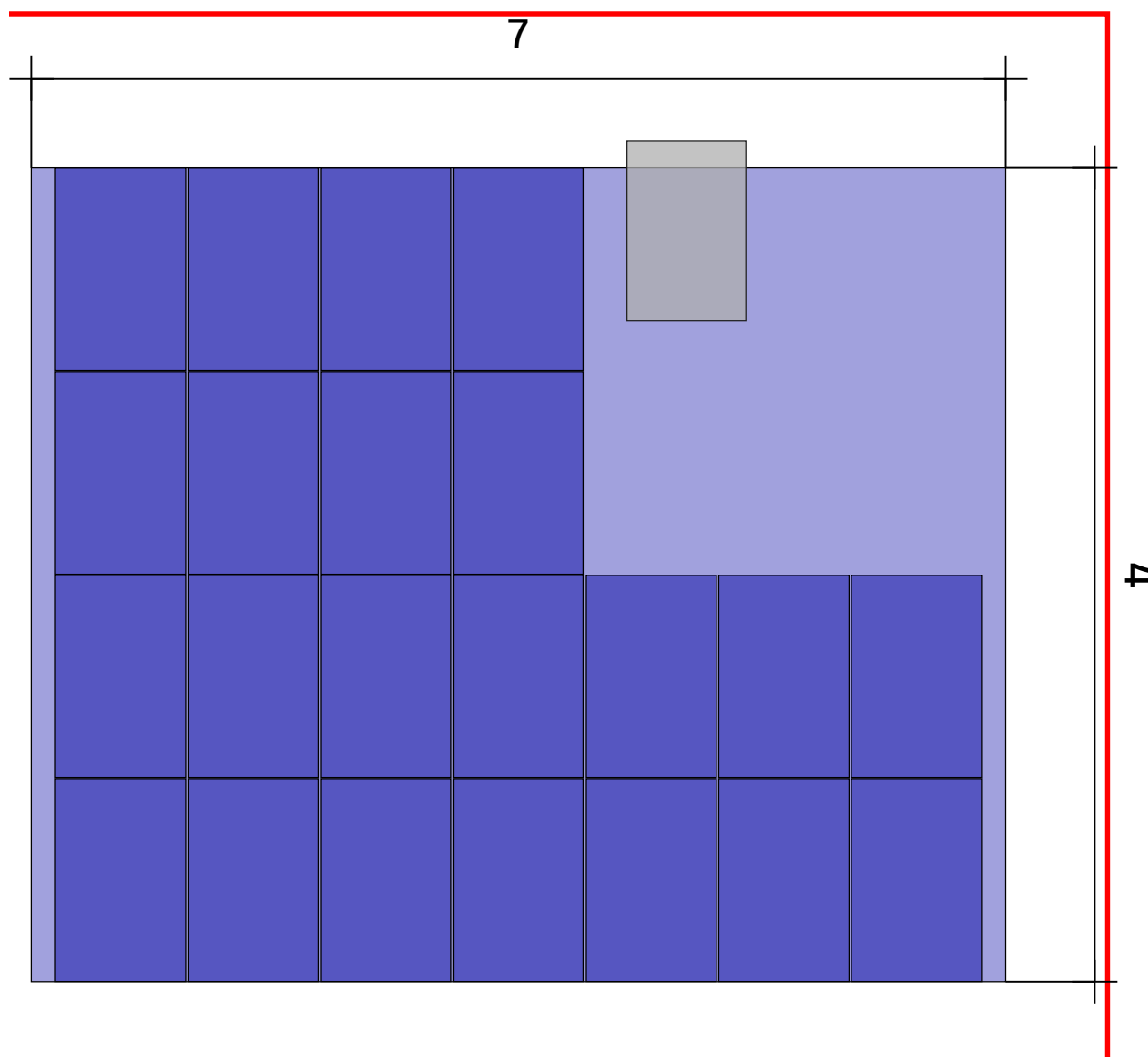
Modules $(7 \times 4) - 6 = 22$

Legend

- Fastener
- Distance to Roof Edge [m]
- D_c Distance for clamping between modules
- D_m Distance between modules



Roofs | Roof 1 | Module array 3



Roof ① Module array ③

Mounting System

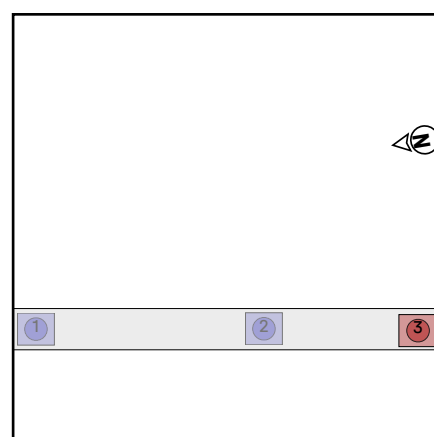
[MiniRail MK2](#)

