

THE CHARTER – CURO LIVING**TECHNICAL SUBMISSION – TS – 001– PV FIXING DETAILS**

REFERENCE	THE CHARTER – PV FIXING DETAILS
DESCRIPTION	RENUSOL FIXING DETAILS AND SETTING OUT PLANS
LOCATION	E01 ROOF'S
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ATTACHMENTS	TECHNICAL PROJECT OVERVIEW NICHOLSON FIXING PLATE DATA SHEET E01 ROF PLAN

NAME	COMPANY	DATE	STATUS
	EDC		
	CURO LIVING		
STATUS A = PROCEED NO COMMENTS, B = PROCEED WITH COMMENTS, C = RE-SUBMIT			
COMMENTS			

Technical project overview

The Charter House

Building project	The Charter House
Date	22.08.2024
In-house project no.	PA_230413_507044
Editor	Renusol Europe GmbH
Link to configurator	Open link
Number of modules	169
Rated output	75.205 kWp

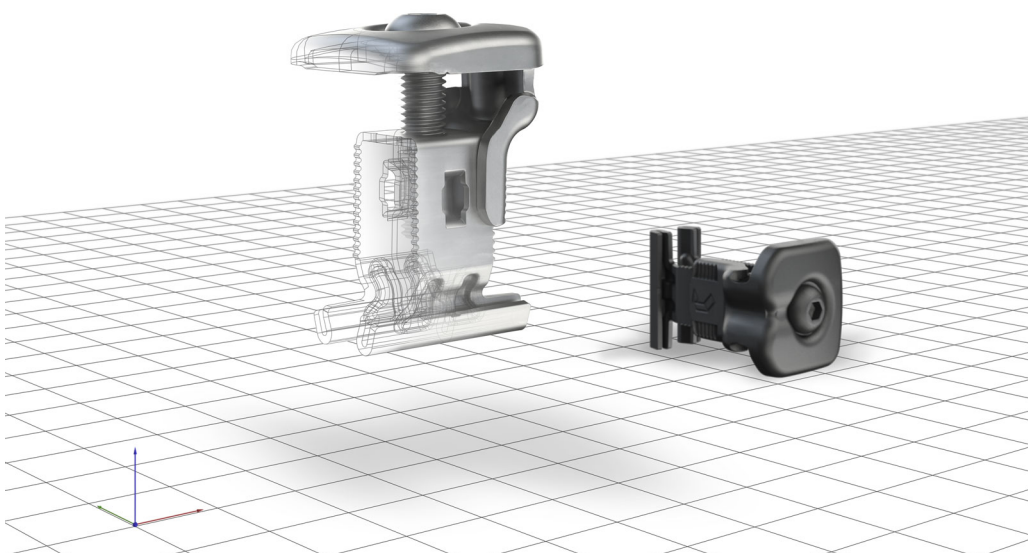


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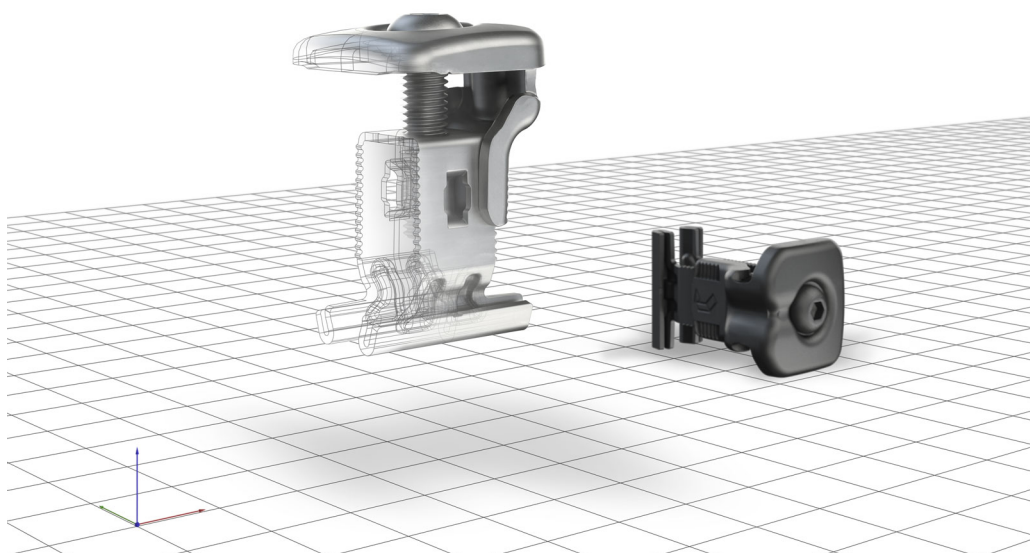
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Module field 4	97
Module field 5	98
Module field 6	99
Module field 7	100
Module field 8	101
Bill of material	102
Statics analysis (S1-S8)	103
Total bill of material	108
Important notes	109

Technical project overview

The Charter House

Building project	The Charter House
Address	High Street 35a, DA11 0AZ
Country	United Kingdom
Module Type	Shanghai JA Solar Technology Co. Ltd. - JAM54D40-445/LB
Number of modules	33
Rated output	14.685 kWp
Mounting system	FixedFS10S
Editor	Renusol Europe GmbH



LOCATION

Street	High Street 35a
City	DA11 0AZ
Country	United Kingdom

SURROUNDINGS

Code	Eurocode NA GB
Terrain height above sealevel	17,00 m
Snow load zone	Zone 3
Use Pressure coefficients from BRE 489 2014 roof pitch 0 -45°	yes
Terrain category	Country
Distance to coast	8,91 km
Surroundings	normal
Service life of PV system	25 years
Failure consequence class	2

LOAD CALCULATION RESULT

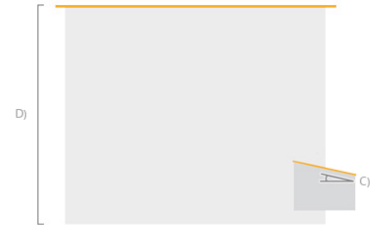
Peak velocity pressure	0,95 kN/m ²
Snow load	0,46 kN/m ²
Snow load on roof	0,36 kN/m ²
Base wind speed ($V_{b,0}$)	22,00 m/s

TOPOGRAPHY

Topography	Not exposed
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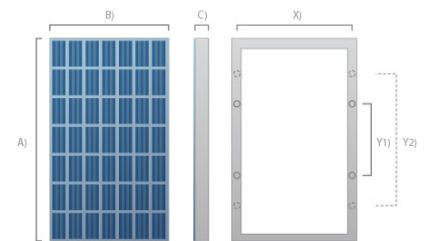
ROOF PROPERTIES

Roof type	Free-form Flat roof
Coverage type	Foil
C) Roof pitch	2,00 °
D) Building height	34,20 m
Parapet height	0,00 mm
Parapet width	0,00 mm



MODULE PARAMETERS

Manufacturer	Shanghai JA Solar Technology Co. Ltd.
Name	JAM54D40-445/LB
Length	1762 mm
Width	1134 mm
Height	30 mm
Weight	22 kg
Rated output	445 W _{peak}
Datasheet	Open datasheet



Please check the compatibility of clamping positions with module manufacturer advice.

The module data was taken from a database. Please check whether this data corresponds to your actual module order. If necessary, please correct the data using the editing function.

FASTENER PARAMETERS

Name	Rooftrak IFP-HM/MW
Manufacturer	Nicholson
Pressure load capacity	5,00 kN
Tensile load capacity	3,50 kN
Lateral force	2,50 kN
Interaction	Linear

The third party product(s) listed above, is (are) not (a) product of Renusol but, from third party Manufacturer(s) (Manufacturer). The PV-Configurator uses static properties of this fastener provided by this Manufacturer. The Manufacturer is responsible for the accurateness and correctness of the static values provided by him, Renusol does not assume any liability regarding the product of the Manufacturer and its static properties.

SYSTEM

System type	Fixed
System	FixedFS10S



Please check the entered row distance for an ideal yield calculation with a correct calculation including consideration of the shading.

FASTENER DETAILS

Mounting rotation	Eave (0°)
Fastener type	Custom fastener
X) Row distance	1740mm

CLAMPS

Clamp type	Mid clamps+ / End clamps+
Clamp colour	black
Max value middle clamps	102 %
Max value end clamps	66 %

STATIC VALIDATION

Your project was validated by our statics check successfully.

