| Connecting Strength

K2 Base Report

Eco Efficency

Planned installation date   04/12/2023
Project address   Roxburgh Terrace, Whitley Bay NE26 1DS, UK
Customer   Eco Efficency Ltd
Company   Lucans Ltd
Author   James Lucan
Issue date & version   12/11/2023 | K2 Base Version 3.1.104.0

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.

Contents

Project overview

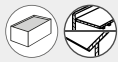## Project information

Name	Eco Efficency
Address	Roxburgh Terrace, Whitley Bay NE26 1DS, UK
Ground elevation	23.83 m
Planned installation date	04/12/2023
Customer	Eco Efficency Ltd
Contact person	Alastair Mcgillvray
Author	James Lucan

Load settings

Design method	BS EN
Failure consequence class (CC)	CC1
Design working life	25 years
Terrain category	Town Terrain
Environment	Normal area
Basic wind speed	24.0 m/s
distance to shoreline	1.00 km
distance inside town terrain	1.00 km
Snow load zone	4
Snow load on ground level	0.60 kN/m²

Roofs

Roof	System	Module	Power	Quantity	Total power
Gym Roof	S-Dome 6.10 Xpress	JKM-425N-54HL4 Tiger Neo N-Type	425 Wp	24	10.2 kWp
Total				**24**	**10.20 kWp**

✓ THE PROJECT IS VERIFIED.
The selected mounting system can be installed as planned
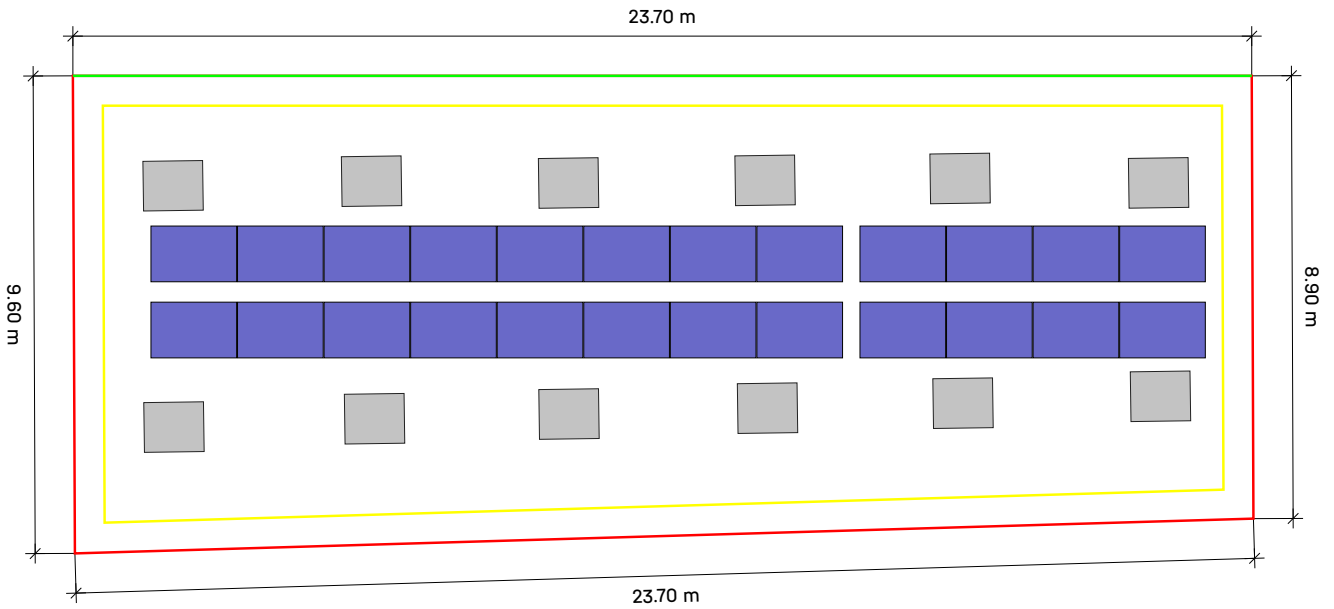Thank you for choosing a K2 mounting system.

