



| Connecting Strength

K2 Base Report



Five Guys, Reading - Solar PV Installation - Arbitrary Building 01 - Mounting Surface South

Project address	Five Guys\nReading Road\nWinnersh\nWokingham, Berkshire\nRG41 5HG
Company	Greenlite Group
Address	Apollo court, Hallam way 10/11, FY4 5FS, Blackpool
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Planner	Sean Roberts
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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
Arbitrary Building 01 - Mounting Surface South  Flat	S-Dome 6.10 Xpress	Tiger Neo JKM440N-54HL4R-B 1,762×1,134×30 mm 440 Wp	5.44 m	24	10.56 kWp
Total				24	10.56 kWp

Project information

Address	Five Guys\nReading Road\nWinnersh\nWokingham, Berkshire\nRG41 5HG
Author	Sean Roberts

Load settings

Design method	BS EN
Failure consequence class (CC)	CC1
Design working life	25 years
Terrain category	Town Terrain
Basic wind speed	21.5 m/s
Distance to shoreline	65.00 km
Distance inside town terrain	3.00 km
Snow load zone	2
Snow load on ground level	0.40 kN/m²

Material values

For material information refer to the product catalogue:

[K2 Catalogue \(k2-systems.com\)](https://k2-systems.com)

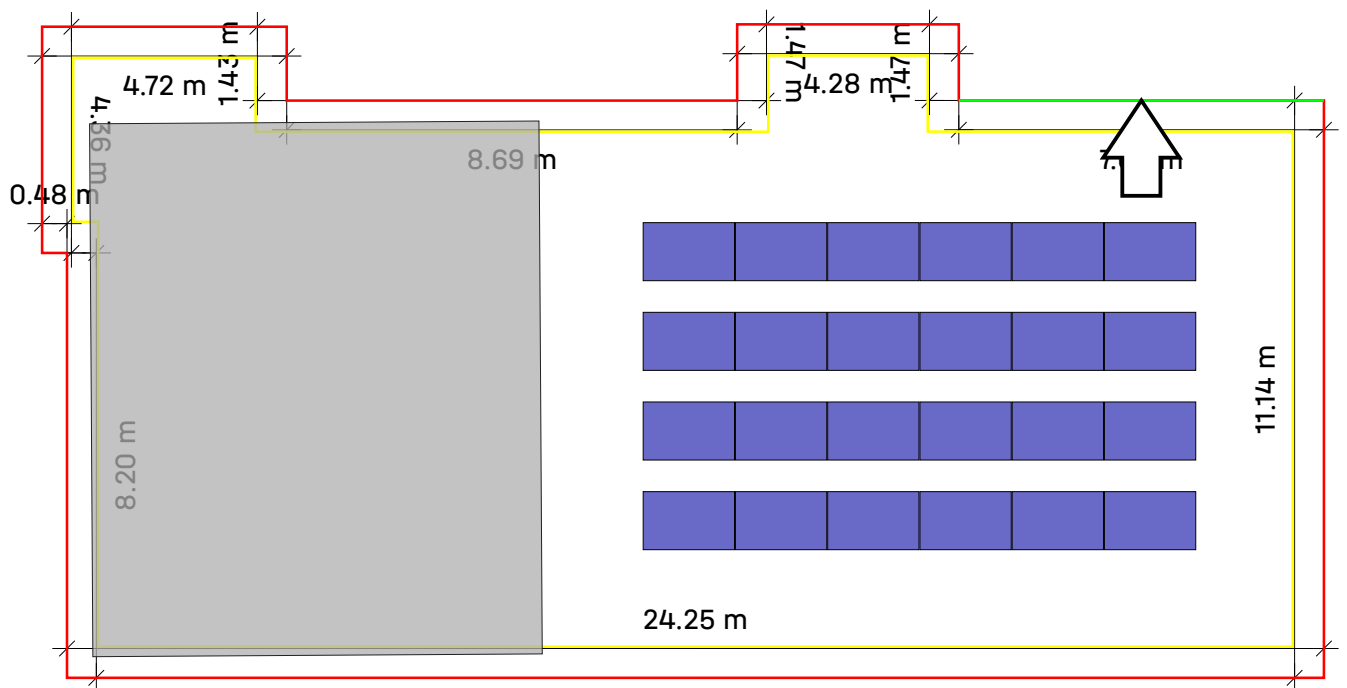


THE PROJECT IS VERIFIED.