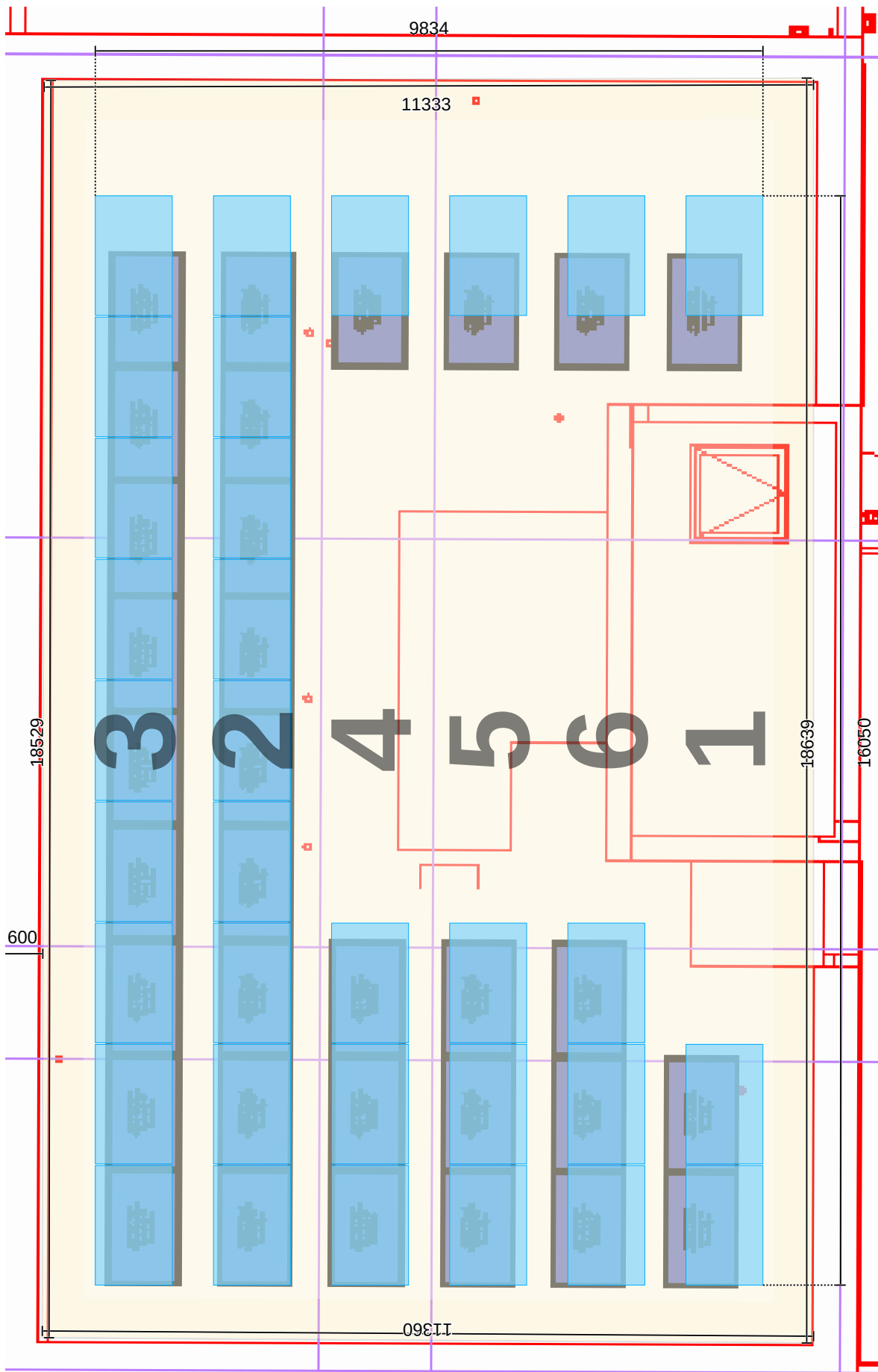
Static utilization factor: 102%

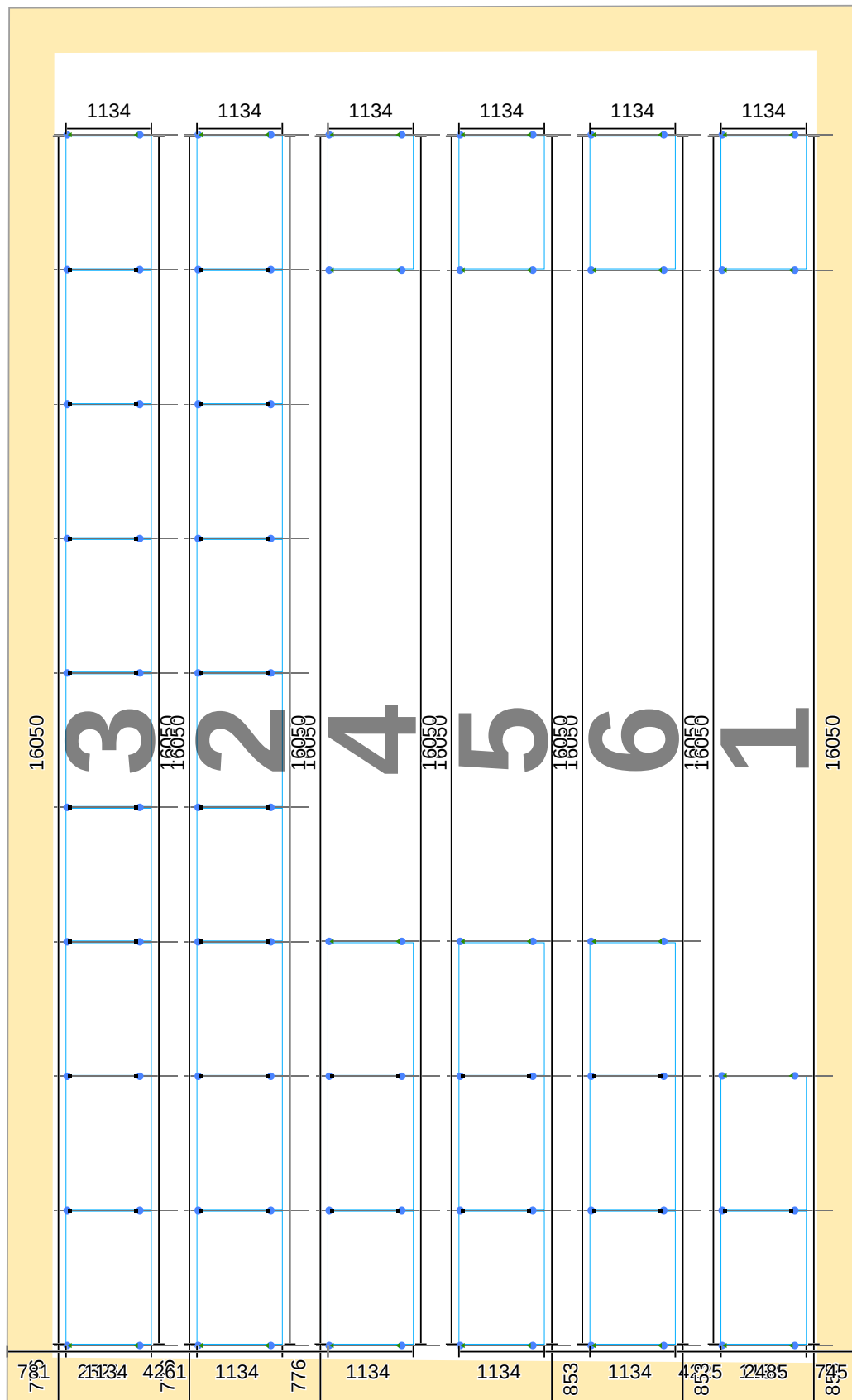
Static utilization fastener: 35%

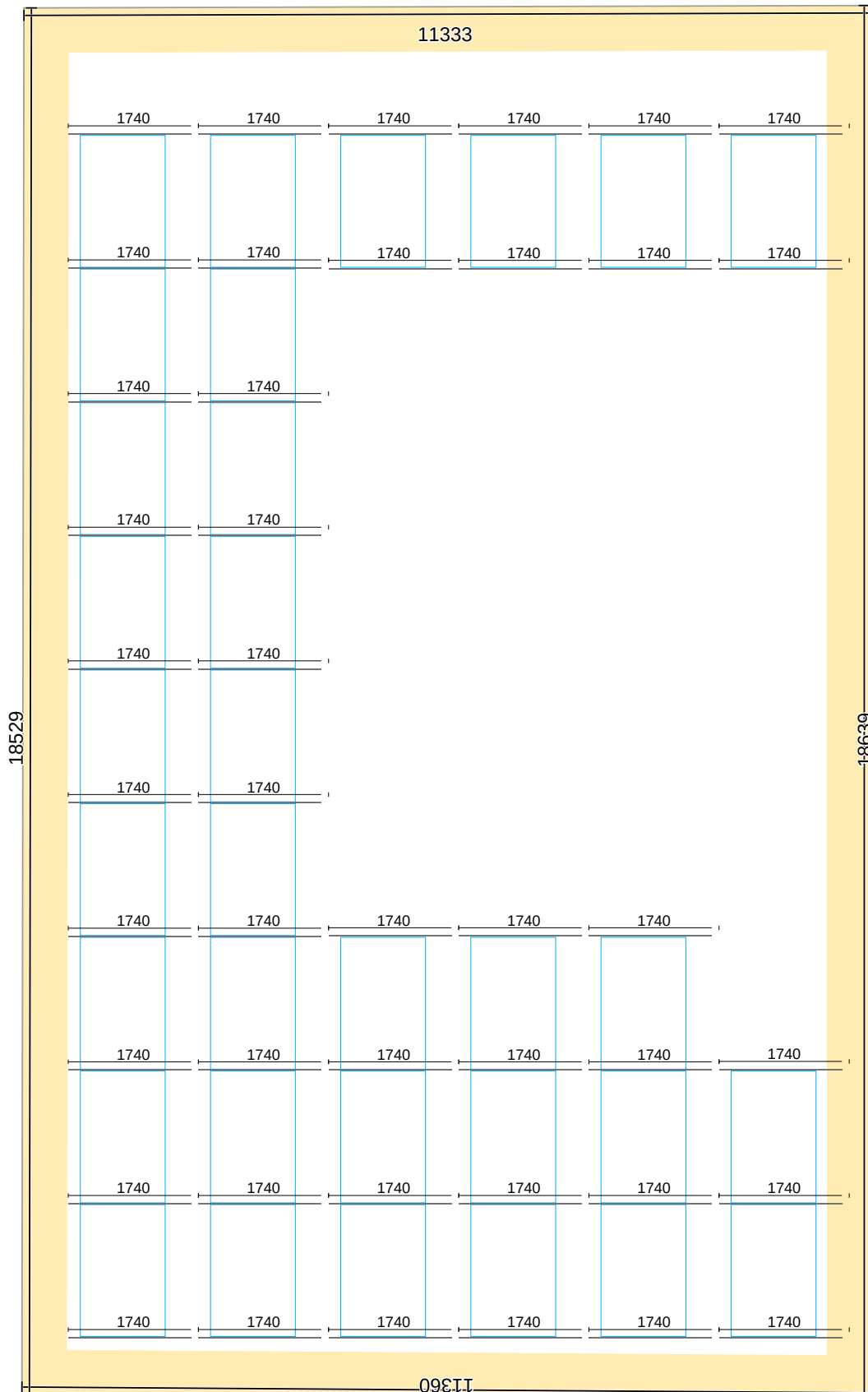
Static utilization clamp: 102%

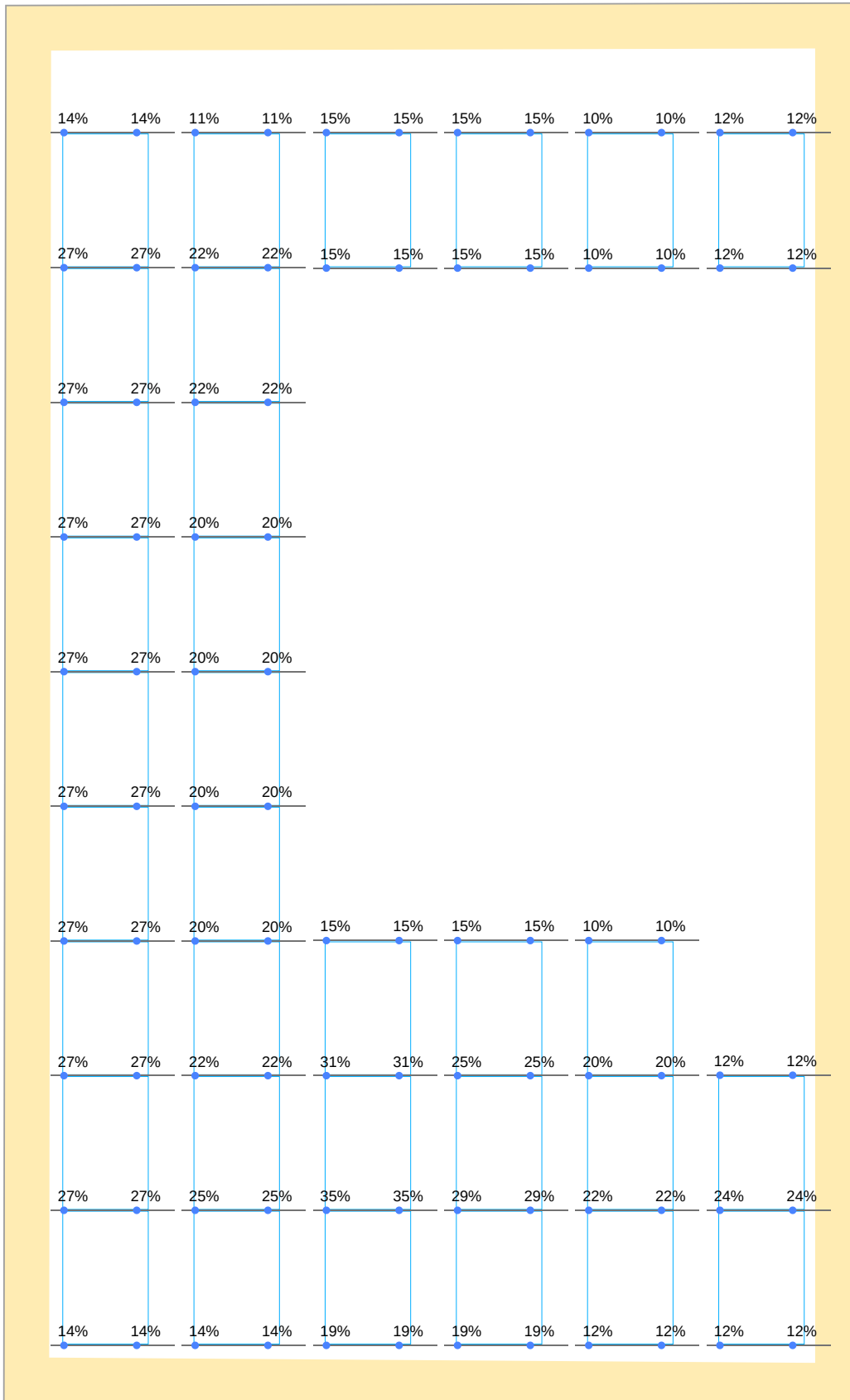
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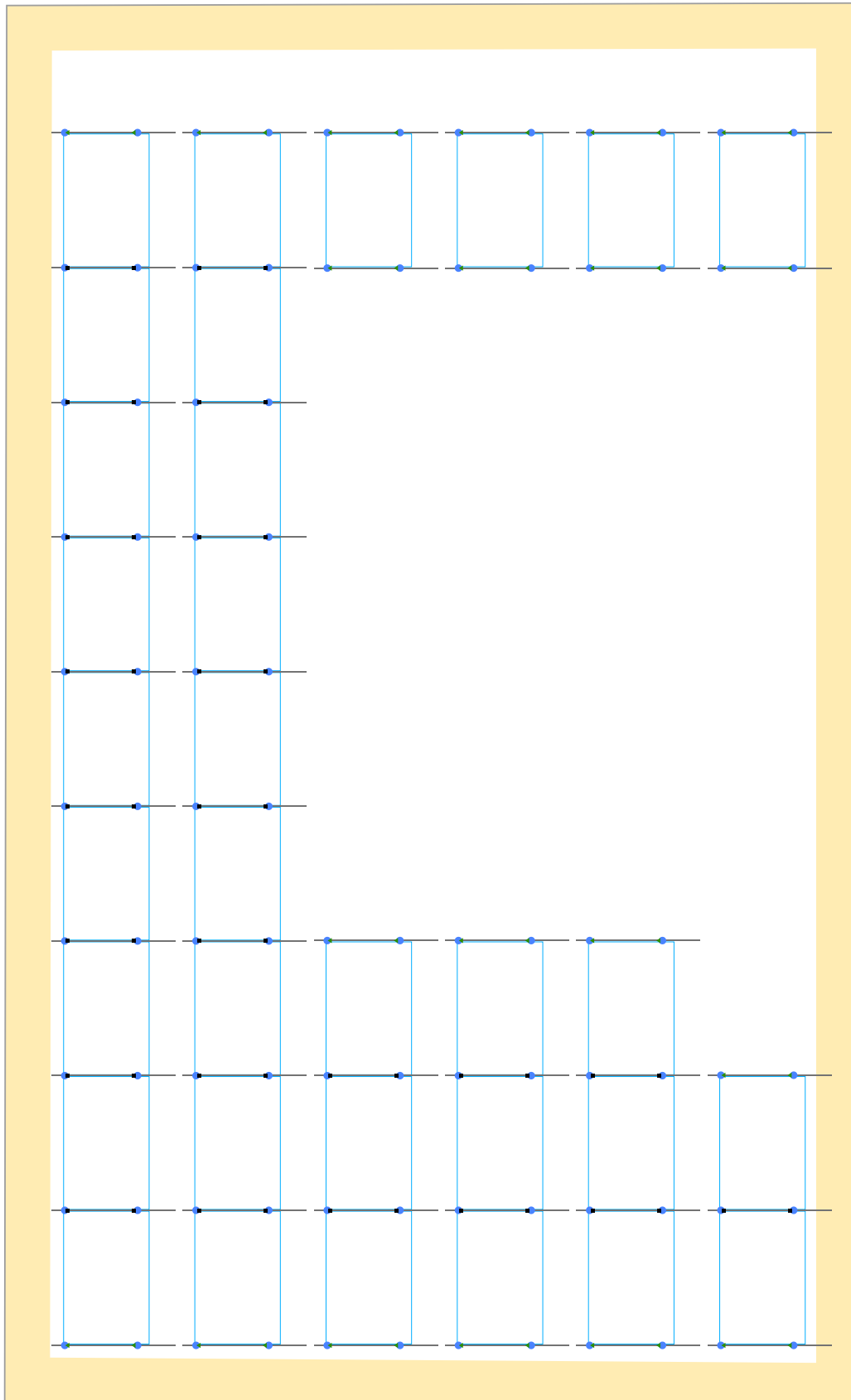
- Service life of PV system: 25 years
- Failure consequence class: 2