Module

22(9.9 kWp) x
JAM54D40-450/LB

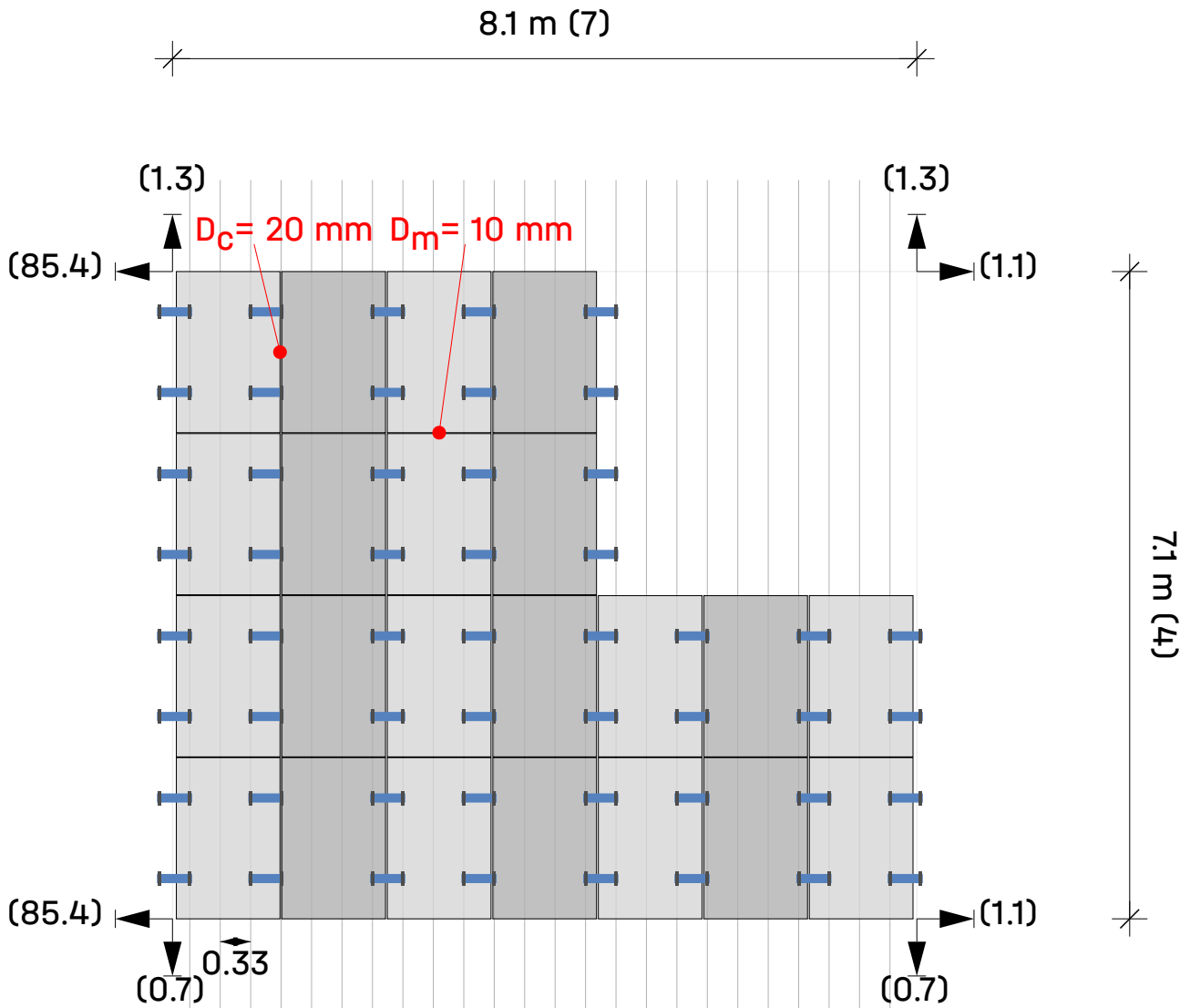
Row spacing

1.77 m





Roofs | Roof 1 | Module array 3 | Module blocks

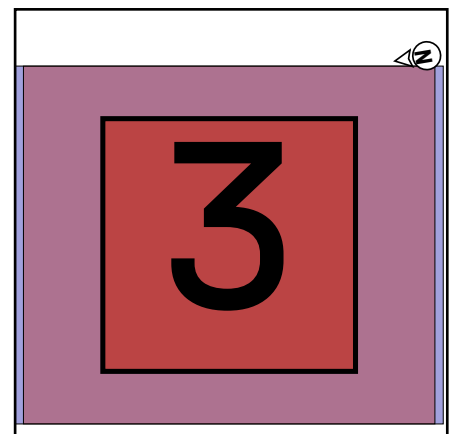


Roof ① Module array ③ Module block ③

Modules $(7 \times 4) - 6 = 22$

Legend

- Fastener
- Distance to Roof Edge [m]
- D_c Distance for clamping between modules
- D_m Distance between modules





Results | Roof 1

Roof	System	Module	Height	Quantity	Total power
<u>Roof 1</u>  Trapezoidal	<u>MiniRail MK2</u>	JAM54D40-450/LB 1,762×1,134×30 mm 450 Wp	10.60 m	66	29.7 kWp

Module

Name	JAM54D40-450/LB
Manufacturer	Shanghai JA Solar Technology Co. Ltd.
Output power	450 Wp
Dimensions	1,762×1,134×30 mm
Weight	22.0 kg

Components

Fastener	Thread-forming metal screw 6.0×25
Base rails	K2 MiniRail MK2

Loads on modules (module dimensioning)

Array	A-TrA [m ²]	ultimate state [Pa]				Serviceability [Pa]			
		Pressure ⊥	Pressure 	Uplift ⊥	Uplift 	Pressure ⊥	Pressure 	Uplift ⊥	Uplift
field area	2.00	606.8	53.1	-410.4	9.8	481.2	42.1	-297.6	9.8
ridge	2.00	606.8	53.1	-671.8	9.8	481.2	42.1	-502.6	9.8
gableboard	2.00	606.8	53.1	-846.0	9.8	481.2	42.1	-639.3	9.8
corner region (eave)	2.00	606.8	53.1	-1,630.2	9.8	481.2	42.1	-1,254.4	9.8
eaves	2.00	606.8	53.1	-933.2	9.8	481.2	42.1	-707.6	9.8
field area	2.00	606.8	53.1	-410.4	9.8	481.2	42.1	-297.6	9.8
ridge	2.00	606.8	53.1	-671.8	9.8	481.2	42.1	-502.6	9.8
eaves	2.00	606.8	53.1	-933.2	9.8	481.2	42.1	-707.6	9.8
field area	2.00	606.8	53.1	-410.4	9.8	481.2	42.1	-297.6	9.8
ridge	2.00	606.8	53.1	-671.8	9.8	481.2	42.1	-502.6	9.8
corner region (eave)	2.00	606.8	53.1	-1,630.2	9.8	481.2	42.1	-1,254.4	9.8
eaves	2.00	606.8	53.1	-933.2	9.8	481.2	42.1	-707.6	9.8