Roofs

Project information

Name	Eco Efficency
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Roofs | Gym Roof

Roof	System	Module	Power	Quantity	Total power
Gym Roof	S-Dome 6.10 Xpress	JKM-425N-54HL4 Tiger Neo N-Type	425 Wp	24	10.2 kWp

Roof ① Module array ❶

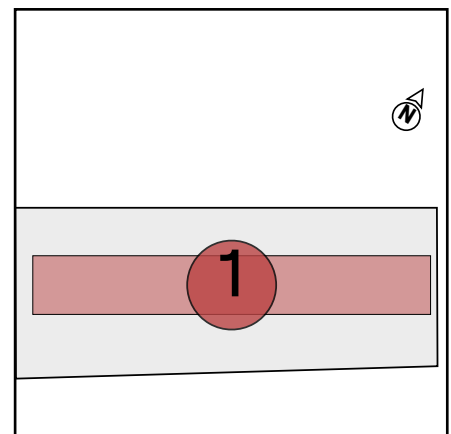|	
Mounting System	S-Dome 6.10 Xpress
Module	24(10.2 kWp) x JKM-425N-54HL4 Tiger Neo N-Type
Row spacing	1.53 m
service corridor	0.41 m

Roofs | Gym Roof | Module array 1 | Module blocks

14.0 m (8)

(2.8)   (2.8)

(1.5)   0.3

| 29.5 | 29.5 | 29.5 | 29.5 | 18.5 | 18.5 | 18.5 | 18.5 |

3.1 m (2)

| 38.5 | 38.5 | 38.5 | 38.5 | 27.0 | 27.0 | 27.0 | 27.0 |

(1.5)   1.50 m
0.3

(3.6)   (3.6)
0.00   1.74   3.48   5.22   6.96   8.70   10.44   12.18   13.92

2 ▷
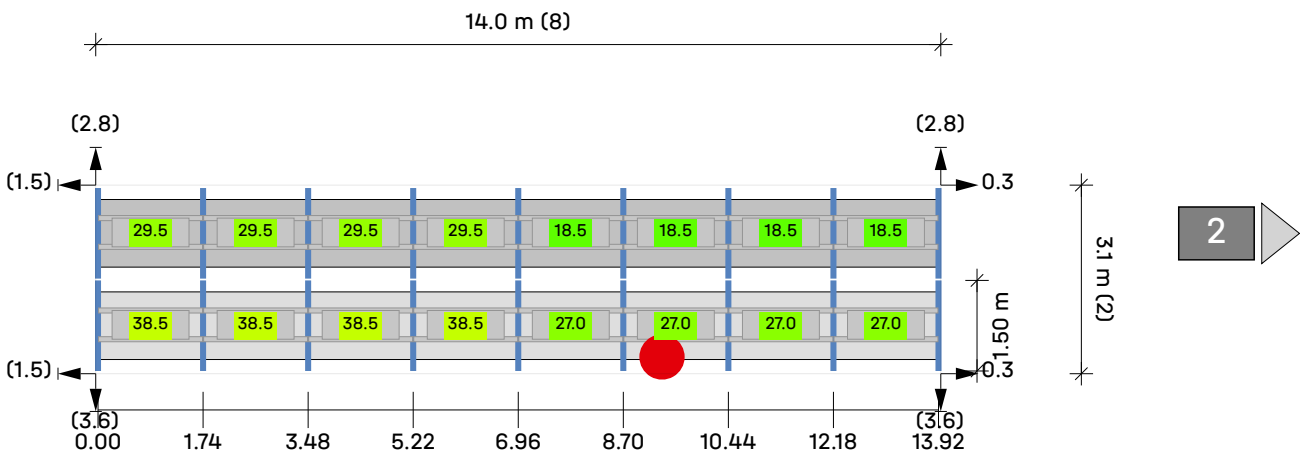
Roof ① Module array ❶ Module block 1

Modules   8 × 2 = **16**

Legend

◁▯1▯ Next block indicator

—— Mounting rail

⊓ Row distance [m]

⊢► Distance to Roof Edge [m]

► Dist. to neighbour module block/array [m]

│25│ Ballast in kilogram (kg)

▭ Porter Ballast

Roofs | Gym Roof | Module array 1 | Module blocks

7.0 m (4)

(2.8)　　　　　　　　　　　　(2.8)

0.3　　　　　　　　　　　　　　(0.9)

| 49.0 | 49.0 | 49.0 | 49.0 |

| 53.5 | 53.5 | 53.5 | 53.5 |

3.1 m (2)