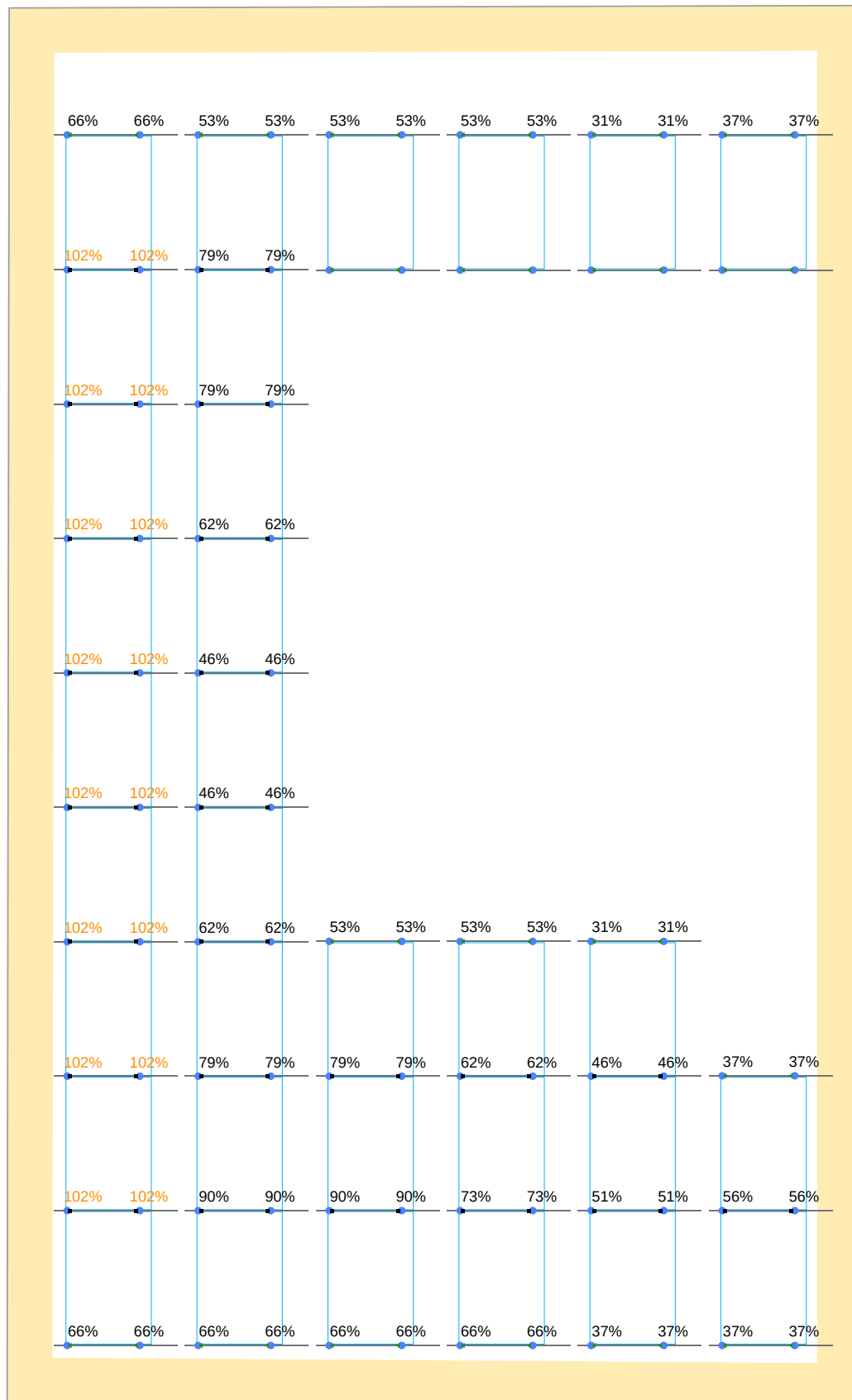


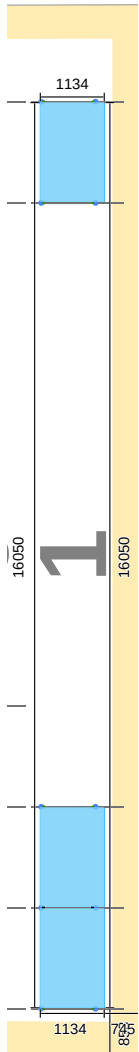


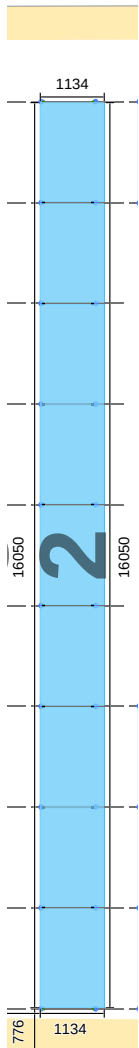


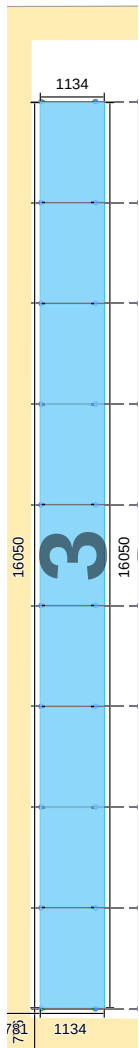


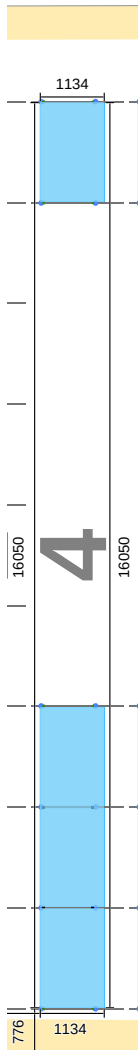


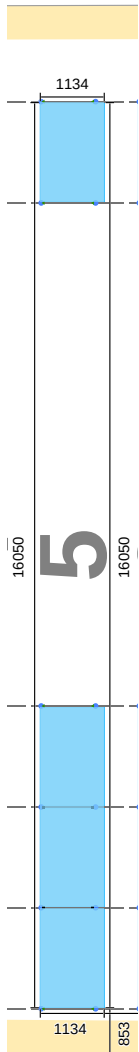


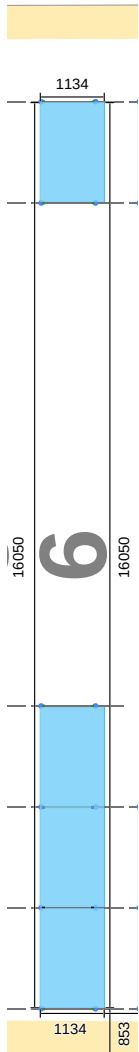












BILL OF MATERIAL

Article No.	Article	Quantity	Ordering Unit	Weight/Piece	Weight
R420081-BE	End clamp+ (black)	40	1	0,064 kg	2,560 kg
R420082-BE	Middle clamp+ (black)	46	1	0,063 kg	2,898 kg
R500409	Base rail FS10-S XL 1639 mm	43	1	1,203 kg	51,729 kg
R500419	Eave support XL	43	1	0,049 kg	2,107 kg
R500423	Ridge support 10° XL	43	1	0,443 kg	19,049 kg
R900314	Socket bolt 6 x 110 mm	86	1	0,009 kg	0,774 kg
R520220	FS Pro 10-S Base rail 1500 (Set)	43	1	1,724 kg	74,132 kg
					Total Weight: 153,249 kg
Third party parts		Quantity			
Rooftrak IFP-HM/MW		86			

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LOAD ASSUMPTIONS

Dead load

Solar modules type JAM54D40-445/LB are used.

The modules are angled horizontally on the roof and are fastened on the larger module edges on the vertical rails with module clamps.

Dimensions: 1762 mm x 1134 mm
Weight: $G = 22.0 \text{ kg}$
 $F_G = 22.0 \text{ kg} \cdot 9.81 \text{ m/s}^2 = 0.216 \text{ kN}$

Snow load

The determination of the snow load is carried out according to BS EN 1991-1-3:2003/NA:2010-06.

Snow-trap formation or snow-load accumulations are not considered in the calculation. Please contact Renusol if necessary.

Height above sea level: 17 m
Snow load zone: 3
Roof pitch: $\alpha = 2^\circ$
Module elevation: $\beta = 10^\circ$
total pitch: 12.0°

Period of use: 25 Year
Snow load: $s_k = s_{k,50} \cdot f_s = 0.50 \text{ kN/m}^2 \cdot 0.93 = 0.46 \text{ kN/m}^2$
 $\mu_{11} = 0.800$
 $s_t = \mu_{11} \cdot s_k = 0.8 \cdot 0.46 \text{ kN/m}^2 = 0.371 \text{ kN/m}^2$
 $s_{t,12^\circ} = 0.371 \text{ kN/m}^2 \cdot \cos(12.0^\circ) = 0.371 \text{ kN/m}^2$
 $F_{S,k} = 0.371 \text{ kN/m}^2 \cdot 1.76 \text{ m} \cdot 1.13 \text{ m} = 0.725 \text{ kN}$

Wind load

The determination of the wind load is carried out according to BS EN 1991-1-4:2005/NA:2011-01.

Building height roof ridge: 34 m
Terrain category: Country terrain
Basic wind velocity: 22.00 m/s
Distance to shoreline: 8.910 km
Period of use: 25 Year
Pressure of the gusts velocity: $q(z) = 0.945 \text{ kN/m}^2$

ANALYSIS

Load cases and load case combinations

Load cases

The respective loads are taken from the load assumptions and converted to a reference system perpendicular to the roof area.

LC 1	Dead load
LC 2	Snow load
LC 3	Wind pressure
LC 4	Wind suction

Significant load case combinations
according to: EN 1990:2012

Ultimate state of load-bearing capacity

LCC 1	Predominant action wind pressure $E_{d,LCC 1} = 1.35 \cdot E_{GK,LC 1} + 1.50 \cdot (E_{QK,LC 3} + 0.5 \cdot E_{QK,LC 2})$
LCC 2	Predominant action snow $E_{d,LCC 2} = 1.35 \cdot E_{GK,LC 1} + 1.50 \cdot (E_{QK,LC 2} + 0.6 \cdot E_{QK,LC 3})$
LCC 3	Predominant action wind suction (lifting) $E_{d,LCC 3} = 1.00 \cdot E_{GK,LC 1} + 1.50 \cdot (E_{QK,LC 4})$

Ultimate state of serviceability

LCC 4	Predominant action wind pressure $E_{d,LCC 4} = 1.00 \cdot E_{GK,LC 1} + 1.00 \cdot (E_{QK,LC 3} + 0.5 \cdot E_{QK,LC 2})$
LCC 5	Predominant action snow $E_{d,LCC 5} = 1.00 \cdot E_{GK,LC 1} + 1.00 \cdot (E_{QK,LC 2} + 0.6 \cdot E_{QK,LC 3})$
LCC 6	Predominant action wind suction $E_{d,LCC 6} = 1.00 \cdot E_{GK,LC 1} + 1.00 \cdot (E_{QK,LC 4})$

ANALYSIS

Middle clamp

General

The module clamps consist of extruded aluminium sheaths material grade EN-AW 6063 T66. The lower part of the module clamps consists of a click profile made of S500 MC, EN 10149-2, which is attached to the module carrying profile and transfers the loads by form closure. On it the module end clamp or module middle clamp is fastened by a screw. When tightening the screw the module clamp presses the module to the rail.

Sketch



Static analysis

The maximum loads established in the load combinations of the tension loads perpendicular to the roof area and the respective shear loads parallel to the roof area or the maximum shear loads in combination with the corresponding tensile loads perpendicular to the roof area are significant for the analysis. Pressure loads perpendicular to the roof area are transferred by contact bearing.

Analysis

LCC 1

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 848 \text{ mm}$ $y = 3510 \text{ mm}$
 Loads: $V_{x,d} = -0.44 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.44/1.05 = 0.42 < 1$

LCC 2

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 848 \text{ mm}$ $y = 3510 \text{ mm}$
 Loads: $V_{x,d} = -0.17 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.17/1.05 = 0.16 < 1$

LCC 3

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 848 \text{ mm}$ $y = 3510 \text{ mm}$
 Loads: $N_d = -0.79 \text{ kN}$
 $V_{x,d} = -0.68 \text{ kN}$
 Comparison stress: $N_d/F_{R,d,x} + V_{x,d}/F_{R,d,y} = 0.79/3.22 + 0.68/0.88 = 1.02 > 1$

ANALYSIS

End clamp

General

The module clamps consist of extruded aluminium sheaths material grade EN-AW 6063 T66. The lower part of the module clamps consists of a click profile made of S500 MC, EN 10149-2, which is attached to the module carrying profile and transfers the loads by form closure. On it the module end clamp or module middle clamp is fastened by a screw. When tightening the screw the module clamp presses the module to the rail.

Sketch



Static analysis

The maximum loads established in the load combinations of the tension loads perpendicular to the roof area and the respective shear loads parallel to the roof area or the maximum shear loads in combination with the corresponding tensile loads perpendicular to the roof area are significant for the analysis. Pressure loads perpendicular to the roof area are transferred by contact bearing.

Analysis

LCC 1

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 2588 \text{ mm}$ $y = 17803 \text{ mm}$
 Loads: $V_{x,d} = -0.22 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.22/0.81 = 0.27 < 1$

LCC 2

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 2588 \text{ mm}$ $y = 17803 \text{ mm}$
 Loads: $V_{x,d} = -0.09 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.09/0.81 = 0.11 < 1$

LCC 3

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 2588 \text{ mm}$ $y = 17803 \text{ mm}$
 Loads: $N_d = -0.39 \text{ kN}$
 $V_{x,d} = -0.34 \text{ kN}$
 Comparison stress: $N_d/F_{R,d,x} + V_{x,d}/F_{R,d,y} = 0.39/1.75 + 0.34/0.78 = 0.66 < 1$

ANALYSIS

Fastener

General

The resistances were determined on the user's own responsibility.

Design values of load capacity

$$F_{R,d,x} = 5.00 \text{ kN}$$

$$F_{R,d,-x} = 3.50 \text{ kN}$$

$$F_{R,d,y} = 2.50 \text{ kN}$$

LCC 1

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 4227 \text{ mm}$ $y = 16012 \text{ mm}$

Loads: $N_d = 0.44 \text{ kN}$

$$V_{x,d} = -0.42 \text{ kN}$$

Comparison stress: $N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.44/5.00 + 0.42/2.50 = 0.25 < 1$

LCC 2

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 4227 \text{ mm}$ $y = 16012 \text{ mm}$

Loads: $N_d = 0.71 \text{ kN}$

$$V_{x,d} = -0.23 \text{ kN}$$

Comparison stress: $N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.71/5.00 + 0.23/2.50 = 0.24 < 1$

LCC 3

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 4227 \text{ mm}$ $y = 16012 \text{ mm}$

Loads: $N_d = -0.64 \text{ kN}$

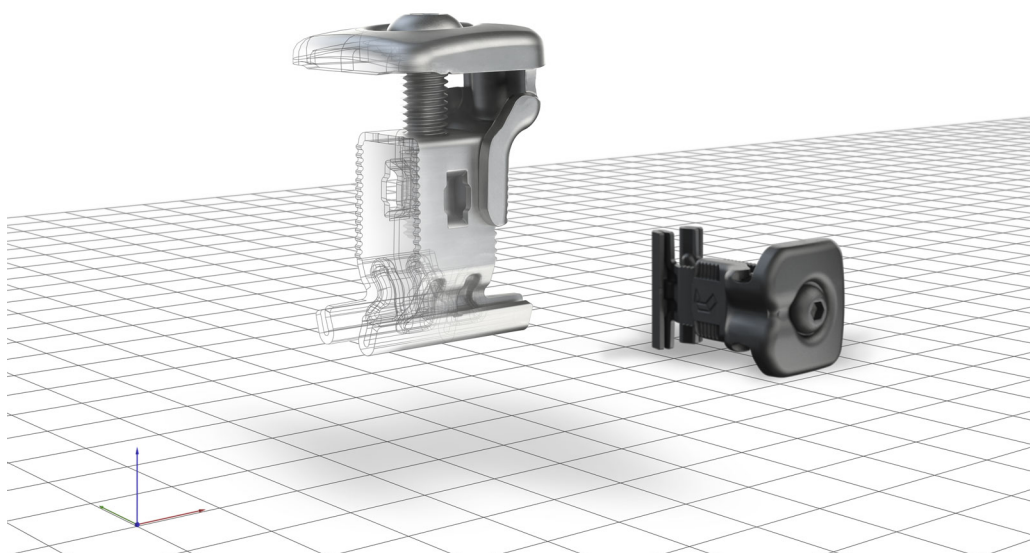
$$V_{x,d} = -0.43 \text{ kN}$$

Comparison stress: $N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.64/3.50 + 0.43/2.50 = 0.35 < 1$

Technical project overview

The Charter House

Building project	The Charter House
Address	High Street 35a, DA11 0AZ
Country	United Kingdom
Module Type	Shanghai JA Solar Technology Co. Ltd. - JAM54D40-445/LB
Number of modules	68
Rated output	30.26 kWp
Mounting system	FixedFS10S
Editor	Renusol Europe GmbH



LOCATION

Street	High Street 35a
City	DA11 0AZ
Country	United Kingdom

SURROUNDINGS

Code	Eurocode NA GB
Terrain height above sealevel	17,00 m
Snow load zone	Zone 3
Use Pressure coefficients from BRE 489 2014 roof pitch 0 -45°	yes
Terrain category	Country
Distance to coast	8,91 km
Surroundings	normal
Service life of PV system	25 years
Failure consequence class	2

LOAD CALCULATION RESULT

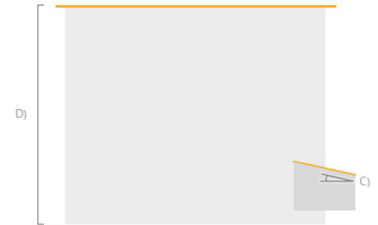
Peak velocity pressure	0,95 kN/m ²
Snow load	0,46 kN/m ²
Snow load on roof	0,36 kN/m ²
Base wind speed ($V_{b,0}$)	22,00 m/s

TOPOGRAPHY

Topography	Not exposed
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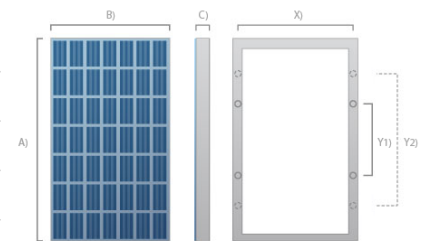
ROOF PROPERTIES

Roof type	Free-form Flat roof
Coverage type	Foil
C) Roof pitch	2,00 °
D) Building height	34,20 m
Parapet height	0,00 mm
Parapet width	0,00 mm



MODULE PARAMETERS

Manufacturer	Shanghai JA Solar Technology Co. Ltd.
Name	JAM54D40-445/LB
Length	1762 mm
Width	1134 mm
Height	30 mm
Weight	22 kg
Rated output	445 W _{peak}
Datasheet	Open datasheet



Please check the compatibility of clamping positions with module manufacturer advice.