Results | Roof 1

Utilisation result

No.	roof areas	middle clamp utilisation [%]	end clamp utilisation [%]	ultimate limit state Rails [%]	ultimate limit state screw [%]	Pull Through utilisation [%]
Module Array						
1	field area	8.2	7.8	20.1	22.5	10.1
1	ridge	13.4	12.8	22.1	36.5	16.5
1	gableboard	16.9	16.1	27.7	45.8	20.8
1	corner region (eave)	32.6	31.1	53.2	87.7	40.0
1	eaves	18.6	17.8	30.6	50.4	22.9
2	field area	8.2	7.8	20.1	22.5	10.1
2	ridge	13.4	12.8	22.1	36.5	16.5
2	eaves	18.6	17.8	30.6	50.4	22.9
3	field area	8.2	7.8	20.1	22.5	10.1
3	ridge	13.4	12.8	22.1	36.5	16.5
3	corner region (eave)	32.6	31.1	53.2	87.7	40.0
3	eaves	18.6	17.8	30.6	50.4	22.9



Results | Roof 1

Important Information

- The structure was statically verified in accordance with Eurocode 9: Design of aluminium structures (DIN EN 1999-1-1:2021) and offers sufficient load-bearing capacity and stability for the loads specified in the chapter 'Maximum actions on the components'.
- Adjustment factor for wind load regarding service life period, f_W , is according to DIN EN 1991-1-4/ NA, NDP for 4.2 (2P) note 5, table 3
- Adjustment factor for snow load regarding service life period, f_S , is according to DIN EN 1991-1-3/ annex D, table 4
- The structural design complies with BS EN 1990 - Basis of Structural Design.
- Snow loads are determined in accordance with National Annex BS NA EN 1991-1-3 (2018) - UK National Annex to EC1 - Action on structures - general actions - snow loads.
- Wind loads are determined in accordance with National Annex BS NA EN 1991-1-4 - UK National Annex to EC1 - Action on structures, general actions - wind actions.
- Service life is recognised according to 'Eurocode EN 1991 - Action on structures, Snow loads' and 'Eurocode EN 1991 - Actions on structures, Wind actions'. Subject to the Building Regulations and for security-relevant reasons the installation has to be dismantled at the end of its service life.
- Failure consequence class is considered according to 'Eurocode EN 1990 - Basis of structural design'.
- The person responsible for the execution of the work must check the load assumptions made with the conditions on site. If deviations are found, the person who prepared the static calculation must be consulted immediately. , in particular § 2 ("technical and specialist requirements for the customer"), § 7 ("warranty provisions") and § 8 ("limitation of liability").



Structural analysis report | Roof 1

General information

Name	Prime Point
Mounting System	MiniRail MK2
Author	National Renewables

Location information

Address	Kirkby Bank Rd, Liverpool L33
Ground elevation	39.05 m

Roof information

Building height	10.60 m
Roof type	Gable roof
Roof pitch	5°
Roof covering	Trapezoidal
Min. roof edge distance	0.00 m
Crest distance	333.0 mm
Crest width	30.0 mm
Crest height	35.0 mm
Roof material	Steel
Sheet quality	S235
Sheet thickness	0.500 mm

Loads

Design method	BS EN
Failure consequence class (CC)	CC1
Design working life	25 years
Terrain category	Town Terrain
Distance to shoreline	20.00 km
Distance inside town terrain	3.00 km

Wind load

Velocity pressure, 50 years	$q_{p,50} = 0.742 \text{ kN/m}^2$
Adjustment factor for service life	$f_w = 1.000$
Velocity pressure, 25 years	$q_{p,25} = 0.683 \text{ kN/m}^2$

Structural analysis report | Roof 1

Roof areas

Array	load impact area [m ²]	maxCpe ₂	minCpe ₂	wind pressure [kN/m ²]	wind suction [kN/m ²]
field area	2.00	0.000	-0.600	0.000	-0.410
ridge	2.00	0.000	-0.900	0.000	-0.615
gableboard	2.00	0.000	-1.100	0.000	-0.752
corner region (eave)	2.00	0.000	-2.000	0.000	-1.367
eaves	2.00	0.000	-1.200	0.000	-0.820
field area	2.00	0.000	-0.600	0.000	-0.410
ridge	2.00	0.000	-0.900	0.000	-0.615
eaves	2.00	0.000	-1.200	0.000	-0.820
field area	2.00	0.000	-0.600	0.000	-0.410
ridge	2.00	0.000	-0.900	0.000	-0.615
corner region (eave)	2.00	0.000	-2.000	0.000	-1.367
eaves	2.00	0.000	-1.200	0.000	-0.820

Snow load

Snow load zone	3
Snow guard	No
Snow load on ground level	$s_k = 0.500 \text{ kN/m}^2$
Shape Coefficient for Snow	$\mu_i = 0.800$
Factor for roof pitch	$d_i = 0.996$
Snow load on roof, 50 year	$s_{i,50} = 0.398 \text{ kN/m}^2$
Adjustment factor for service life	$f_s = 1.000$
Snow load on roof, 25 years	$s_{i,25} = 0.370 \text{ kN/m}^2$