The selected mounting system can be installed as planned
Thank you for choosing a K2 mounting system.



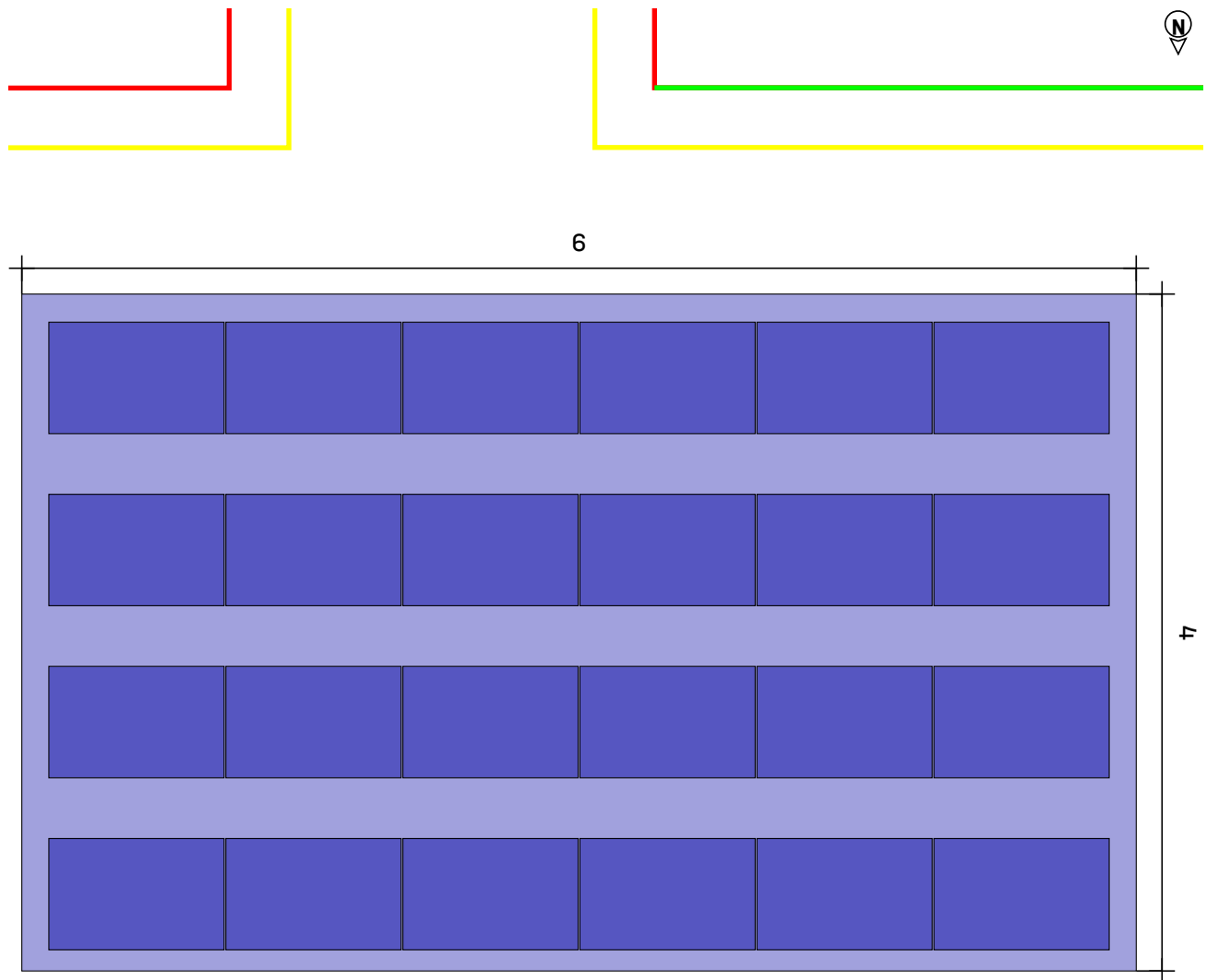
Arbitrary Building 01 - Mounting Surface South