The module data was taken from a database. Please check whether this data corresponds to your actual module order. If necessary, please correct the data using the editing function.

FASTENER PARAMETERS

Name	Rooftrak IFP-HM/MW
Manufacturer	Nicholson
Pressure load capacity	5,00 kN
Tensile load capacity	3,50 kN
Lateral force	2,50 kN
Interaction	Linear

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SYSTEM

System type	Fixed
System	FixedFS10S



Please check the entered row distance for an ideal yield calculation with a correct calculation including consideration of the shading.

FASTENER DETAILS

Mounting rotation	Eave (0°)
Fastener type	Custom fastener
X) Row distance	1740mm

CLAMPS

Clamp type	Mid clamps+ / End clamps+
Clamp colour	black
Max value middle clamps	102 %
Max value end clamps	66 %

STATIC VALIDATION

Your project was validated by our statics check successfully.

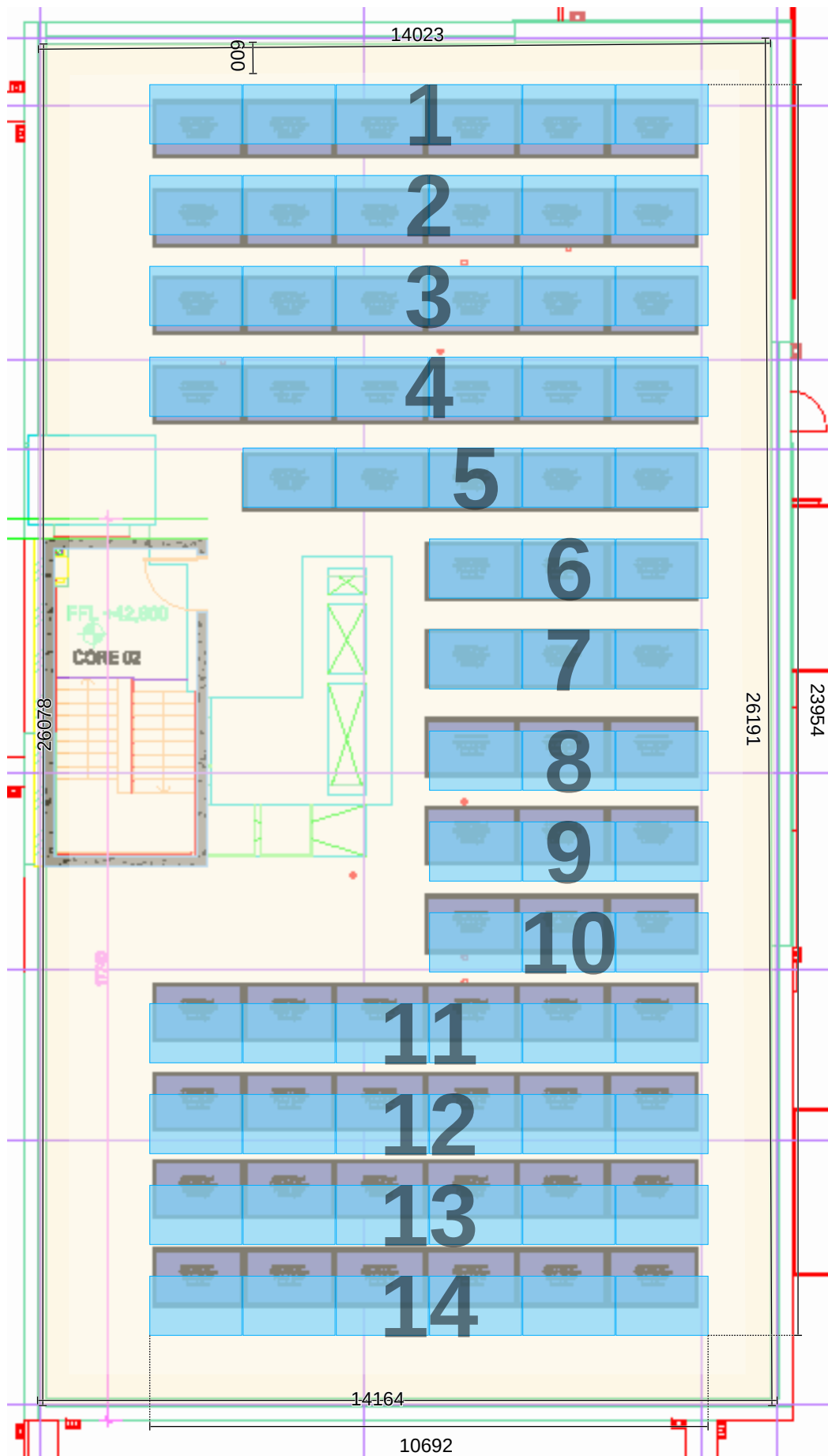
Static utilization factor: 102%

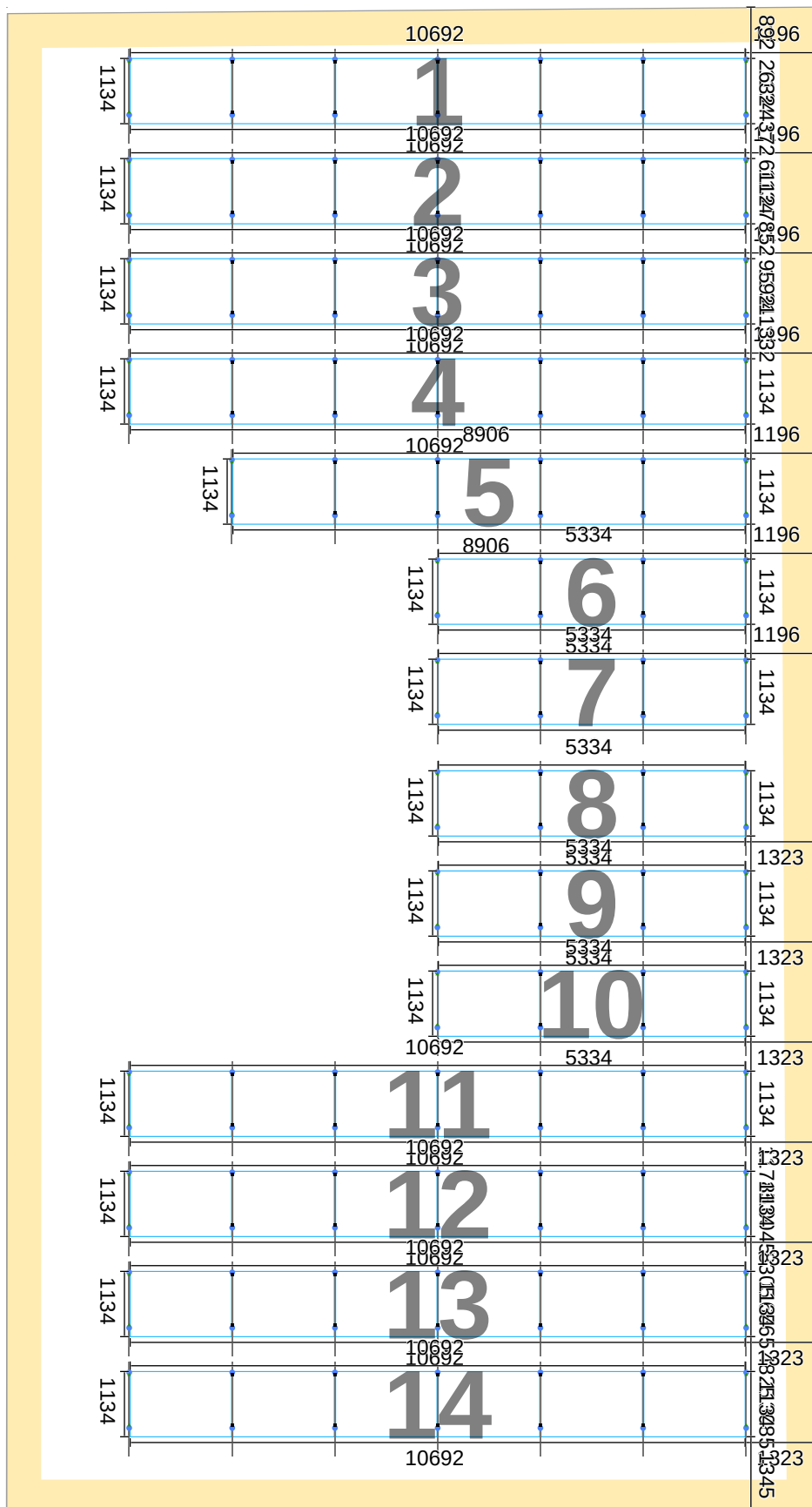
Static utilization fastener: 35%

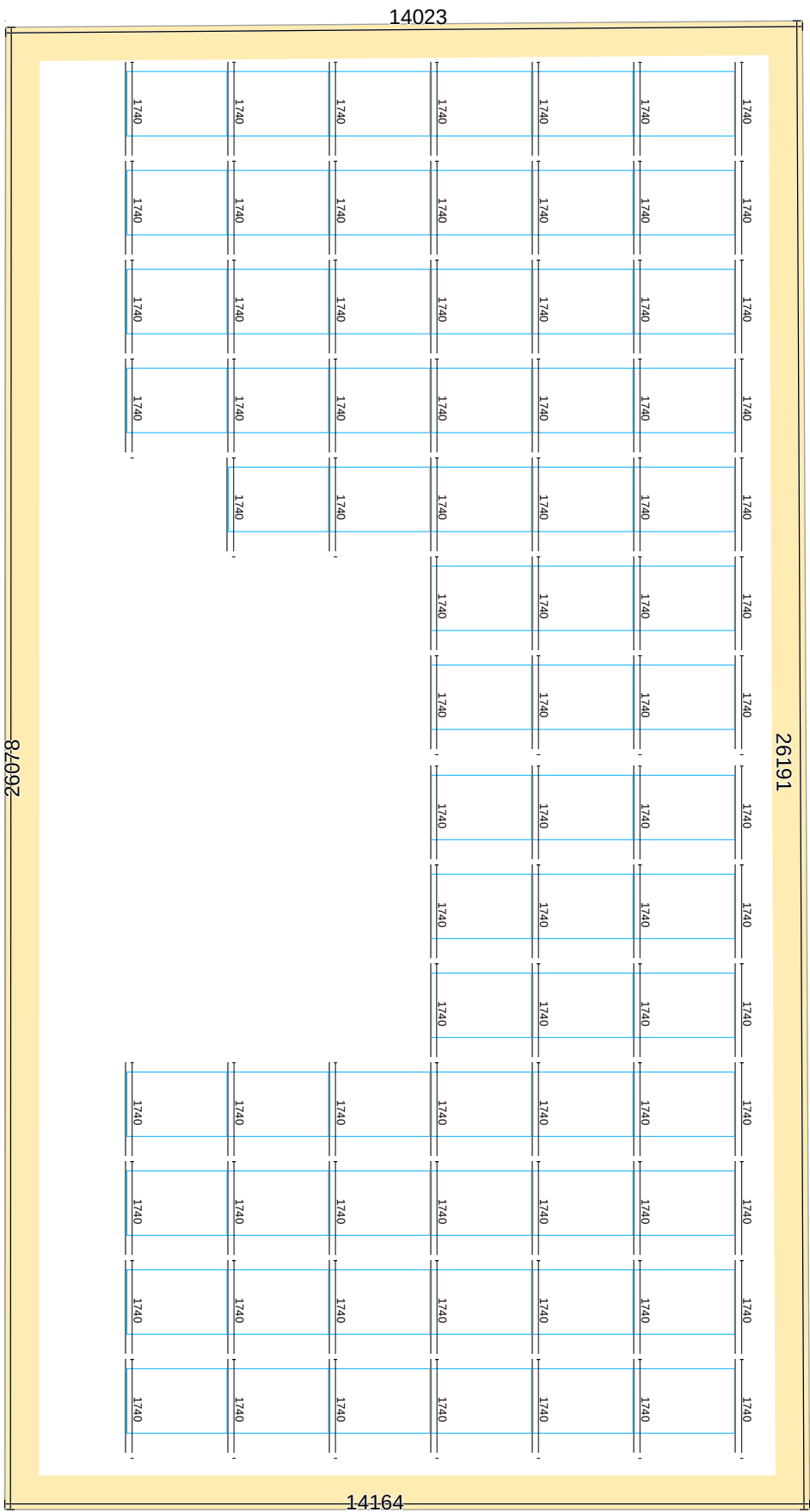
Static utilization clamp: 102%

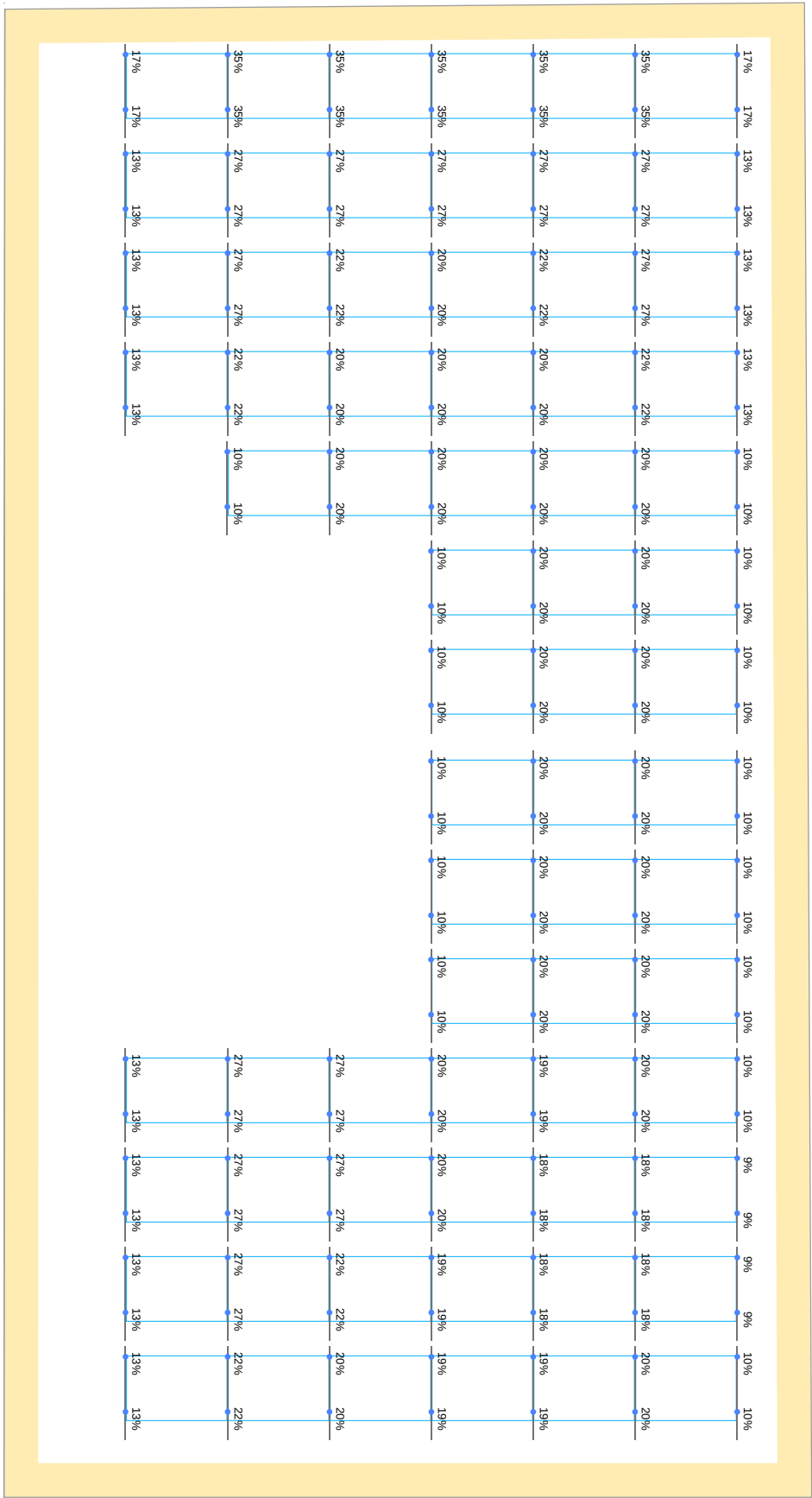
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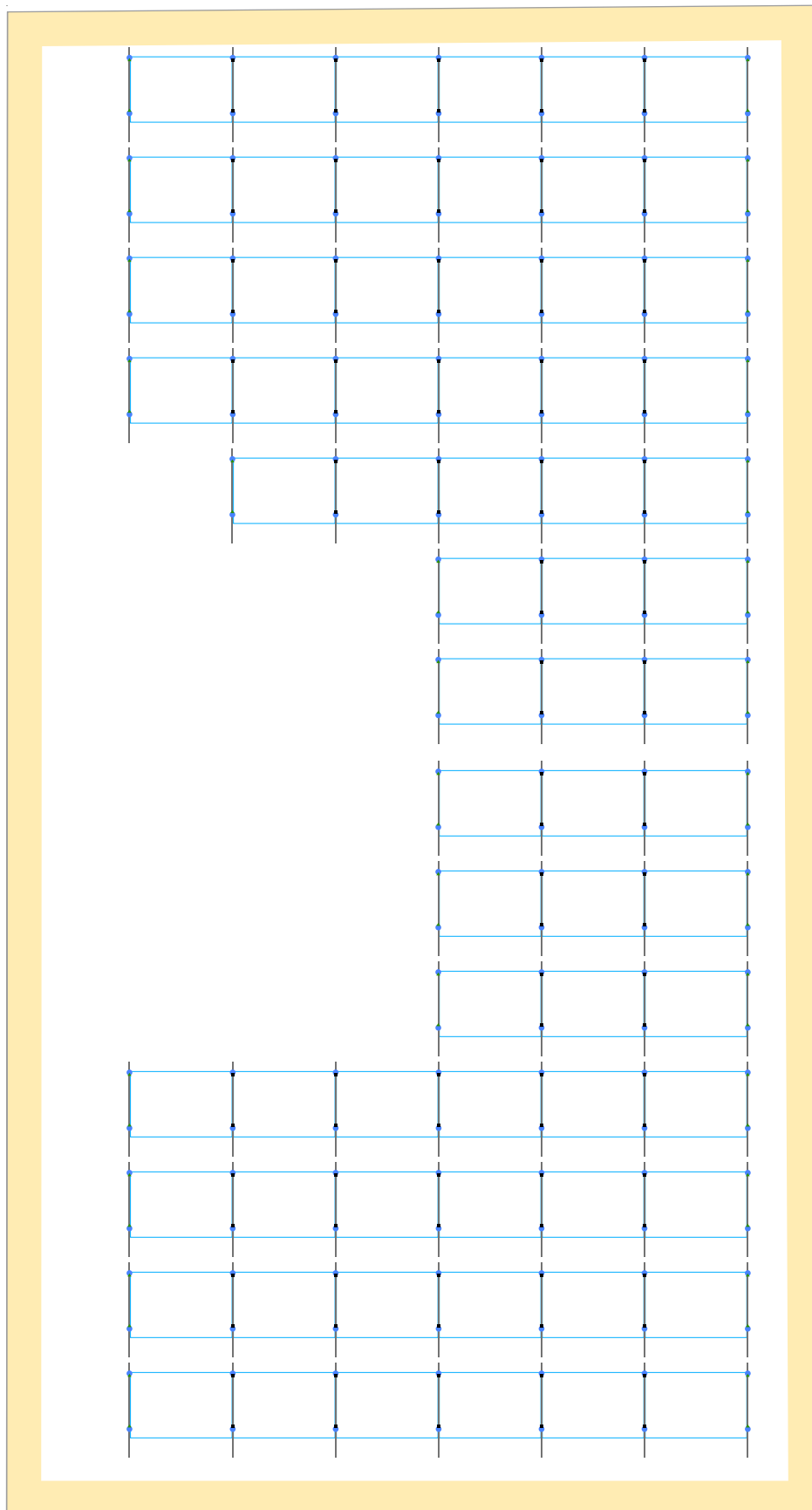
- Service life of PV system: 25 years
- Failure consequence class: 2