Dead Load

Weight of module	$G_M = 22.0 \text{ kg}$
Weight of mounting system per module	$= 1.0 \text{ kg}$
Module area	$A_M = 2.00 \text{ m}^2$
Dead weight of module per m ²	$= 11.01 \text{ kg/m}^2$
Dead weight of mounting system per m ²	$= 0.50 \text{ kg/m}^2$
Total Dead Load (excl. ballast) per m ²	$= 0.11 \text{ kN/m}^2$

Load Combinations



Structural analysis report | Roof 1

Ultimate limit state

Partial safety factor unfavourable permanent load	$\gamma_{G,sup} = 1.35$
Partial safety factor favourable permanent load	$\gamma_{G,inf} = 1.00$
Partial safety factor destabilising permanent load	$\gamma_{G,dst} = 1.10$
Partial safety factor stabilising permanent load	$\gamma_{G,stab} = 0.90$
Partial safety factor variable loads	$\gamma_Q = 1.50$
Combination coefficient with regards to wind	$\psi_{0,W} = 0.60$
Combination coefficient with regards to wind (additional varying influences)	$\psi_{1,W} = 0.20$
Combination coefficient with regards to Snow	$\psi_{0,S} = 0.50$
Importance factor permanent	$k_{Fl,G} = 0.90$
Importance factor variable	$k_{Fl,Q} = 0.85$
Characteristic dead weight	G_k
Characteristic snow load on the roof	$S_{i,n}$
Characteristic wind load	W_k

Load case combination 01	$LCC\ 01_{uls} = \gamma_{G,sup} * k_{Fl,G} * G_k + \gamma_Q * k_{Fl,Q} * S_{i,n}$
Load case combination 02	$LCC\ 02_{uls} = \gamma_{G,sup} * k_{Fl,G} * G_k + \gamma_Q * k_{Fl,Q} * W_{k,Pressure}$
Load case combination 03	$LCC\ 03_{uls} = \gamma_{G,sup} * k_{Fl,G} * G_k + \gamma_Q * k_{Fl,Q} * (W_{k,Pressure} + \psi_{0,S} * S_{i,n})$
Load case combination 04	$LCC\ 04_{uls} = \gamma_{G,sup} * k_{Fl,G} * G_k + \gamma_Q * k_{Fl,Q} * (S_{i,n} + \psi_{0,W} * W_{k,Pressure})$
Load case combination 06	$LCC\ 06_{uls} = \gamma_{G,inf} * G_k + \gamma_Q * k_{Fl,Q} * W_{k,Suction}$

Serviceability limit state

Combination coefficient with regards to wind	$\psi_{0,W} = 0.60$
Combination coefficient with regards to Snow	$\psi_{0,S} = 0.50$

Load case combination 01	$LCC\ 01_{sls} = G_k + S_{i,n}$
Load case combination 02	$LCC\ 02_{sls} = G_k + W_{k,Pressure}$
Load case combination 03	$LCC\ 03_{sls} = G_k + W_{k,Pressure} + \psi_{0,S} * S_{i,n}$
Load case combination 04	$LCC\ 04_{sls} = G_k + S_{i,n} + \psi_{0,W} * W_{k,Pressure}$
Load case combination 06	$LCC\ 06_{sls} = G_k + W_{k,Suction}$

Structural analysis report | Roof 1

Maximum load on modules (Mounting system dimensioning)

Array	A-TrA [m ²]	ultimate state [kN/m ²]				Serviceability [kN/m ²]			
		Pressure ⊥	Pressure 	Uplift ⊥	Uplift 	Pressure ⊥	Pressure 	Uplift ⊥	Uplift
field area	2.00	0.607	0.053	-0.410	0.010	0.481	0.042	-0.298	0.010
ridge	2.00	0.607	0.053	-0.672	0.010	0.481	0.042	-0.503	0.010
gableboard	2.00	0.607	0.053	-0.846	0.010	0.481	0.042	-0.639	0.010
corner region (eave)	2.00	0.607	0.053	-1.630	0.010	0.481	0.042	-1.254	0.010
eaves	2.00	0.607	0.053	-0.933	0.010	0.481	0.042	-0.708	0.010
field area	2.00	0.607	0.053	-0.410	0.010	0.481	0.042	-0.298	0.010
ridge	2.00	0.607	0.053	-0.672	0.010	0.481	0.042	-0.503	0.010
eaves	2.00	0.607	0.053	-0.933	0.010	0.481	0.042	-0.708	0.010
field area	2.00	0.607	0.053	-0.410	0.010	0.481	0.042	-0.298	0.010
ridge	2.00	0.607	0.053	-0.672	0.010	0.481	0.042	-0.503	0.010
corner region (eave)	2.00	0.607	0.053	-1.630	0.010	0.481	0.042	-1.254	0.010
eaves	2.00	0.607	0.053	-0.933	0.010	0.481	0.042	-0.708	0.010

Resistance Values of Components

Base Rails

Base Rails	A [cm ²]	I _y [cm ⁴]	I _z [cm ⁴]	W _y [cm ³]	W _z [cm ³]	F _{p,Rd} [kN]
K2 MiniRail MK2	2.710	2.15	9.27	1.37	2.17	1.42

F_{p,Rd} Pull-through resistance

Module clamp

module clamp	R _{D,Uplift,Perpendicular} [kN]	R _{D,Pressure,Perpendicular} [kN]	R _{D,Pressure,Parallel} [kN]
OneMid Black Set 30-42	5.00	-	1.04
OneEnd Black Set 30-42	2.62	-	1.16

Fastener

Fastener	R _{D,Uplift,Perpendicular} [kN]	R _{D,Pressure,Perpendicular} [kN]	R _{D,Pressure,Parallel} [kN]
Thread-forming metal screw 6.0×25	0.65	0.00	0.62