1.50 m

0.3　　　　　　　　　　　　　　(0.9)
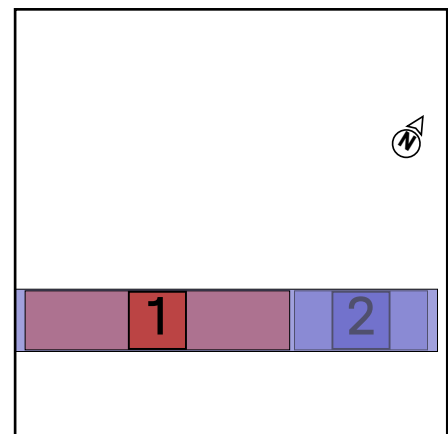
(3.2)　　　　　　　　　　　　(3.2)

0.00　　1.74　　3.48　　5.22　　6.96

1

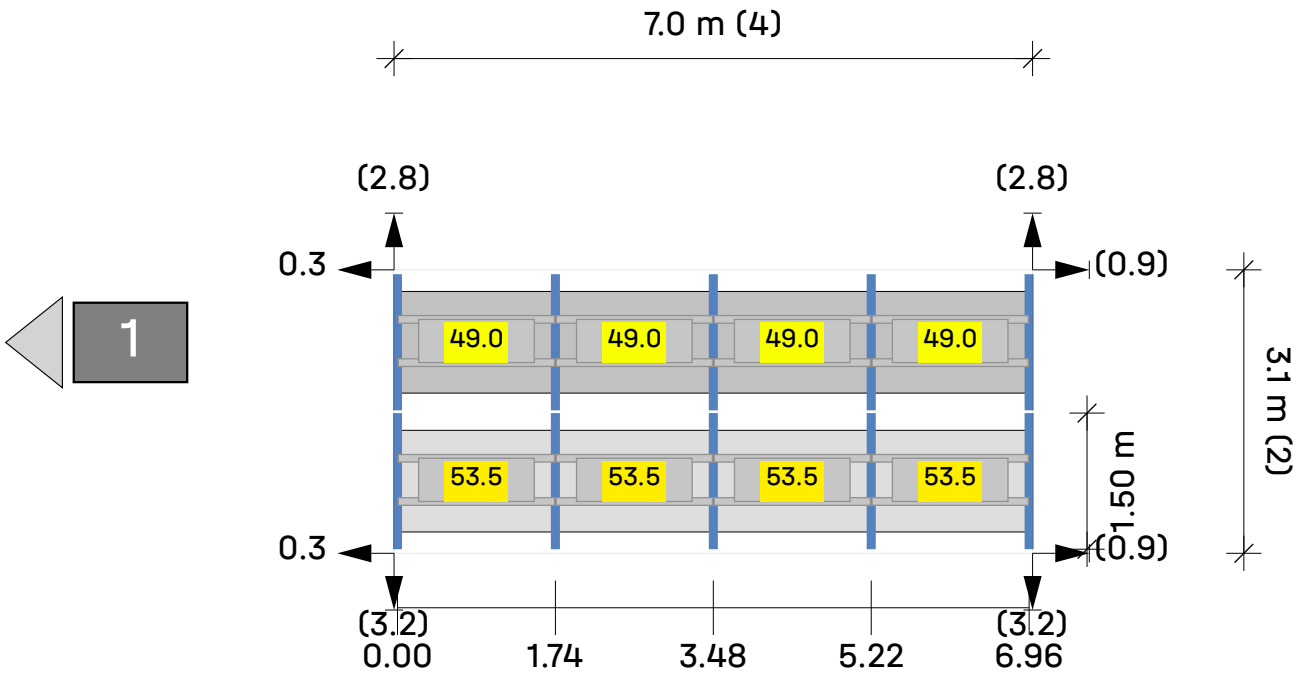**Roof** (1)　　**Module array** ① **Module block** [2]

| Modules | 4 × 2 = **8** |

Legend

◁[1]　Next block indicator

———　Mounting rail

▭　Row distance [m]

▸—　Distance to Roof Edge [m]

▸　Dist. to neighbour module block/array [m]

[25]　Ballast in kilogram (kg)