Roof	System	Module	Height	Quantity	Total power
Arbitrary Building 01 - Mounting Surface South  Flat	S-Dome 6.10 Xpress	Tiger Neo JKM440N-54HL4R-B 1,762×1,134×30 mm 440 Wp	5.44 m	24	10.56 kWp



Arbitrary Building 01 - Mounting Surface South | Module



Roof ① Module array ①

Mounting System

[S-Dome 6.10 Xpress](#)

Module

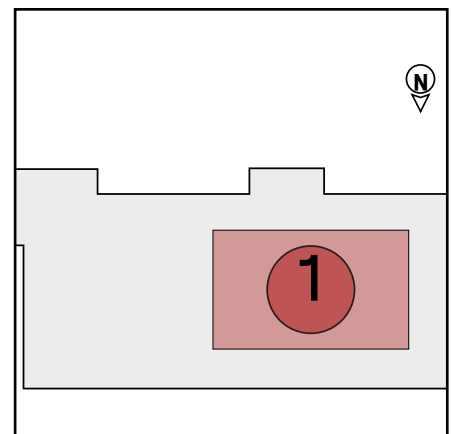
24(10.56 kWp) x Tiger Neo
JKM440N-54HL4R-B

Row spacing

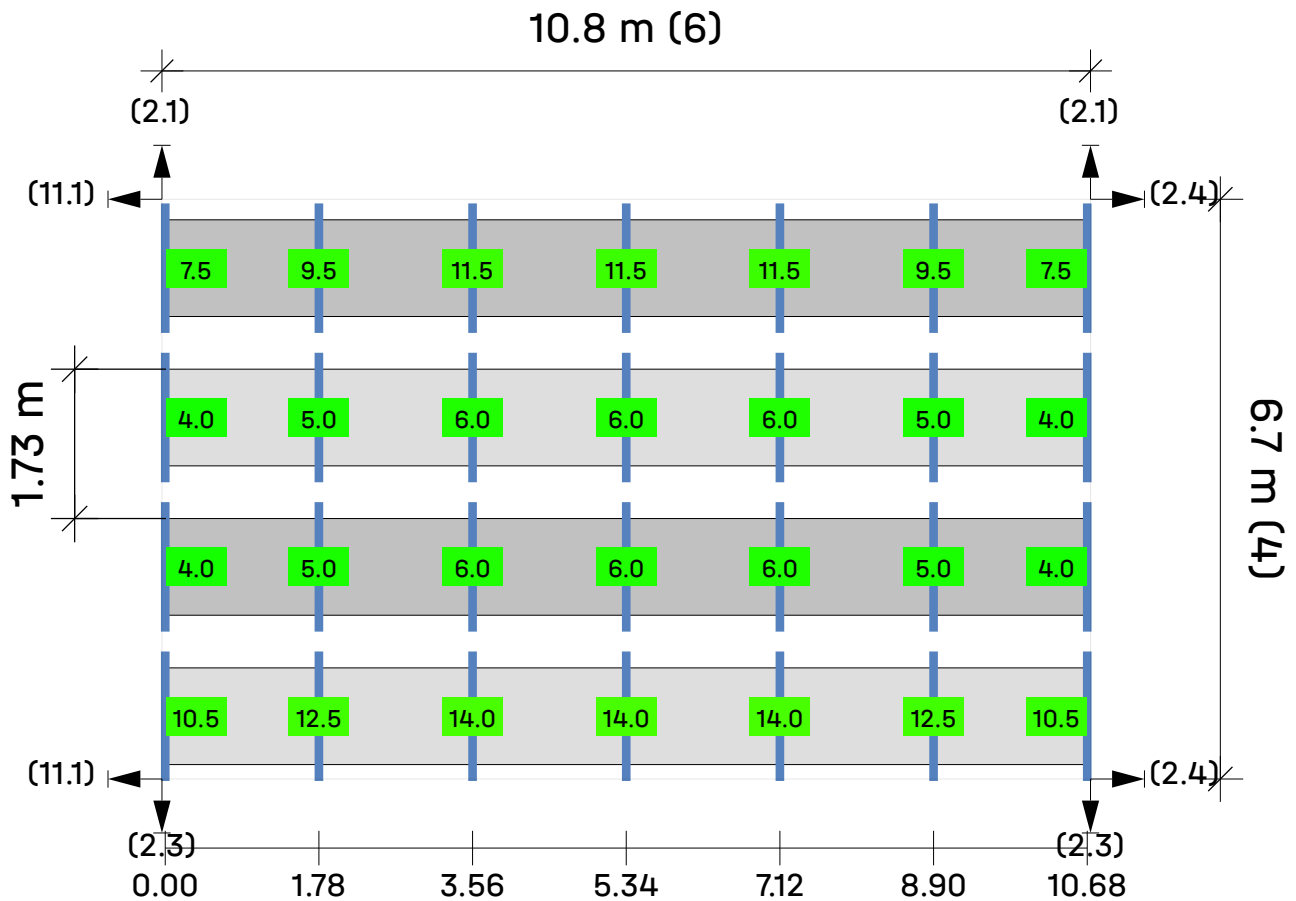
1.73 m

service corridor

0.61 m



Arbitrary Building 01 - Mounting Surface South | Module

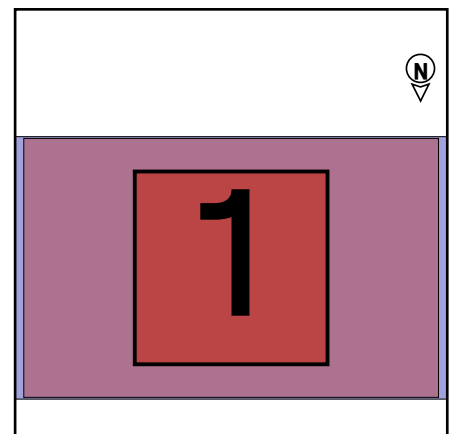


Roof ① Module array ① Module block 1

Modules $6 \times 4 = 24$

Legend

- Mounting rail
- Row distance [m]
- Distance to Roof Edge [m]
- Ballast in kilogram (kg)
- Porter Ballast



Results | Arbitrary Building 01 - Mounting Surface South

Roof	System	Module	Height	Quantity	Total power
Arbitrary Building 01 - Mounting Surface South  Flat	S-Dome 6.10 Xpress	Tiger Neo JKM440N-54HL4R-B 1,762×1,134×30 mm 440 Wp	5.44 m	24	10.56 kWp

Module

Name	Tiger Neo JKM440N-54HL4R-B
Manufacturer	Jinko Solar
Output power	440 Wp
Dimensions	1,762×1,134×30 mm
Weight	22.0 kg

Module clamps

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

Ballast capacity

Speed Porter	40.0 kg
Porter	108.0 kg

Verification system utilisation

Type	pressure	suction
Verification system utilisation	17.46%	30.72%
Loads on modules (ultimate state)	1.05 kN/m ²	-0.63 kN/m ²
Loads on modules (Serviceability)	0.79 kN/m ²	-0.43 kN/m ²