Structural analysis report | Roof 1

Utilisation result

No.	roof areas	middle clamp utilisation [%]	end clamp utilisation [%]	ultimate limit state Rails [%]	ultimate limit state screw [%]	Pull Through utilisation [%]
Module Array						
1	field area	8.2	7.8	20.1	22.5	10.1
1	ridge	13.4	12.8	22.1	36.5	16.5
1	gableboard	16.9	16.1	27.7	45.8	20.8
1	corner region (eave)	32.6	31.1	53.2	87.7	40.0
1	eaves	18.6	17.8	30.6	50.4	22.9
2	field area	8.2	7.8	20.1	22.5	10.1
2	ridge	13.4	12.8	22.1	36.5	16.5
2	eaves	18.6	17.8	30.6	50.4	22.9
3	field area	8.2	7.8	20.1	22.5	10.1
3	ridge	13.4	12.8	22.1	36.5	16.5
3	corner region (eave)	32.6	31.1	53.2	87.7	40.0
3	eaves	18.6	17.8	30.6	50.4	22.9

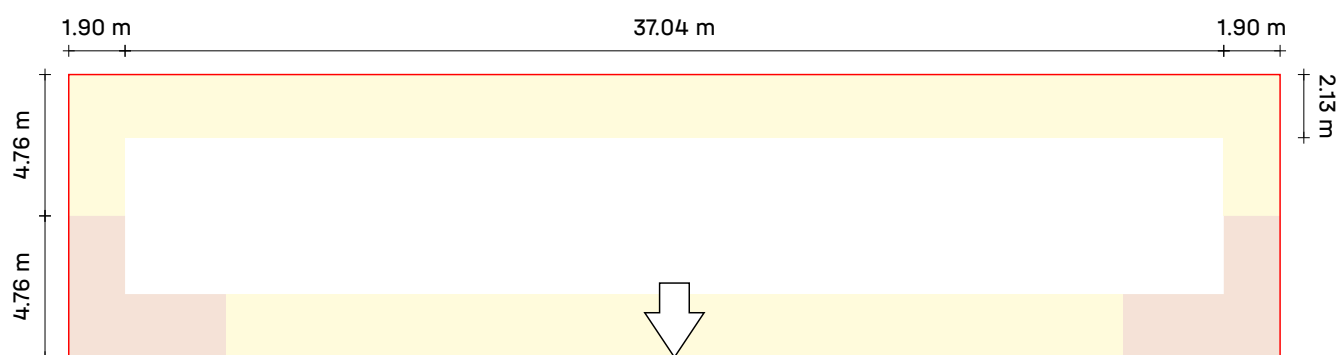


Roofs | Roof 1 | Bill of material

Position	Item no.	Item description	Quantity	Weight
1	2002589	OneEnd Black Set 30-42	48	4.2 kg
2	2003072	OneMid Black Set 30-42	108	8.5 kg
3	2004211	MiniRail MK2 Set	156	50.2 kg
Total				62.9 kg