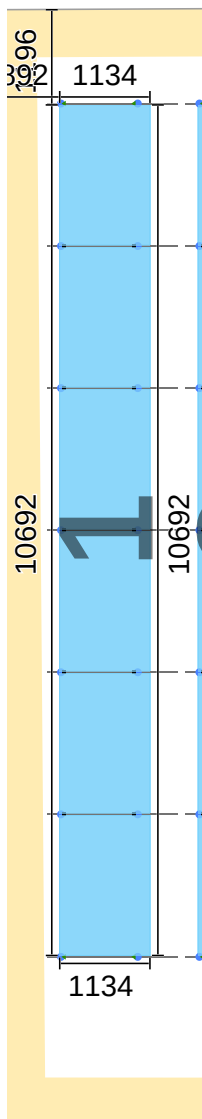


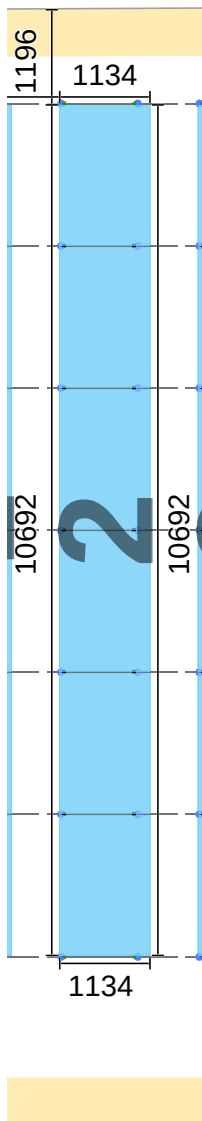


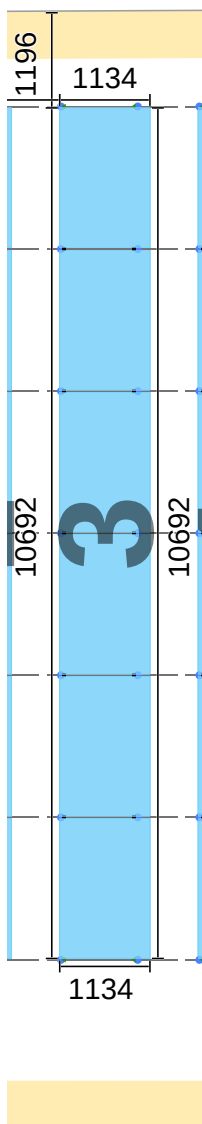


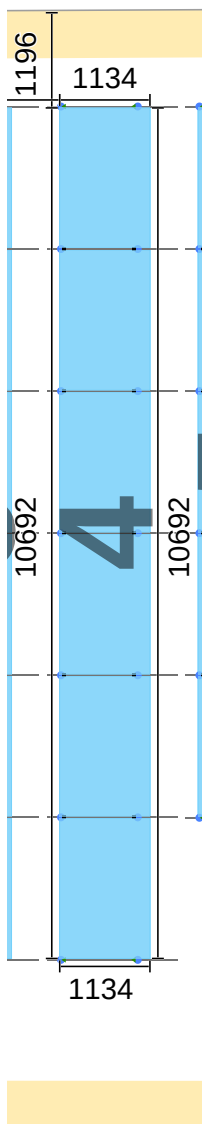


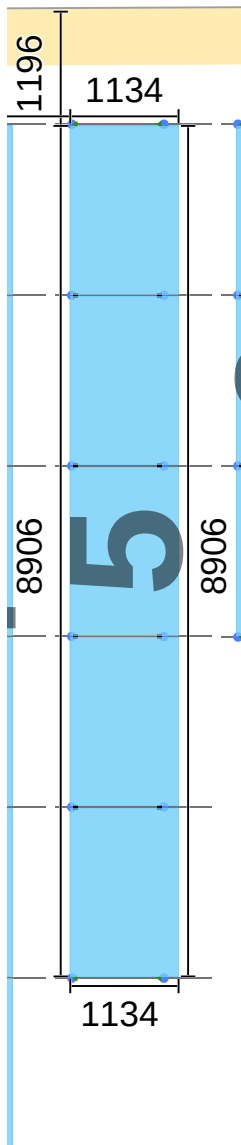


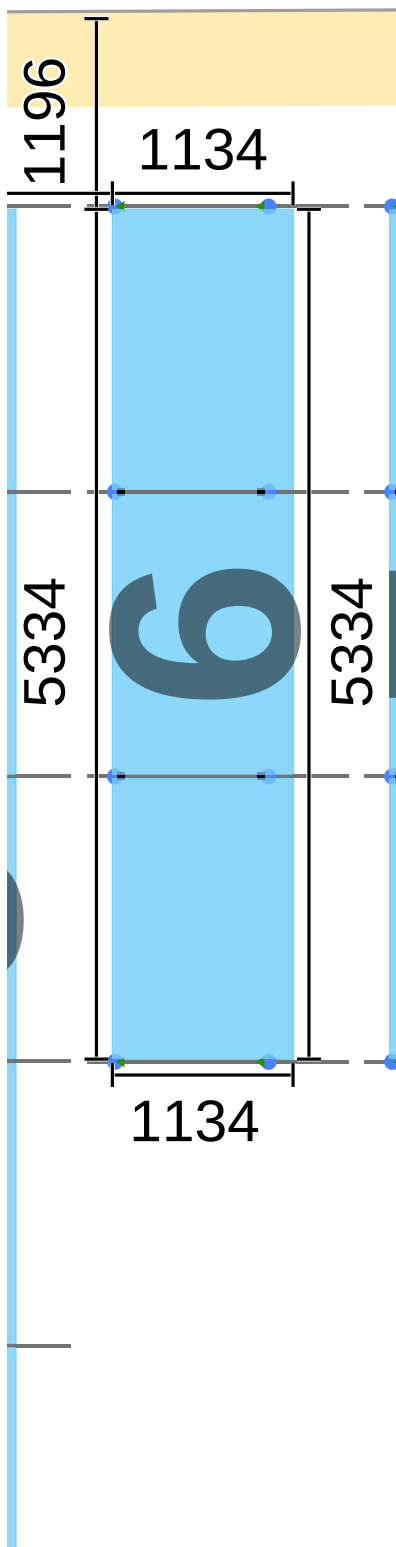


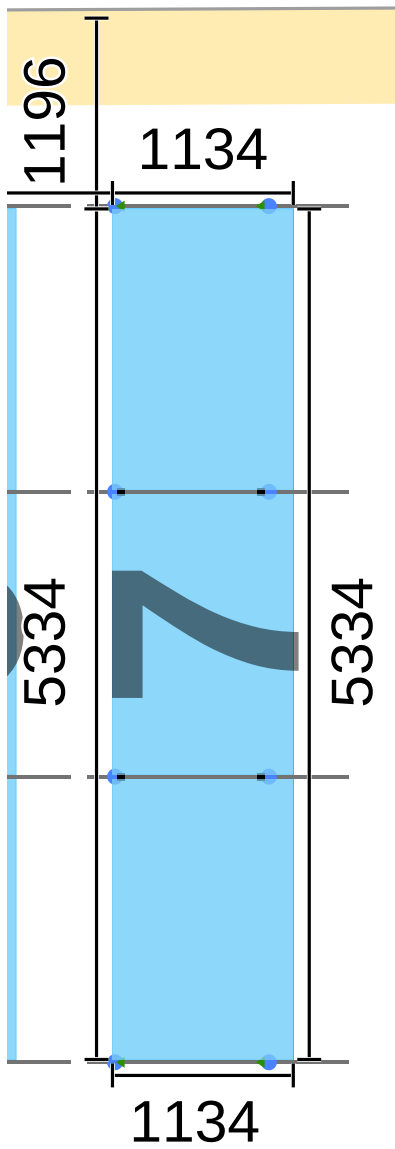


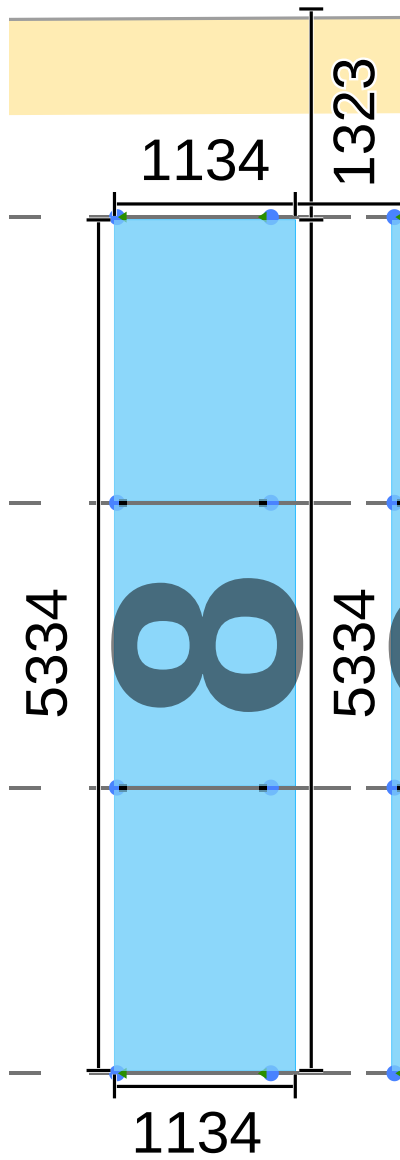


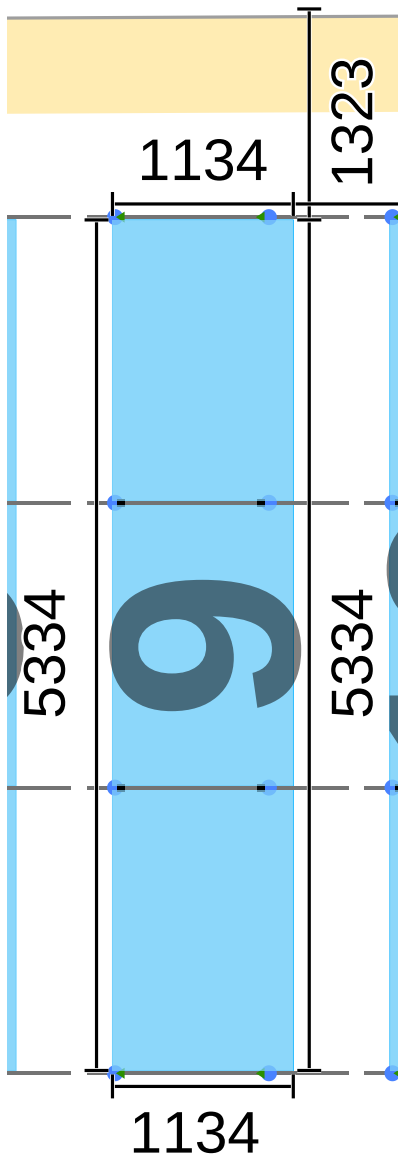


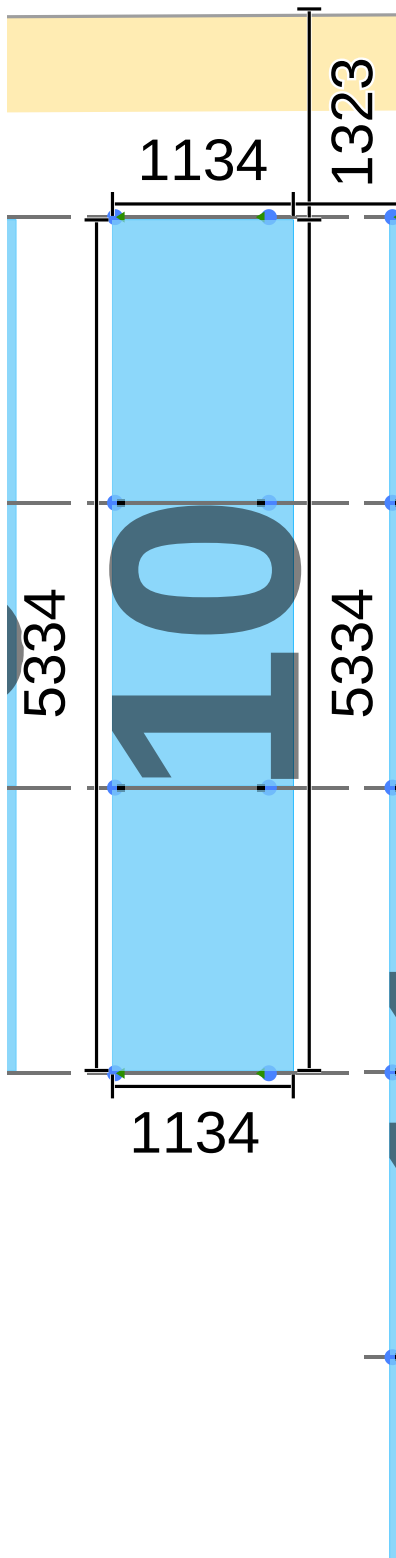


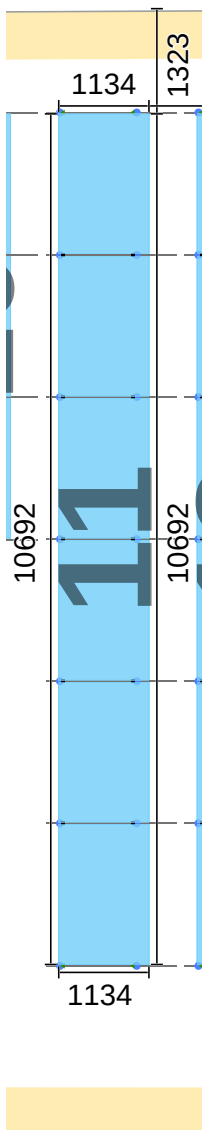


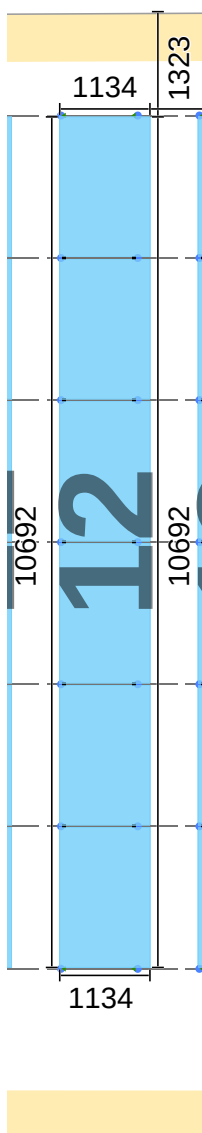


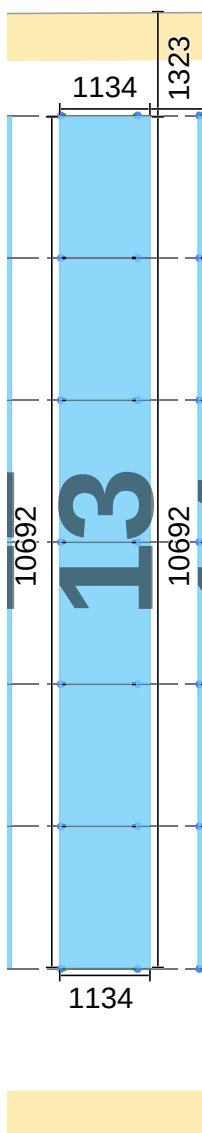


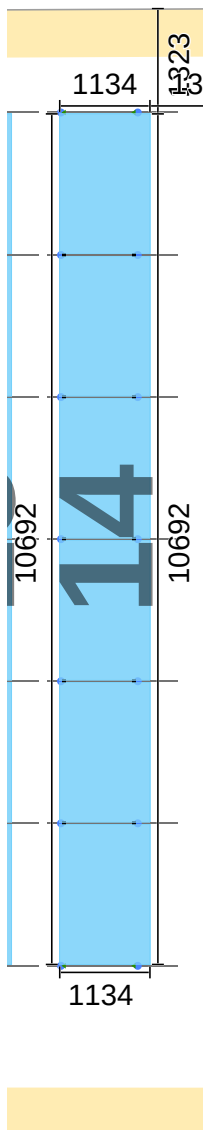












BILL OF MATERIAL

Article No.	Article	Quantity	Ordering Unit	Weight/Piece	Weight
R420081-BE	End clamp+ (black)	56	1	0,064 kg	3,584 kg
R420082-BE	Middle clamp+ (black)	108	1	0,063 kg	6,804 kg
R500409	Base rail FS10-S XL 1639 mm	82	1	1,203 kg	98,646 kg
R500419	Eave support XL	82	1	0,049 kg	4,018 kg
R500423	Ridge support 10° XL	82	1	0,443 kg	36,326 kg
R900314	Socket bolt 6 x 110 mm	164	1	0,009 kg	1,476 kg
R520220	FS Pro 10-S Base rail 1500 (Set)	82	1	1,724 kg	141,368 kg
					Total Weight: 292,222 kg
Third party parts		Quantity			
Rooftrak IFP-HM/MW		164			

The third party product(s) listed above, is (are) not (a) product of Renusol but, from third party Manufacturer(s) (Manufacturer). The PV-Configurator uses static properties of this fastener provided by this Manufacturer. The Manufacturer is responsible for the accurateness and correctness of the static values provided by him, Renusol does not assume any liability regarding the product of the Manufacturer and its static properties.

LOAD ASSUMPTIONS

Dead load

Solar modules type JAM54D40-445/LB are used.

The modules are angled horizontally on the roof and are fastened on the larger module edges on the vertical rails with module clamps.

Dimensions: 1762 mm x 1134 mm
Weight: $G = 22.0 \text{ kg}$
 $F_G = 22.0 \text{ kg} * 9.81 \text{ m/s}^2 = 0.216 \text{ kN}$

Snow load

The determination of the snow load is carried out according to BS EN 1991-1-3:2003/NA:2010-06.

Snow-trap formation or snow-load accumulations are not considered in the calculation. Please contact Renusol if necessary.

Height above sea level: 17 m
Snow load zone: 3
Roof pitch: $\alpha = 2^\circ$
Module elevation: $\beta = 10^\circ$
total pitch: 12.0°

Period of use: 25 Year
Snow load: $s_k = s_{k,50} * f_s = 0.50 \text{ kN/m}^2 * 0.93 = 0.46 \text{ kN/m}^2$
 $\mu_1 = 0.800$
 $s_t = \mu_1 * s_k = 0.8 * 0.46 \text{ kN/m}^2 = 0.371 \text{ kN/m}^2$
 $s_{t,12^\circ} = 0.371 \text{ kN/m}^2 * \cos(12.0^\circ) = 0.371 \text{ kN/m}^2$
 $F_{S,k} = 0.371 \text{ kN/m}^2 * 1.76 \text{ m} * 1.13 \text{ m} = 0.725 \text{ kN}$

Wind load

The determination of the wind load is carried out according to BS EN 1991-1-4:2005/NA:2011-01.

Building height roof ridge: 34 m
Terrain category: Country terrain
Basic wind velocity: 22.00 m/s
Distance to shoreline: 8.910 km
Period of use: 25 Year
Pressure of the gusts velocity: $q(z) = 0.945 \text{ kN/m}^2$

ANALYSIS

Load cases and load case combinations

Load cases

The respective loads are taken from the load assumptions and converted to a reference system perpendicular to the roof area.

LC 1	Dead load
LC 2	Snow load
LC 3	Wind pressure
LC 4	Wind suction

Significant load case combinations
according to: EN 1990:2012

Ultimate state of load-bearing capacity

LCC 1	Predominant action wind pressure $E_{d,LCC 1} = 1.35 * E_{Gk,LC 1} + 1.50 * (E_{Qk,LC 3} + 0.5 * E_{Qk,LC 2})$
LCC 2	Predominant action snow $E_{d,LCC 2} = 1.35 * E_{Gk,LC 1} + 1.50 * (E_{Qk,LC 2} + 0.6 * E_{Qk,LC 3})$
LCC 3	Predominant action wind suction (lifting) $E_{d,LCC 3} = 1.00 * E_{Gk,LC 1} + 1.50 * (E_{Qk,LC 4})$

Ultimate state of serviceability

LCC 4	Predominant action wind pressure $E_{d,LCC 4} = 1.00 * E_{Gk,LC 1} + 1.00 * (E_{Qk,LC 3} + 0.5 * E_{Qk,LC 2})$
LCC 5	Predominant action snow $E_{d,LCC 5} = 1.00 * E_{Gk,LC 1} + 1.00 * (E_{Qk,LC 2} + 0.6 * E_{Qk,LC 3})$
LCC 6	Predominant action wind suction $E_{d,LCC 6} = 1.00 * E_{Gk,LC 1} + 1.00 * (E_{Qk,LC 4})$

ANALYSIS

Middle clamp

General

The module clamps consist of extruded aluminium sheaths material grade EN-AW 6063 T66. The lower part of the module clamps consists of a click profile made of S500 MC, EN 10149-2, which is attached to the module carrying profile and transfers the loads by form closure. On it the module end clamp or module middle clamp is fastened by a screw. When tightening the screw the module clamp presses the module to the rail.

Sketch



Static analysis

The maximum loads established in the load combinations of the tension loads perpendicular to the roof area and the respective shear loads parallel to the roof area or the maximum shear loads in combination with the corresponding tensile loads perpendicular to the roof area are significant for the analysis. Pressure loads perpendicular to the roof area are transferred by contact bearing.

Analysis

LCC 1

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 958 \text{ mm}$ $y = 3097 \text{ mm}$
 Loads: $V_{x,d} = -0.44 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.44/1.05 = 0.42 < 1$

LCC 2

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 958 \text{ mm}$ $y = 3097 \text{ mm}$
 Loads: $V_{x,d} = -0.17 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.17/1.05 = 0.16 < 1$

LCC 3

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 958 \text{ mm}$ $y = 3097 \text{ mm}$
 Loads: $N_d = -0.79 \text{ kN}$
 $V_{x,d} = -0.68 \text{ kN}$
 Comparison stress: $N_d/F_{R,d,x} + V_{x,d}/F_{R,d,y} = 0.79/3.22 + 0.68/0.88 = 1.02 > 1$

ANALYSIS

End clamp

General

The module clamps consist of extruded aluminium sheaths material grade EN-AW 6063 T66. The lower part of the module clamps consists of a click profile made of S500 MC, EN 10149-2, which is attached to the module carrying profile and transfers the loads by form closure. On it the module end clamp or module middle clamp is fastened by a screw. When tightening the screw the module clamp presses the module to the rail.

Sketch



Static analysis

The maximum loads established in the load combinations of the tension loads perpendicular to the roof area and the respective shear loads parallel to the roof area or the maximum shear loads in combination with the corresponding tensile loads perpendicular to the roof area are significant for the analysis. Pressure loads perpendicular to the roof area are transferred by contact bearing.