Specific loads

Module block	No. of modules	Ballast [kg]	Dead weight [kg]	Module block area [m ²] (incl. service corridor)	Dead Load [kN/m ²]	Dead load (roof surface area) [kN/m ²]
Block 1	24	228.5	900.50	72.23 m ²	0.12	
Total	24	228.5	900.50			0.03

Results | Arbitrary Building 01 - Mounting Surface South

Note

- The proof of static equilibrium and load capacity of the system are carried out by checking the load cases uplift and sliding by wind according to wind tunnel expertise from IFI institute
- You will find a short version of the wind tunnel report and a certificate for the further static calculations on our homepage.
- 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
- All resistance values of components are determined from an extern static engineering office.
- 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.
- Please note our General Terms and Conditions of Use (TCU-E) in their currently valid version, available at: <https://k2-systems.com/en/digital-services/general-terms-and-conditions-of-use-for-entrepreneurs-tcu-e/>

Please note in particular § 1, Special provisions for K2 Base, clause 3 ("Technical and specialist requirements on the Customer's premises."), § 6 ("Limitation of warranty") and § 7 ("Limitation of liability").



Structural analysis report | Arbitrary Building 01 - Mounting

General information

Name	Five Guys, Reading - Solar PV Installation - Arbitrary Building 01 - Mounting Surface South
Mounting System	S-Dome 6.10 Xpress
Author	Sean Roberts

Location information

Address	Five Guys\nReading Road\nWinnersh\nWokingham, Berkshire\nRG41 5HG
Ground elevation	41.43 m

Roof information

Building height	5.44 m
Roof type	Flat roof
Roof pitch	2°
Fastening method	with Ballast
Roof covering	Flat
Min. roof edge distance	0.60 m
Parapet wall height	0.50 m
Material	Single ply membrane
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	65.00 km
Distance inside town terrain	3.00 km

Wind load

Velocity pressure, 50 years	$q_{p,50} = 0.475 \text{ kN/m}^2$
Adjustment factor for service life	$f_w = 0.921$
Velocity pressure, 25 years	$q_{p,25} = 0.437 \text{ kN/m}^2$



Structural analysis report | Arbitrary Building 01 - Mounting

Snow load

Snow load zone	2
Snow guard	No
Snow load on ground level	$s_k = 0.400 \text{ kN/m}^2$
Shape Coefficient for Snow	$\mu_i = 0.800$
Factor for roof pitch	$d_i = 0.999$
Snow load on roof, 50 year	$s_{i,50} = 0.320 \text{ kN/m}^2$
Adjustment factor for service life	$f_s = 0.929$
Snow load on roof, 25 years	$s_{i,25} = 0.297 \text{ kN/m}^2$

Dead Load

Weight of module	$G_M = 22.0 \text{ kg}$
Weight of mounting system per module	$= 6.0 \text{ kg}$
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	$= 3.00 \text{ kg/m}^2$
Total Dead Load (excl. ballast) per m^2	$= 0.14 \text{ kN/m}^2$

Load Combinations

Ultimate limit state

Partial safety factor unfavourable permanent load	$V_{G,sup} = 1.35$
Partial safety factor favourable permanent load	$V_{G,inf} = 1.00$
Partial safety factor destabilising permanent load	$V_{G,dst} = 1.10$
Partial safety factor stabilising permanent load	$V_{G,stab} = 0.90$
Partial safety factor variable loads	$V_Q = 1.50$
Combination coefficient with regards to wind	$\psi_{0,W} = 0.60$
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	$LCC\ 01_{uls} = V_{G,sup} * \kappa_{Fl,G} * G_k + V_Q * \kappa_{Fl,Q} * S_{i,n}$
Load case combination 02	$LCC\ 02_{uls} = V_{G,sup} * \kappa_{Fl,G} * G_k + V_Q * \kappa_{Fl,Q} * W_{k,Pressure}$
Load case combination 03	$LCC\ 03_{uls} = V_{G,sup} * \kappa_{Fl,G} * G_k + V_Q * \kappa_{Fl,Q} * (W_{k,Pressure} + \psi_{0,S} * S_{i,n})$
Load case combination 04	$LCC\ 04_{uls} = V_{G,sup} * \kappa_{Fl,G} * G_k + V_Q * \kappa_{Fl,Q} * (S_{i,n} + \psi_{0,W} * W_{k,Pressure})$
Load case combination 06	$LCC\ 06_{uls} = V_{G,inf} * G_k + V_Q * \kappa_{Fl,Q} * W_{k,Suction}$