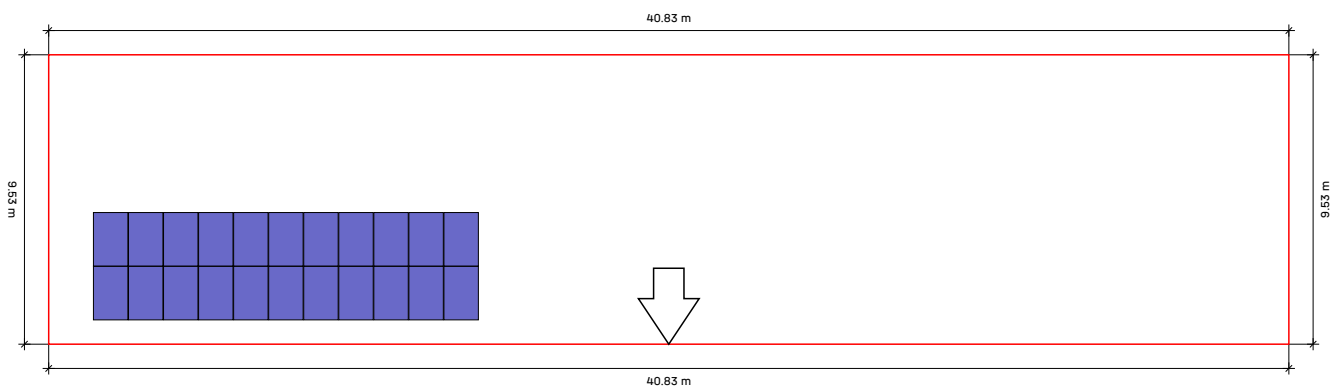


Roofs | Roof 2



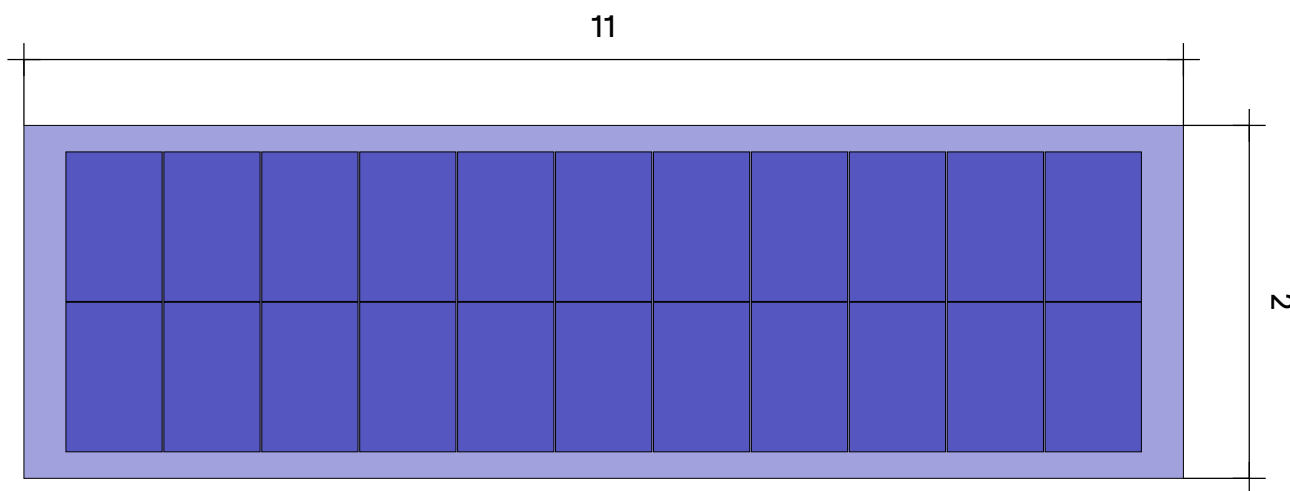


Roofs | Roof 2



Roof	System	Module	Height	Quantity	Total power
<u>Roof 2</u>  Trapezoidal	<u>MiniRail MK2</u>	JAM54D40-450/LB 1,762×1,134×30 mm 450 Wp	10.60 m	22	9.9 kWp

Roofs | Roof 2 | Module array 1



Roof ② Module array ①

Mounting System

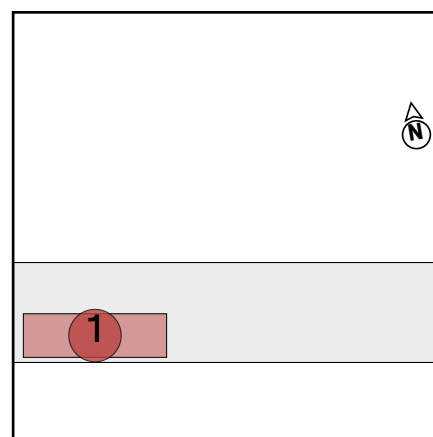
[MiniRail MK2](#)

Module

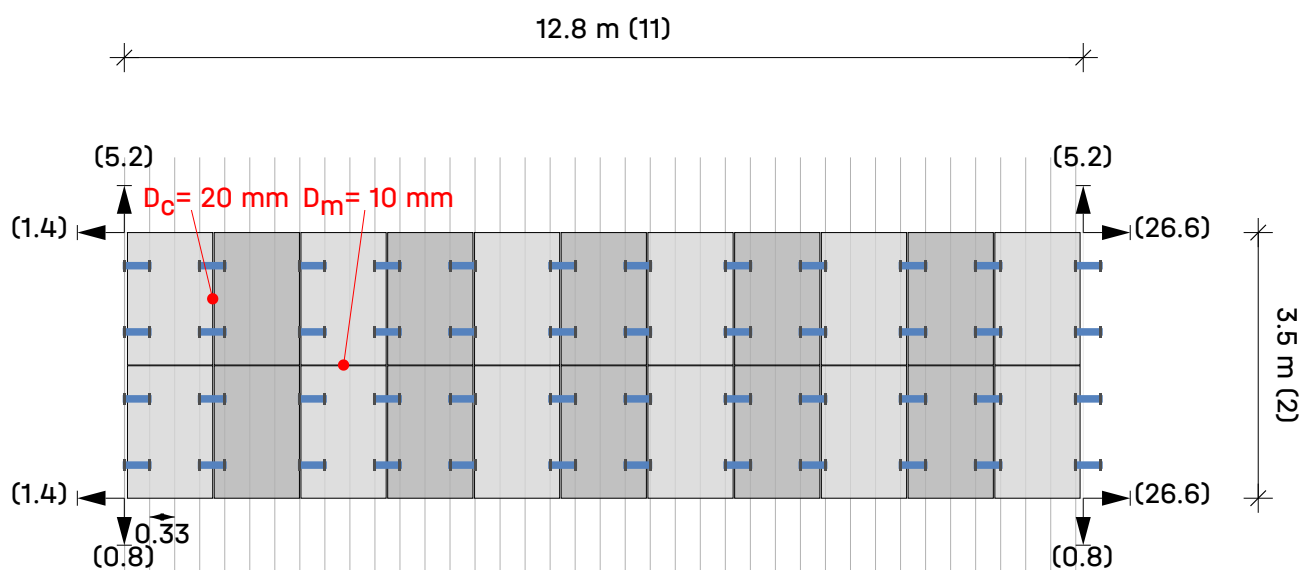
22(9.9 kWp) x
JAM54D40-450/LB

Row spacing

1.77 m



Roofs | Roof 2 | Module array 1 | Module blocks

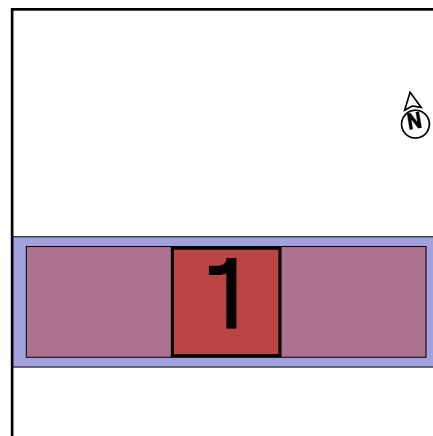


Roof ② Module array ① Module block 1

Modules $11 \times 2 = 22$

Legend

- Fastener
- Distance to Roof Edge [m]
- D_c Distance for clamping between modules
- D_m Distance between modules