▭　Porter Ballast

| 1 | 2 |
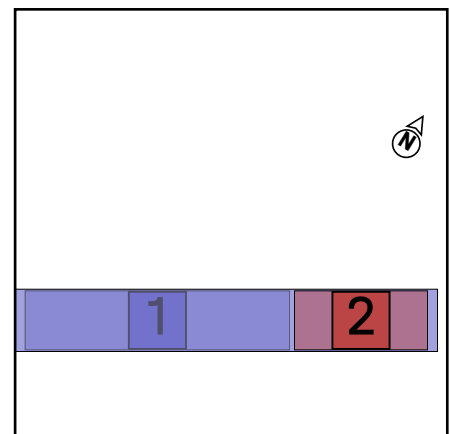
Results | Gym Roof

Roof	System	Module	Power	Quantity	Total power
Gym Roof	S-Dome 6.10 Xpress	JKM-425N-54HL4 Tiger Neo N-Type	425 Wp	24	10.2 kWp

Module

Name	JKM-425N-54HL4 Tiger Neo N-Type
Manufacturer	JinkoSolar Holding Co. Ltd.
Output power	425 Wp
Dimensions	1,722×1,134×30 mm
Weight	22.0 kg

Module clamps

module clamp	DomeClamp MC Set 30-50
end clamp	DomeClamp EC Set 30-50

Ballast capacity

Porter	108.0 kg

Verification system utilisation

Type	pressure	suction
Verification system utilisation	41.80%	36.78%
Loads on modules (ultimate state)	1.55 kN/m²	-1.02 kN/m²
Loads on modules (Serviceability)	1.16 kN/m²	-0.72 kN/m²

Specific loads

Module block	No. of modules	Ballast [kg]	Dead weight [kg]	Module block area [m²] (incl. service corridor)	Dead Load [kN/m²]	Dead load (roof surface area) [kN/m²]
Block 1	16	454.0	871.60	43.71	0.20	
Block 2	8	410.0	618.80	21.97	0.28	
Total	**24**	**864.0**	**1,490.40**			**0.07**

Results | Gym Roof

Notes

- The proof of static equilibrium and load capacity of the system are carried out by checking the load cases lifting and sliding by wind and by further static calculations.
- You will find a short version of the wind tunnel report and a certificate for the further static calculations on our homepage.
- 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.
- If the distance to the coast is less than one kilometer, the materials must be checked for corrosion resistance and adjusted if necessary.
- 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'.
- Data and results must be verified with regard to local conditions and checked by a suitably qualified person. Please see our TCU under https://k2-systems.com/en/base-tcu , in particular § 2 ("technical and specialist requirements for the customer"), § 7 ("warranty provisions") and § 8 ("limitation of liability").

Structural analysis report | Gym Roof

General information

Name	Eco Efficency
Mounting System	S-Dome 6.10 Xpress
Author	James Lucan

Location information

Address	Roxburgh Terrace, Whitley Bay NE26 1DS, UK
Ground elevation	23.83 m

Roof information

Building height	6.00 m
Roof type	Flat roof
Roof pitch	0°
Fastening method	with Ballast
Roof covering	Flat
Min. roof edge distance	0.60 m
Parapet wall height	0.00 m
Material	Bitumen
Friction coefficient	0.5

The friction coefficients given here must be checked onsite. If a lower value is found, this must be specified here for the ballast calculation!

Loads

Design method	BS EN
Failure consequence class (CC)	CC1
Design working life	25 years
Terrain category	Town Terrain
distance to shoreline	1.00 km
distance inside town terrain	1,000.00 m

Wind load

Velocity pressure	$q_{p,50}$	= 0.751 kN/m²
Adjustment factor for service life	f_w	= 0.921
Velocity pressure	$q_{p,25}$	= 0.692 kN/m²

Structural analysis report | Gym Roof

Snow load

Snow load zone		4
Environment		Normal terrain
Snow guard		No
Snow load on ground level	s_k	= 0.600 kN/m²
Shape Coefficient for Snow	μ_i	= 0.800
Factor for roof pitch	d_i	= 1.000
Snow load on roof	$s_{i,50}$	= 0.480 kN/m²
Adjustment factor for service life	f_s	= 0.929
Snow load on roof	$s_{i,25}$	= 0.446 kN/m²

Dead Load

Weight of module	G_M	= 22.0 kg
Weight of mounting system per module		= 4.1 kg
Module area	A_M	= 1.95 m²
Dead weight of module per m²		= 11.27 kg/m²
Dead weight of mounting system per m²		= 2.10 kg/m²
Total Dead Load (excl. ballast) per m²		= 0.13 kN/m²