Structural analysis report | Arbitrary Building 01 - Mounting

Static equilibrium

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

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	$LCC_{01_sls} = G_k + S_{i, n}$
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	$LCC_{06_sls} = G_k + W_{k, Suction}$

Max. Pressure on insulation

General information

dead load system	$g_{System} = 0.14 \text{ kN/m}^2$
aerodynamic coefficient	$C_{p, Pressure} = 0.20$

Load distribution underneath the building protection mat under Peak

Dimensions	$75.3 \times 380.0 \times 23.1 \text{ mm}$
	$A_{eff} = 28,614.00 \text{ mm}^2$
	$A_{load \text{ range area}} = 1.00 \text{ m}^2$
maximum ballast	$G_{ballast \text{ required}} = 9.2 \text{ kg}$

Load distribution underneath the building protection mat under SD

Dimensions	$75.3 \times 380.0 \times 23.1 \text{ mm}$
	$A_{eff} = 28,614.00 \text{ mm}^2$
	$A_{load \text{ range area}} = 1.00 \text{ m}^2$
maximum ballast	$G_{ballast \text{ required}} = 4.8 \text{ kg}$

Load Combinations

	$\sigma_{Ek, heat \text{ insulation, Peak}} [\text{Pa}]$	$\sigma_{Ek, heat \text{ insulation, SD}} [\text{Pa}]$
Load case combination 00	7,965	6,429
Load case combination 01	18,217	16,681



Structural analysis report | Arbitrary Building 01 - Mounting

Actions from dead loads (PV system + ballast)

 $\sigma_{\text{Ek,heat insulation,Peak}}$

$$\sigma_{\text{Ek}} = 7,965 \text{ Pa}$$

 $\sigma_{\text{Ek,heat insulation,SD}}$

$$\sigma_{\text{Ek}} = 6,429 \text{ Pa}$$

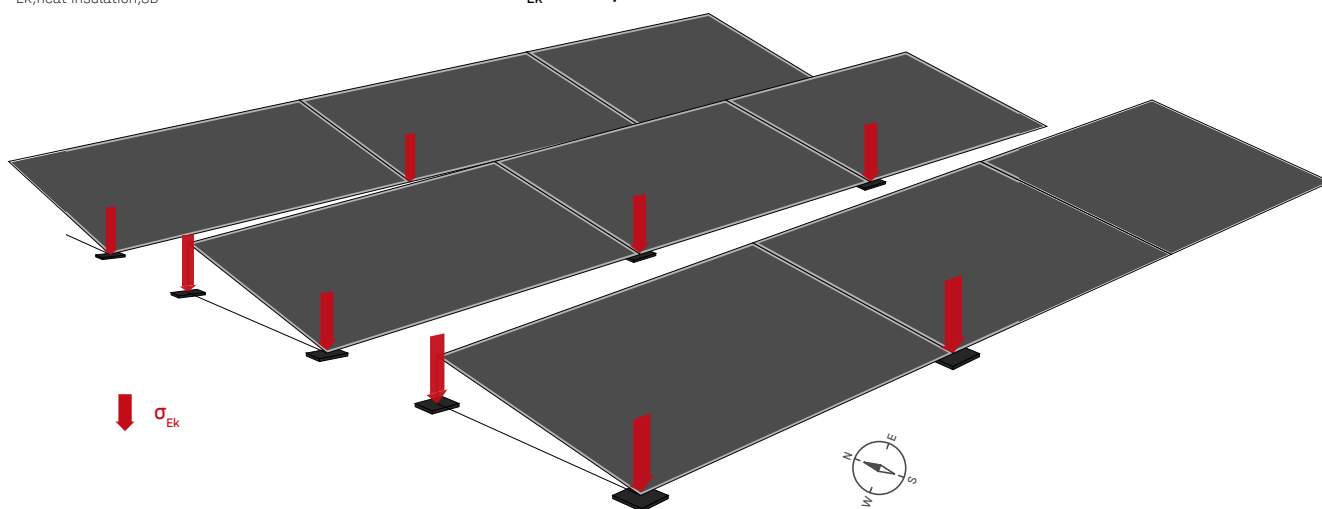
Maximum actions (PV system + ballast + snow)