Results | Roof 2

Roof	System	Module	Height	Quantity	Total power
<u>Roof 2</u>  Trapezoidal	<u>MiniRail MK2</u>	JAM54D40-450/LB 1,762×1,134×30 mm 450 Wp	10.60 m	22	9.9 kWp

Module

Name	JAM54D40-450/LB
Manufacturer	Shanghai JA Solar Technology Co. Ltd.
Output power	450 Wp
Dimensions	1,762×1,134×30 mm
Weight	22.0 kg

Components

Fastener	Thread-forming metal screw 6.0×25
Base rails	K2 MiniRail MK2

Loads on modules (module dimensioning)

Array	A-TrA [m ²]	ultimate state [Pa]				Serviceability [Pa]			
		Pressure ⊥	Pressure ∥	Uplift ⊥	Uplift ∥	Pressure ⊥	Pressure ∥	Uplift ⊥	Uplift ∥
field area	2.00	606.8	53.1	-410.4	9.8	481.2	42.1	-297.6	9.8
corner region (eave)	2.00	606.8	53.1	-1,630.2	9.8	481.2	42.1	-1,254.4	9.8
eaves	2.00	606.8	53.1	-933.2	9.8	481.2	42.1	-707.6	9.8

Utilisation result

No.	roof areas	middle clamp utilisation [%]	end clamp utilisation [%]	ultimate limit state Rails [%]	ultimate limit state screw [%]	Pull Through utilisation [%]
Module Array						
1	field area	8.2	7.8	20.1	22.5	10.1
1	corner region (eave)	32.6	31.1	53.2	87.7	40.0
1	eaves	18.6	17.8	30.6	50.4	22.9



Results | Roof 2

Important Information

- The structure was statically verified in accordance with Eurocode 9: Design of aluminium structures (DIN EN 1999-1-1:2021) and offers sufficient load-bearing capacity and stability for the loads specified in the chapter 'Maximum actions on the components'.
- Adjustment factor for wind load regarding service life period, f_W , is according to DIN EN 1991-1-4/ NA, NDP for 4.2 (2P) note 5, table 3
- Adjustment factor for snow load regarding service life period, f_S , is according to DIN EN 1991-1-3/ annex D, table 4
- The structural design complies with BS EN 1990 - Basis of Structural Design.
- Snow loads are determined in accordance with National Annex BS NA EN 1991-1-3 (2018) - UK National Annex to EC1 - Action on structures - general actions - snow loads.
- Wind loads are determined in accordance with National Annex BS NA EN 1991-1-4 - UK National Annex to EC1 - Action on structures, general actions - wind actions.
- Service life is recognised according to 'Eurocode EN 1991 - Action on structures, Snow loads' and 'Eurocode EN 1991 - Actions on structures, Wind actions'. Subject to the Building Regulations and for security-relevant reasons the installation has to be dismantled at the end of its service life.
- Failure consequence class is considered according to 'Eurocode EN 1990 - Basis of structural design'.
- The person responsible for the execution of the work must check the load assumptions made with the conditions on site. If deviations are found, the person who prepared the static calculation must be consulted immediately. , in particular § 2 ("technical and specialist requirements for the customer"), § 7 ("warranty provisions") and § 8 ("limitation of liability").



Structural analysis report | Roof 2

General information

Name	Prime Point
Mounting System	MiniRail MK2
Author	National Renewables

Location information

Address	Kirkby Bank Rd, Liverpool L33
Ground elevation	39.05 m

Roof information

Building height	10.60 m
Roof type	Gable roof
Roof pitch	5°
Roof covering	Trapezoidal
Min. roof edge distance	0.00 m
Crest distance	333.0 mm
Crest width	30.0 mm
Crest height	35.0 mm
Roof material	Steel
Sheet quality	S235
Sheet thickness	0.500 mm

Loads

Design method	BS EN
Failure consequence class (CC)	CC1
Design working life	25 years
Terrain category	Town Terrain
Distance to shoreline	20.00 km
Distance inside town terrain	3.00 km

Wind load

Velocity pressure, 50 years	$q_{p,50} = 0.742 \text{ kN/m}^2$
Adjustment factor for service life	$f_w = 0.921$
Velocity pressure, 25 years	$q_{p,25} = 0.683 \text{ kN/m}^2$



Structural analysis report | Roof 2

Roof areas

Array	load impact area [m ²]	maxCpe ₂	minCpe ₂	wind pressure [kN/m ²]	wind suction [kN/m ²]
field area	2.00	0.000	-0.600	0.000	-0.410
corner region (eave)	2.00	0.000	-2.000	0.000	-1.367
eaves	2.00	0.000	-1.200	0.000	-0.820

Snow load

Snow load zone	3
Snow guard	No
Snow load on ground level	s_k = 0.500 kN/m²
Shape Coefficient for Snow	μ_i = 0.800
Factor for roof pitch	d_i = 0.996
Snow load on roof, 50 year	s_{i,50} = 0.398 kN/m²
Adjustment factor for service life	f_s = 0.929
Snow load on roof, 25 years	s_{i,25} = 0.370 kN/m²

Dead Load

Weight of module	G_M = 22.0 kg
Weight of mounting system per module	= 1.0 kg
Module area	A_M = 2.00 m²
Dead weight of module per m ²	= 11.01 kg/m²
Dead weight of mounting system per m ²	= 0.50 kg/m²
Total Dead Load (excl. ballast) per m ²	= 0.11 kN/m²