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	$\gamma_{G,stb}$	= 0.90
Partial safety factor first variable load	γ_Q	= 1.50
Partial safety factor variable loads	γ_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 $E_d = \gamma_{G,sup} * \kappa_{Fl,G} * G_k + \gamma_Q * \kappa_{Fl,Q} * S_{i,n}$

Structural analysis report | Gym Roof

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

Static equilibrium

Uplift Verification	$E_d = \gamma_{G,stb} * G_k + \gamma_Q * \kappa_{Fl,Q} * W_{k,n,Uplift}$
Displacement verification	$E_d = \gamma_{G,stb} * G_k + \gamma_Q * \kappa_{Fl,Q} * W_{k,n,Displacement}$

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	$E_d = G_k + S_{i,n}$
Load case combination 02	$E_d = G_k + W_{k,Pressure}$
Load case combination 03	$E_d = G_k + W_{k,Pressure} + \psi_{0,S} * S_{i,n}$
Load case combination 04	$E_d = G_k + S_{i,n} + \psi_{0,W} * W_{k,Pressure}$
Load case combination 06	$E_d = G_k + W_{k,Uplift}$

Max. Pressure on insulation

General information

dead load system	g_{System}	= 0.13 kN/m²
aerodynamic coefficient	$c_{p,Pressure}$	= 0.20

Load distribution underneath the building protection mat under Peak (45°)

Dimensions	75.3 × 380.0 × 23.1 mm	
	A_{eff}	= 28,614.00 mm²
	$A_{load\ range\ area}$	= 0.98 m²
maximum ballast	$G_{ballast\ required}$	= 35.3 kg

Load distribution underneath the building protection mat under SD (45°)

Dimensions	75.3 × 380.0 × 23.1 mm	
	A_{eff}	= 28,614.00 mm²
	$A_{load\ range\ area}$	= 0.98 m²
maximum ballast	$G_{ballast\ required}$	= 18.2 kg

Structural analysis report | Gym Roof

Load Combinations

	$\sigma_{Ek,\text{heat insulation},S6\_10}$ [Pa]	$\sigma_{Ek,\text{heat insulation},SD}$ [Pa]
Load case combination 00	16,574	10,707
Load case combination 01	31,603	25,735
Load case combination 02	21,296	15,428
Load case combination 03	28,810	22,942
Load case combination 04	34,435	28,568

Dead loads (PV system + ballast)

$\sigma_{Ek,\text{heat insulation},S6\_10}$ σ_{Ek} = 16,574 Pa

$\sigma_{Ek,\text{heat insulation},SD}$ σ_{Ek} = 10,707 Pa

Maximum actions (sum of dead loads and the maximum variable actions from wind and snow)

$\sigma_{Ek,\text{heat insulation},S6\_10}$ max σ_{Ek} = 34,435 Pa

$\sigma_{Ek,\text{heat insulation},SD}$ max σ_{Ek} = 28,568 Pa

σ_{Ek}
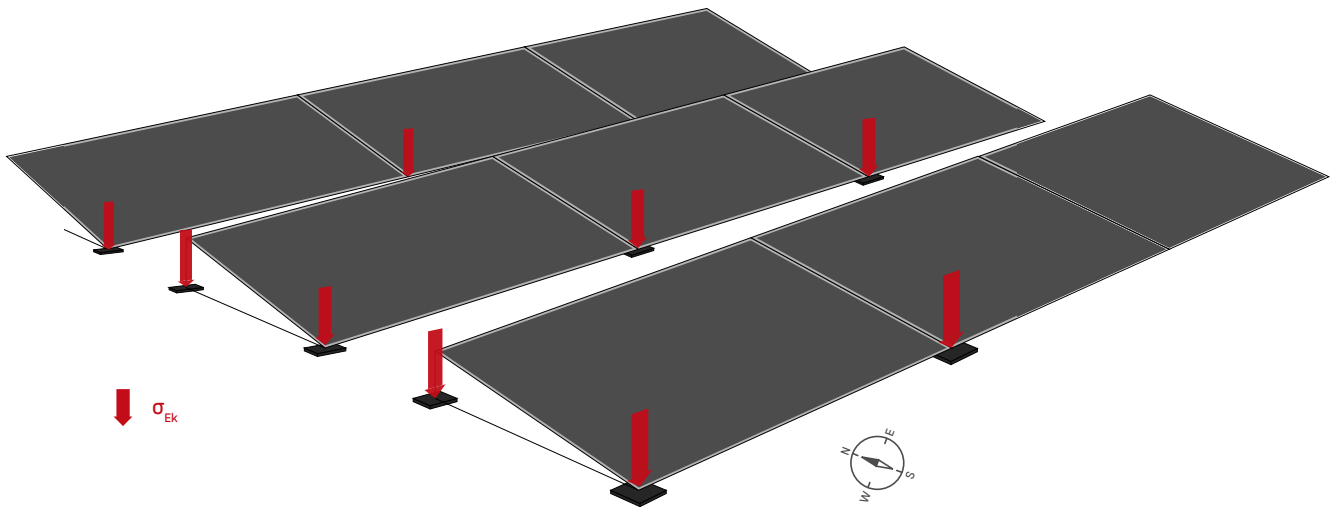
Structural analysis report | Gym Roof