 $\sigma_{\text{Ek,heat insulation,Peak}}$

$$\max \sigma_{\text{Ek}} = 18,217 \text{ Pa}$$

 $\sigma_{\text{Ek,heat insulation,SD}}$

$$\max \sigma_{\text{Ek}} = 16,681 \text{ Pa}$$





Structural analysis report | Arbitrary Building 01 - Mounting

Ballast Calculation

Ballast Calculation Uplift

Force per module perpendicular to the roof

$$F_z = q_p \cdot (-c_{pD} \cos(\delta) A_D - c_{pM} \cos(\alpha) A_M)$$

F_z	uplift force per module unit in z-direction
q_p	local peak velocity pressure at roof height z
A_D	deflector area
A_M	module area
δ	deflector tilt angle
α	module tilt angle
c_{pD}	deflector pressure coefficient
c_{pM}	module pressure coefficient

Ballast against uplift

$$m_{B,uplift} = \frac{\gamma_Q \cdot \kappa_{Fl,Q} \cdot F_z}{\gamma_{G,stab} \cdot \cos(\beta) \cdot g} \cdot \prod_i k_i - m_{DL}$$

m_{DL}	weight of module(s) and mounting system
β	roof pitch angle
k_a	correction factor for roof pitch
k_d	correction factor for wind direction
k_A	correction factor for module blocks with more than 60 modules
k_c	correction factor for module cantilever over windbreaker
k_p	correction factor for parapet walls
k_s	correction factor for large modules
k_R	correction factor for large row spacings
k_{RWS}	correction factor for the gap between windbreaker and module



Structural analysis report | Arbitrary Building 01 - Mounting

Ballast Calculation Sliding

Force per module parallel to the roof

$$F_x = q_p \cdot (c_{pD} \sin(\delta) A_D - c_{pM} \sin(\alpha) A_M)$$

$$F_y \approx 0$$

F_x sliding force per module unit in x-direction

F_y sliding force per module unit in y-direction

q_p local peak velocity pressure at roof height z

c_{pD} deflector pressure coefficient

c_{pM} module pressure coefficient

A_D deflector area

A_M module area

δ deflector tilt angle

α module tilt angle

Ballast against sliding

$$m_{B,sliding} = \frac{\gamma_Q \cdot \kappa_{Fl,Q} \cdot \left(\frac{\sqrt{F_x^2 + F_y^2}}{\mu_{R,0}} + F_z \right)}{\gamma_{G,stab} \cdot g} \cdot \prod_i k_i - m_{DL}$$

m_{DL} weight of module(s) and mounting system

$\mu_{R,0}$ Friction coefficient

k_a correction factor for roof pitch

k_d correction factor for wind direction

k_A correction factor for module blocks with more than 60 modules

k_c correction factor for module cantilever over windbreaker

k_p correction factor for parapet walls

k_s correction factor for large modules

k_R correction factor for large row spacings

k_{RWS} correction factor for the gap between windbreaker and module

Case	Highest ballast		Lowest ballast	
	Sliding	Uplift	Sliding	Uplift
c_{pM}	-0.179		-0.314	-0.140
c_{pD}	0.236		0.407	0.222
k_a	1.08		1.00	1.08
k_d	0.90		0.90	0.90