Analysis

LCC 1

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 958 \text{ mm}$ $y = 1305 \text{ mm}$
 Loads: $V_{x,d} = -0.22 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.22/0.81 = 0.27 < 1$

LCC 2

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 958 \text{ mm}$ $y = 1305 \text{ mm}$
 Loads: $V_{x,d} = -0.09 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.09/0.81 = 0.11 < 1$

LCC 3

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 958 \text{ mm}$ $y = 1305 \text{ mm}$
 Loads: $N_d = -0.39 \text{ kN}$
 $V_{x,d} = -0.34 \text{ kN}$
 Comparison stress: $N_d/F_{R,d,x} + V_{x,d}/F_{R,d,y} = 0.39/1.75 + 0.34/0.78 = 0.66 < 1$

ANALYSIS

Fastener

General

The resistances were determined on the user's own responsibility.

Design values of load capacity

$$F_{R,d,x} = 5.00 \text{ kN}$$

$$F_{R,d,-x} = 3.50 \text{ kN}$$

$$F_{R,d,y} = 2.50 \text{ kN}$$

LCC 1

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 858 \text{ mm}$ $y = 3097 \text{ mm}$

Loads: $N_d = 0.44 \text{ kN}$

$$V_{x,d} = -0.42 \text{ kN}$$

Comparison stress: $N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.44/5.00 + 0.42/2.50 = 0.26 < 1$

LCC 2

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 858 \text{ mm}$ $y = 3097 \text{ mm}$

Loads: $N_d = 0.71 \text{ kN}$

$$V_{x,d} = -0.24 \text{ kN}$$

Comparison stress: $N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.71/5.00 + 0.24/2.50 = 0.24 < 1$

LCC 3

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 858 \text{ mm}$ $y = 3097 \text{ mm}$

Loads: $N_d = -0.61 \text{ kN}$

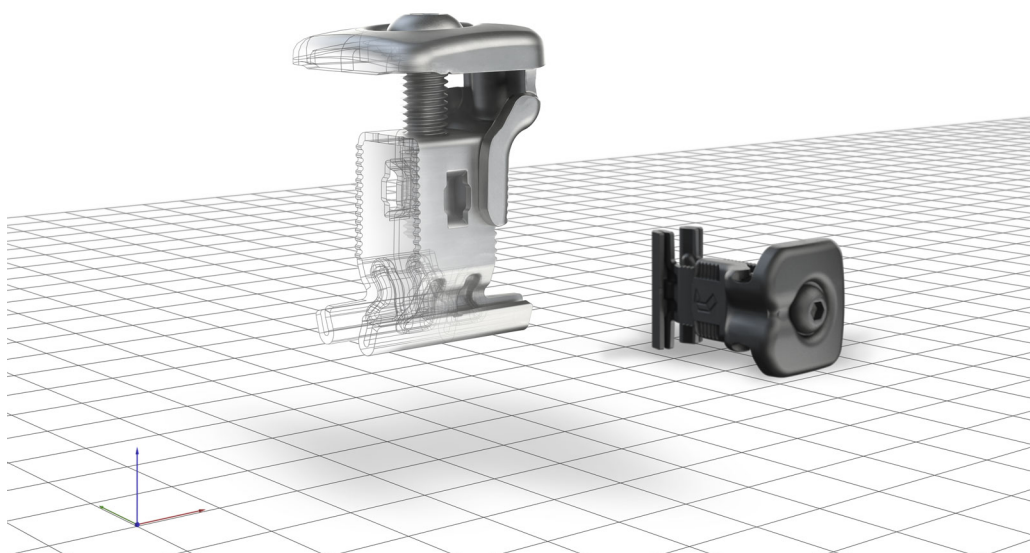
$$V_{x,d} = -0.43 \text{ kN}$$

Comparison stress: $N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.61/3.50 + 0.43/2.50 = 0.35 < 1$

Technical project overview

The Charter House

Building project	The Charter House
Address	High Street 35a, DA11 0AZ
Country	United Kingdom
Module Type	Shanghai JA Solar Technology Co. Ltd. - JAM54D40-445/LB
Number of modules	20
Rated output	8.9 kWp
Mounting system	FixedFS10S
Editor	Renusol Europe GmbH



LOCATION

Street	High Street 35a
City	DA11 0AZ
Country	United Kingdom

SURROUNDINGS

Code	Eurocode NA GB
Terrain height above sealevel	17,00 m
Snow load zone	Zone 3
Use Pressure coefficients from BRE 489 2014 roof pitch 0 -45°	yes
Terrain category	Country
Distance to coast	8,91 km
Surroundings	normal
Service life of PV system	25 years
Failure consequence class	2

LOAD CALCULATION RESULT

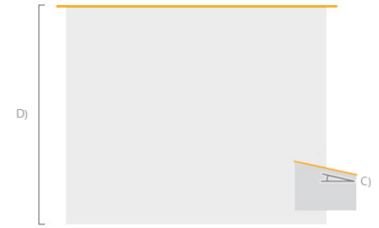
Peak velocity pressure	0,95 kN/m ²
Snow load	0,46 kN/m ²
Snow load on roof	0,36 kN/m ²
Base wind speed ($V_{b,0}$)	22,00 m/s

TOPOGRAPHY

Topography	Not exposed
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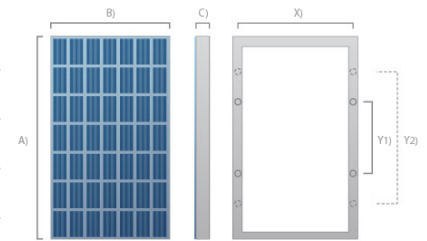
ROOF PROPERTIES

Roof type	Free-form Flat roof
Coverage type	Foil
C) Roof pitch	2,00 °
D) Building height	34,20 m
Parapet height	0,00 mm
Parapet width	0,00 mm



MODULE PARAMETERS

Manufacturer	Shanghai JA Solar Technology Co. Ltd.
Name	JAM54D40-445/LB
Length	1762 mm
Width	1134 mm
Height	30 mm
Weight	22 kg
Rated output	445 W _{peak}
Datasheet	Open datasheet



Please check the compatibility of clamping positions with module manufacturer advice.

The module data was taken from a database. Please check whether this data corresponds to your actual module order. If necessary, please correct the data using the editing function.

FASTENER PARAMETERS

Name	Rooftrak IFP-HM/MW
Manufacturer	Nicholson
Pressure load capacity	5,00 kN
Tensile load capacity	3,50 kN
Lateral force	2,50 kN
Interaction	Linear

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SYSTEM

System type	Fixed
System	FixedFS10S



Please check the entered row distance for an ideal yield calculation with a correct calculation including consideration of the shading.

FASTENER DETAILS

Mounting rotation	Eave (0°)
Fastener type	Custom fastener
X) Row distance	1740mm

CLAMPS

Clamp type	Mid clamps+ / End clamps+
Clamp colour	black
Max value middle clamps	79 %
Max value end clamps	53 %

STATIC VALIDATION

Your project was validated by our statics check successfully.