H-V-loads

According to wind tunnel report by I.F.I. Institut für Industrieaerodynamik GmbH

General information

Number of modules in the middle area	0	
Number of modules in the edge area	24	
Total number of modules	24	
Roof areas covered with modules	A	$= ca.\ 65.68\ m^2$
Dead Load	$g_{k,System\ incl.\ ballast}$	$= 0.22\ kN/m^2$

Aerodynamic coefficients

	$C_{p,Pressure}$	= according to EN 1991-1-4
	$C_{F,x,averaged}$	= 0.01
	$C_{F,y,averaged}$	= -0.03
edge distance correction	$k_{S|xy}$	= 1.00
Parapet wall- correction coefficient	k_p	= 1.00
Factor building height		= 1.00

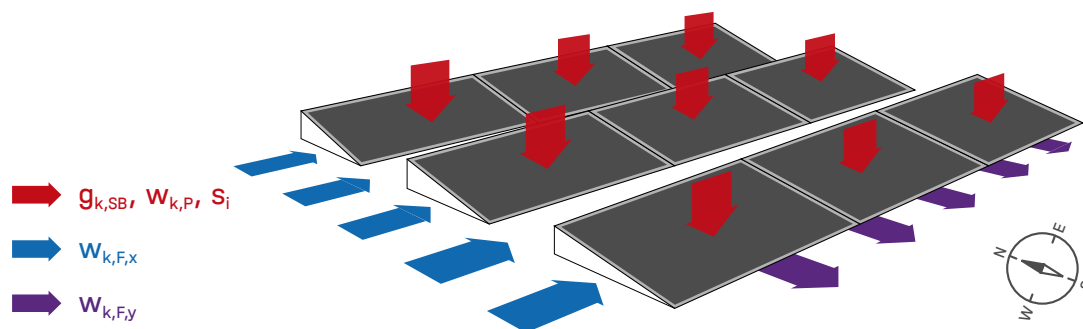### Horizontal pressure

$W_{k,F,x}$ = 0.006 kN/m²

$W_{k,F,y}$ = 0.062 kN/m²

Vertical pressure

$g_{k,System\ incl.\ ballast}$ = 0.22 kN/m²

$W_{k,Pressure}$ - according to EN 1991-1-4

s_i - according to EN 1991-1-3

$g_{k,SB}$, $W_{k,P}$, s_i

$W_{k,F,x}$

$W_{k,F,y}$

Comment:

Flat roof vertical wind loads are essentially determined by its displacement effect and remain unchanged even with a flat pv structure. We advise using the aerodynamic coefficients according to DIN EN 1991-1-4 to calculate flat roofs.

Bill of material

Position	Item no.	Item description	Quantity	Weight
1	2004096	S-Dome 6.10 Base Set L	28	52.6 kg
2	2004125	Dome 6.10 Peak	28	8.4 kg
3	2004123	Dome 6 Connector 195 Set	14	3.0 kg
4	2003249	S-Dome 6.10 Windbreaker short	24	43.2 kg
5	2003427	Thread-forming metal screw 4,8×20	56	0.2 kg
6	2002870	K2 Solar Cable Manager	24	0.1 kg
7	2002558	DomeClamp MC Set 30-50	40	2.3 kg
8	2002559	DomeClamp EC Set 30-50	16	1.1 kg
9	2003150	Dome Porter short	48	71.0 kg
10	1001643	MK2	96	1.7 kg
11	2001729	Socket Head Bolt serrated M8×20	96	1.2 kg
Total				**184.8 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

Service Hotline: +44 1189 701280

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

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