Structural analysis report | Arbitrary Building 01 - Mounting

k_A	1.00	1.00	1.00	1.00
k_C	1.05	1.05	1.05	1.05
k_p	1.07	1.09	1.07	1.09
k_s	1.03	1.03	1.03	1.03
k_R	1.03	1.03	1.03	1.03
k_{RWS}	1.03	1.03	1.03	1.03
A_M [m ²]	2.00	2.00	2.00	2.00
A_D [m ²]	0.21	0.21	0.21	0.21
delta [°]	81.0	81.0	81.0	81.0
alpha [°]	9.0	9.0	9.0	9.0
qp [kN/m ²]	0.44	0.44	0.44	0.44
μ	0.5	-	0.5	-
Fx [kN]	0.046	-	0.040	-
Fz [kN]	0.151	0.265	0.118	0.184
$m_{ballast}$ [kg]	13.9	15.3	5.9	2.0
m_{DL} [kg]	28.0	28.0	28.0	28.0

Structural analysis report | Arbitrary Building 01 - Mounting

H-V-loads

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

General information

Total number of modules	24	
Roof areas covered with modules	A	= ca. 72.23 m ²
Dead Load	$g_{k, \text{System incl. ballast}}$	= 0.12 kN/m ²

Aerodynamic coefficients

	$C_{p, \text{Pressure}}$	= according to EN 1991-1-4
	$C_{F, x, \text{average}}$	= 0.01
	$C_{F, y, \text{averaged}}$	= -0.02
edge distance correction	$k_{s, xy}$	= 1.00
Parapet wall- correction coefficient	k_p	= 1.08
Factor building height		= 1.00

Horizontal pressure

$$W_{k, F, x} = 0.004 \text{ kN/m}^2$$

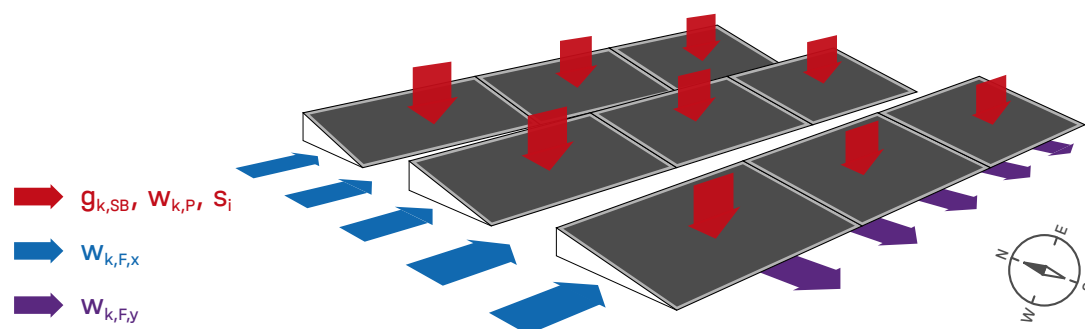
$$W_{k, F, y} = -0.010 \text{ kN/m}^2$$

Vertical pressure

$$g_{k, \text{System incl. ballast}} = 0.12 \text{ kN/m}^2$$

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

$$S_i - \text{according to EN 1991-1-3}$$



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	30	9.0 kg
3	2004178	Dome 6 Connector 495mm Set	21	8.7 kg
4	2003249	S-Dome 6.10 Windbreaker short	30	54.0 kg
5	2002937	Thread-forming metal screw 6×25	160	1.1 kg
6	2002870	K2 Solar Cable Manager	100	0.3 kg
7	2002609	DomeClamp Black MC Set 30-50	40	2.3 kg
8	2002610	DomeClamp Black EC Set 30-50	20	1.3 kg
9	2002300	Dome SpeedPorter	60	4.6 kg
Total				133.9 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

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