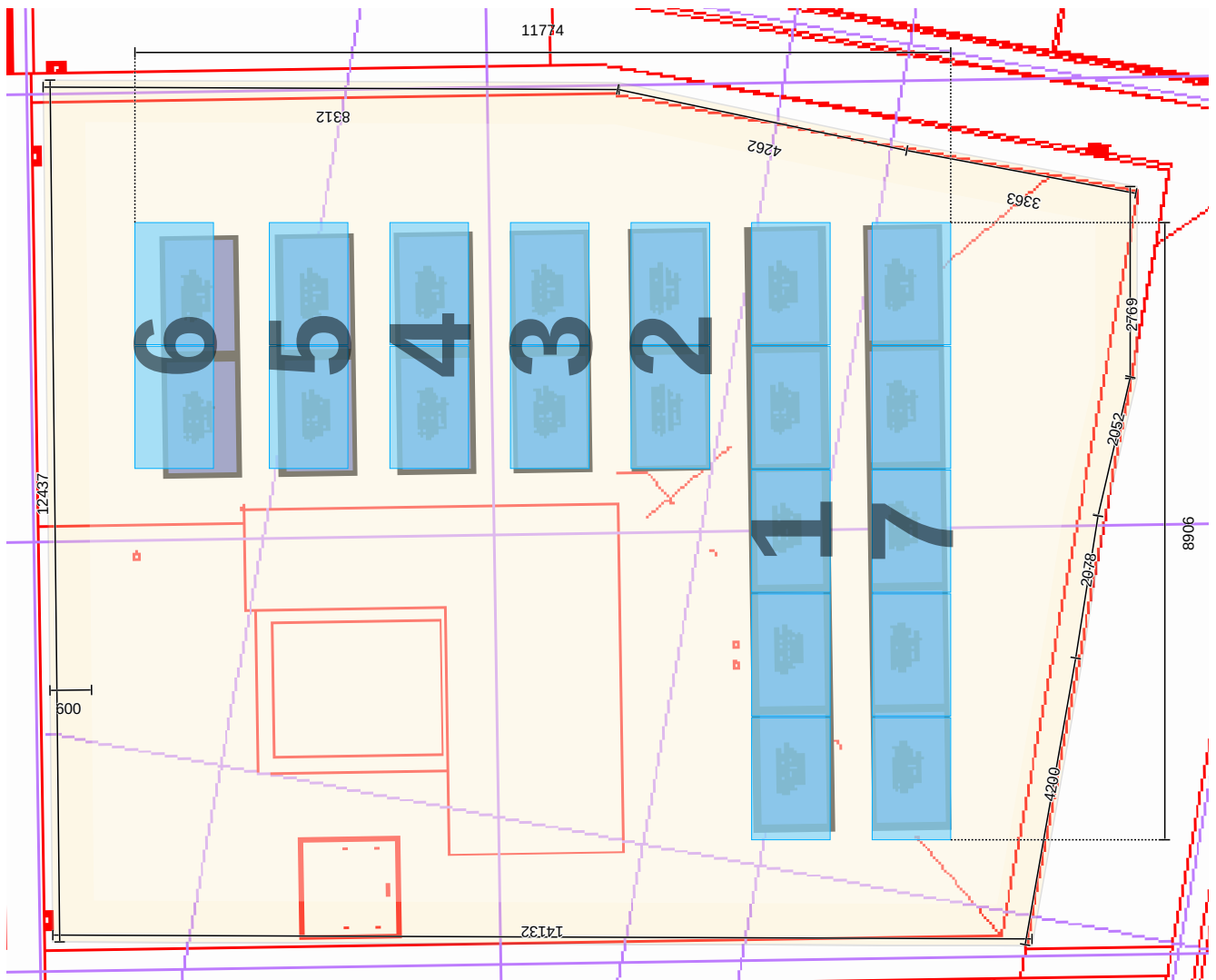
Static utilization factor: 79%

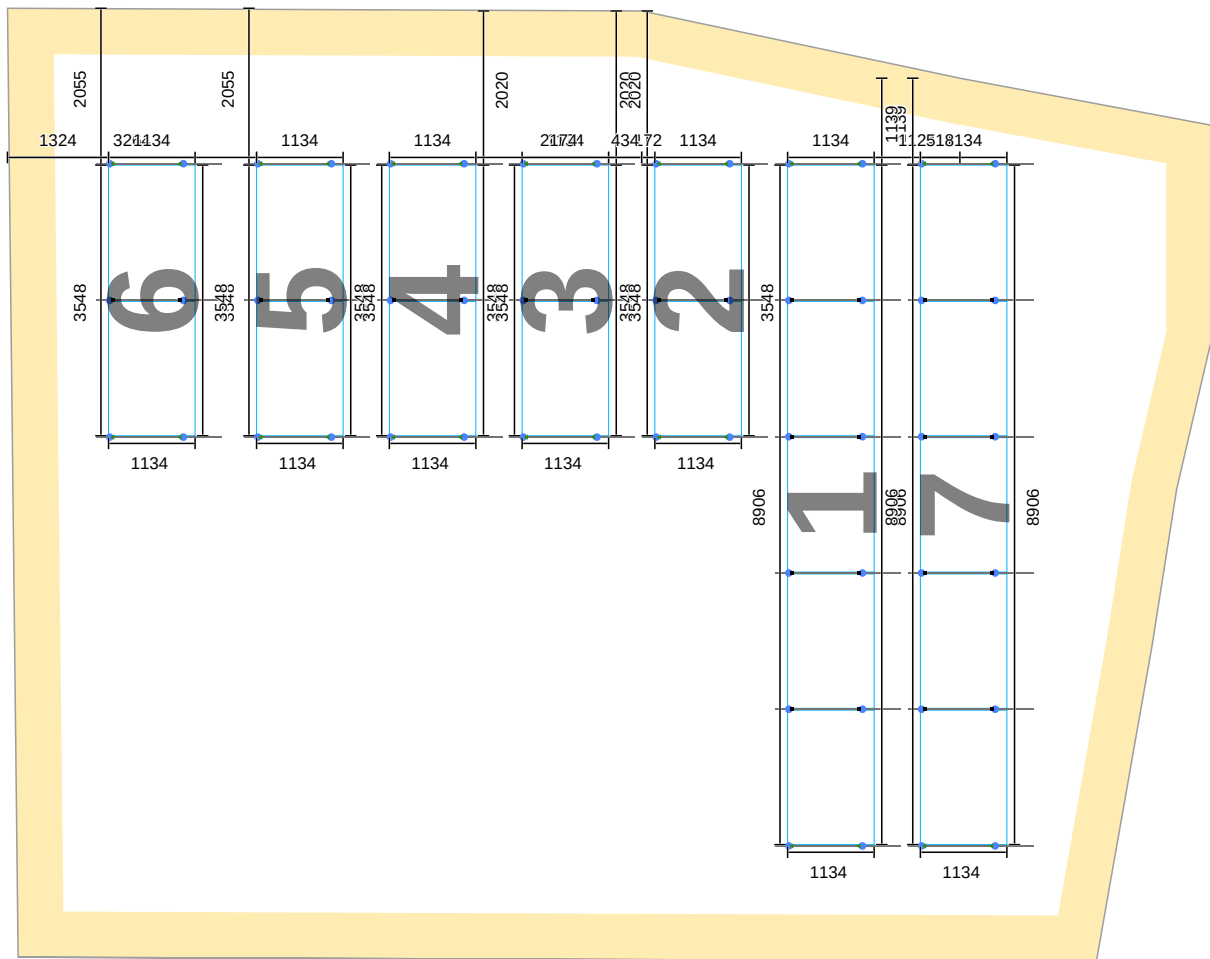
Static utilization fastener: 35%

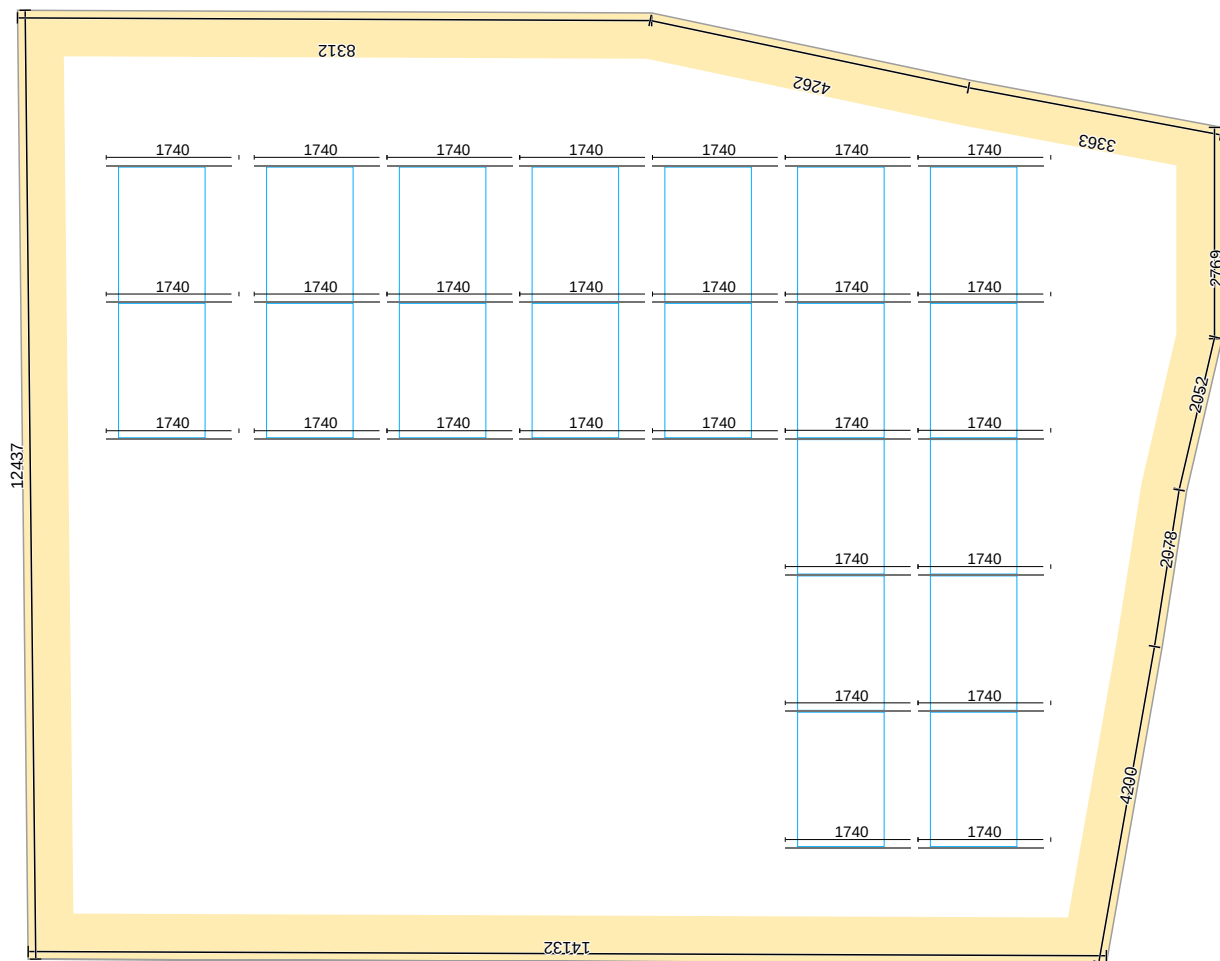
Static utilization clamp: 79%

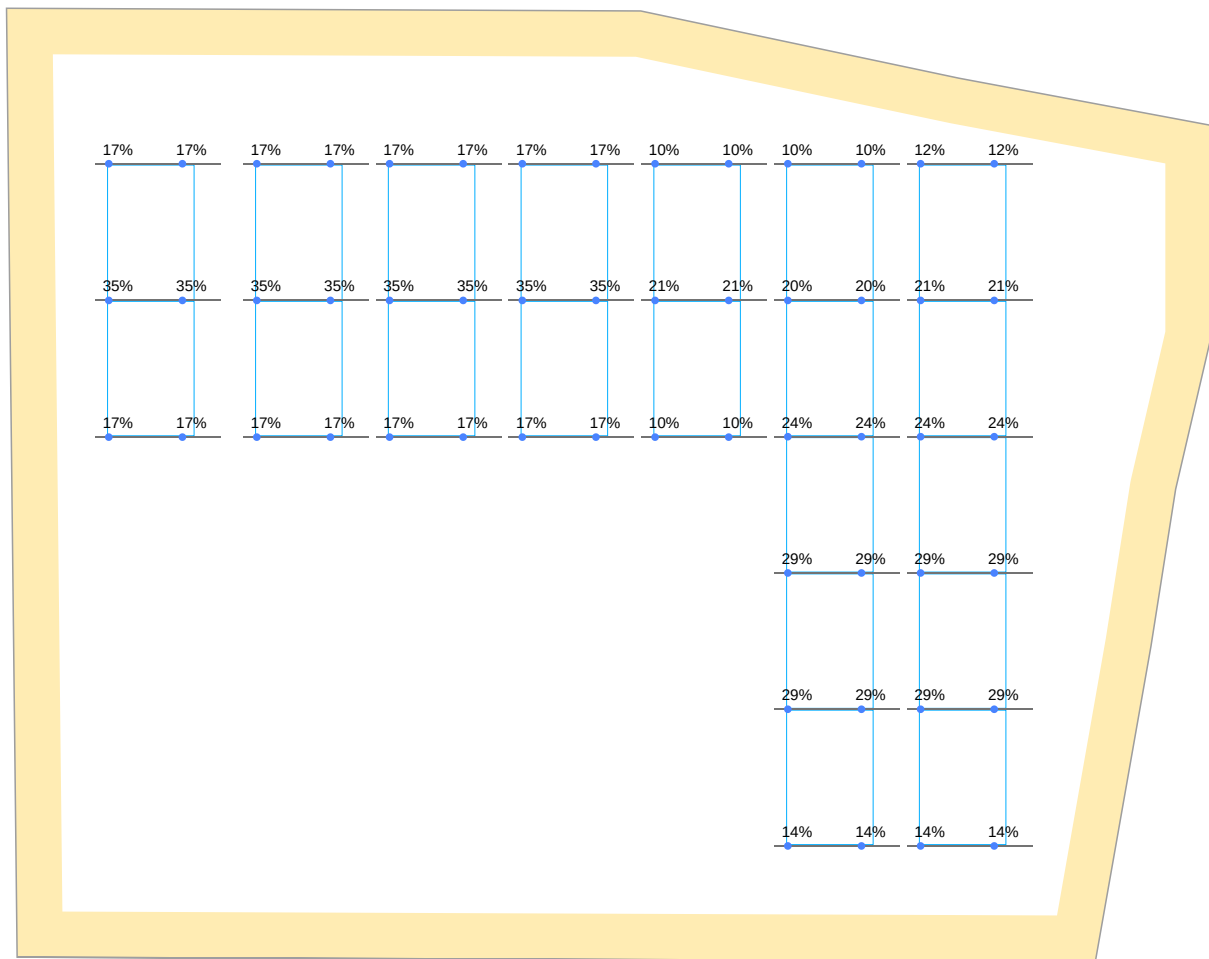
The predefined default values for input fields have to be compared