Structural analysis report | Roof 2

Load Combinations

Ultimate limit state

Partial safety factor unfavourable permanent load	$\gamma_{G,sup} = 1.35$
Partial safety factor favourable permanent load	$\gamma_{G,inf} = 1.00$
Partial safety factor destabilising permanent load	$\gamma_{G,dst} = 1.10$
Partial safety factor stabilising permanent load	$\gamma_{G,stab} = 0.90$
Partial safety factor variable loads	$\gamma_Q = 1.50$
Combination coefficient with regards to wind	$\psi_{0,W} = 0.60$
Combination coefficient with regards to wind (additional varying influences)	$\psi_{1,W} = 0.20$
Combination coefficient with regards to Snow	$\psi_{0,S} = 0.50$
Importance factor permanent	$\kappa_{Fl,G} = 0.90$
Importance factor variable	$\kappa_{Fl,Q} = 0.85$
Characteristic dead weight	G_k
Characteristic snow load on the roof	$S_{i,n}$
Characteristic wind load	W_k

Load case combination 01	$LCC\ 01_{uls} = \gamma_{G,sup} * \kappa_{Fl,G} * G_k + \gamma_Q * \kappa_{Fl,Q} * S_{i,n}$
Load case combination 02	$LCC\ 02_{uls} = \gamma_{G,sup} * \kappa_{Fl,G} * G_k + \gamma_Q * \kappa_{Fl,Q} * W_{k,Pressure}$
Load case combination 03	$LCC\ 03_{uls} = \gamma_{G,sup} * \kappa_{Fl,G} * G_k + \gamma_Q * \kappa_{Fl,Q} * (W_{k,Pressure} + \psi_{0,S} * S_{i,n})$
Load case combination 04	$LCC\ 04_{uls} = \gamma_{G,sup} * \kappa_{Fl,G} * G_k + \gamma_Q * \kappa_{Fl,Q} * (S_{i,n} + \psi_{0,W} * W_{k,Pressure})$
Load case combination 06	$LCC\ 06_{uls} = \gamma_{G,inf} * G_k + \gamma_Q * \kappa_{Fl,Q} * W_{k,Suction}$

Serviceability limit state

Combination coefficient with regards to wind	$\psi_{0,W} = 0.60$
Combination coefficient with regards to Snow	$\psi_{0,S} = 0.50$

Load case combination 01	$LCC\ 01_{sls} = G_k + S_{i,n}$
Load case combination 02	$LCC\ 02_{sls} = G_k + W_{k,Pressure}$
Load case combination 03	$LCC\ 03_{sls} = G_k + W_{k,Pressure} + \psi_{0,S} * S_{i,n}$
Load case combination 04	$LCC\ 04_{sls} = G_k + S_{i,n} + \psi_{0,W} * W_{k,Pressure}$
Load case combination 06	$LCC\ 06_{sls} = G_k + W_{k,Suction}$

Maximum load on modules (Mounting system dimensioning)

Array	A-TrA [m ²]	ultimate state [kN/m ²]				Serviceability [kN/m ²]			
		Pressure ⊥	Pressure 	Uplift ⊥	Uplift 	Pressure ⊥	Pressure 	Uplift ⊥	Uplift
field area	2.00	0.607	0.053	-0.410	0.010	0.481	0.042	-0.298	0.010
corner region (eave)	2.00	0.607	0.053	-1.630	0.010	0.481	0.042	-1.254	0.010
eaves	2.00	0.607	0.053	-0.933	0.010	0.481	0.042	-0.708	0.010



Structural analysis report | Roof 2

Resistance Values of Components

Base Rails

Base Rails	A [cm ²]	I _y [cm ⁴]	I _z [cm ⁴]	W _y [cm ³]	W _z [cm ³]	F _{p,Rd} [kN]
K2 MiniRail MK2	2.710	2.15	9.27	1.37	2.17	1.42

F_{p,Rd} Pull-through resistance

Module clamp

module clamp	R _{D,Uplift,Perpendicular} [kN]	R _{D,Pressure,Perpendicular} [kN]	R _{D,Pressure,Parallel} [kN]
OneMid Black Set 30-42	5.00	-	1.04
OneEnd Black Set 30-42	2.62	-	1.16

Fastener

Fastener	R _{D,Uplift,Perpendicular} [kN]	R _{D,Pressure,Perpendicular} [kN]	R _{D,Pressure,Parallel} [kN]
Thread-forming metal screw 6.0×25	0.65	0.00	0.62

Utilisation result

No.	roof areas	middle clamp utilisation [%]	end clamp utilisation [%]	ultimate limit state Rails [%]	ultimate limit state screw [%]	Pull Through utilisation [%]
Module Array						
1	field area	8.2	7.8	20.1	22.5	10.1
1	corner region (eave)	32.6	31.1	53.2	87.7	40.0
1	eaves	18.6	17.8	30.6	50.4	22.9



Roofs | Roof 2 | Bill of material

Position	Item no.	Item description	Quantity	Weight
1	2002589	OneEnd Black Set 30-42	8	0.7 kg
2	2003072	OneMid Black Set 30-42	40	3.2 kg
3	2004211	MiniRail MK2 Set	48	15.5 kg
Total				19.3 kg



Bill of material

Position	Item no.	Item description	Quantity	Weight
1	2002589	OneEnd Black Set 30-42	56	4.9 kg
2	2003072	OneMid Black Set 30-42	148	11.7 kg
3	2004211	MiniRail MK2 Set	204	65.7 kg
Total				82.3 kg



Thank you for choosing a K2 mounting system.

Systems from K2 Systems are quick and easy to install.

We hope these instructions have helped.

Please contact us with any questions or suggestions for improvement.

Our contact data:

k2-systems.com/en/contact

Our General Terms of Business apply. Please refer to k2-systems.com

K2 Solar Mounting Solutions Ltd

Unit 46 Easter Park

Benyon Road

Aldermaston, RG7 2PQ

Great Britain

+44 1189 701280

info@k2-systems.uk.com

k2-systems.com/en