with the conditions of the project. Necessary changes to adapt to local conditions must be carried out. The following relevant input fields contain their default value:

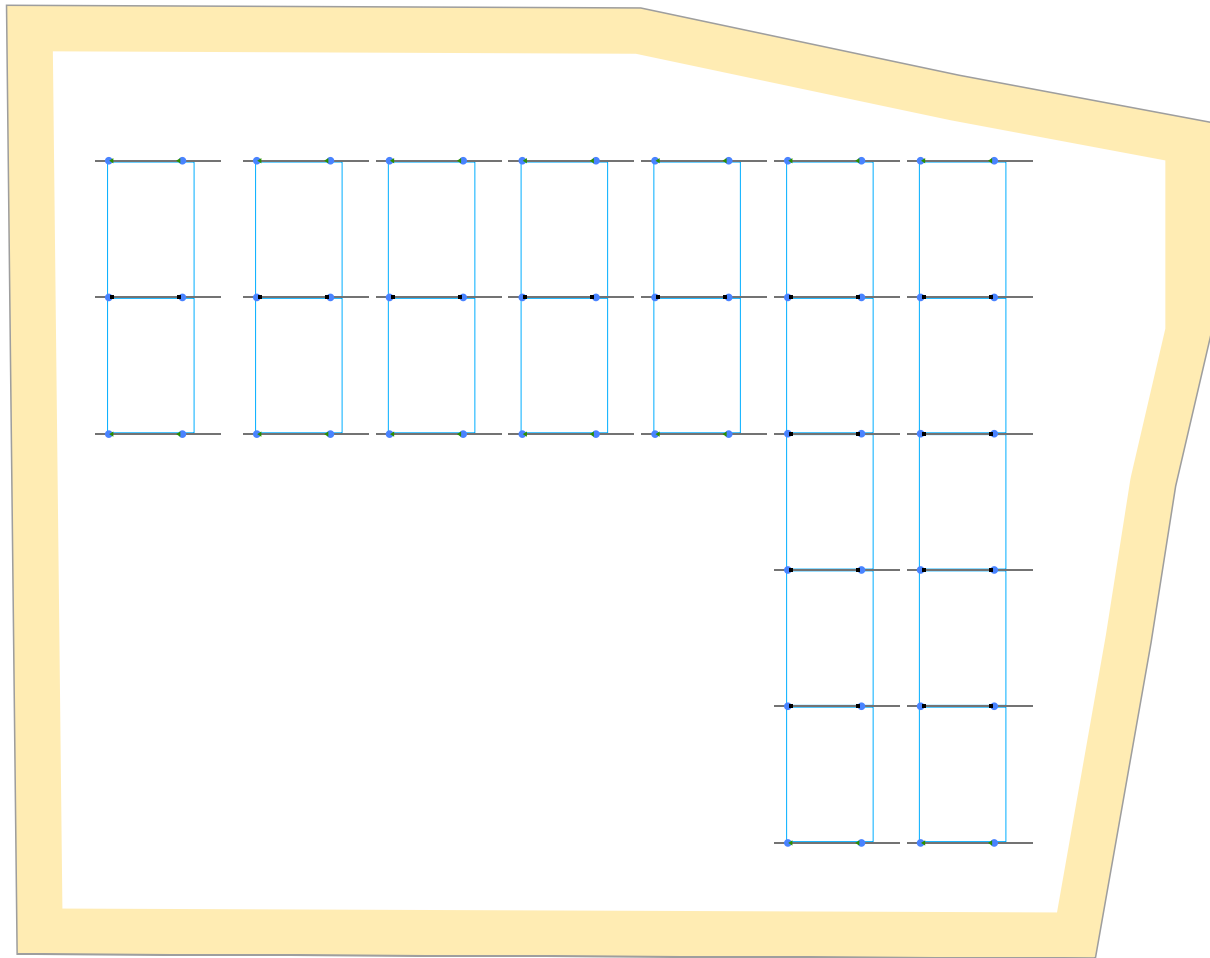
- Service life of PV system: 25 years
- Failure consequence class: 2

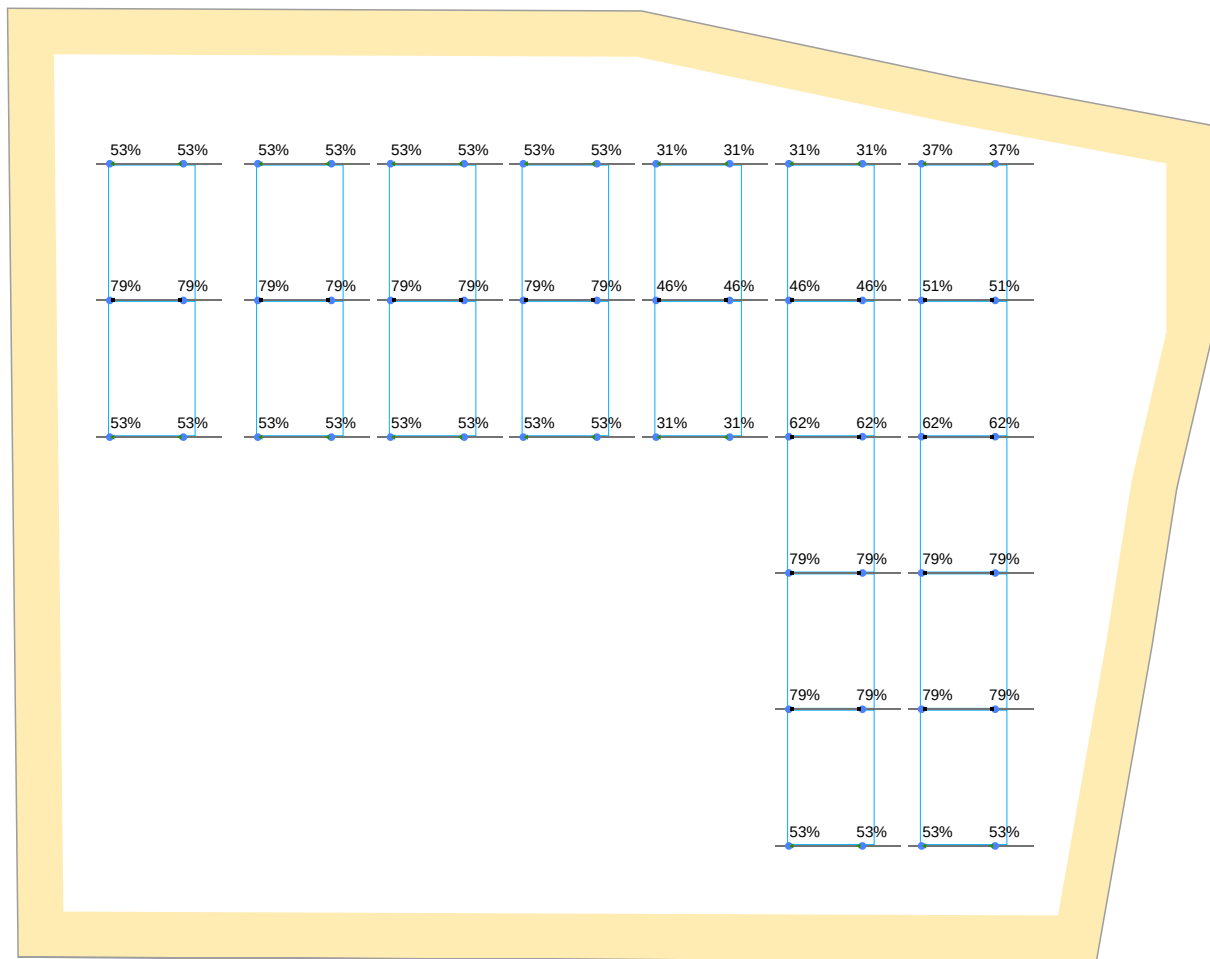


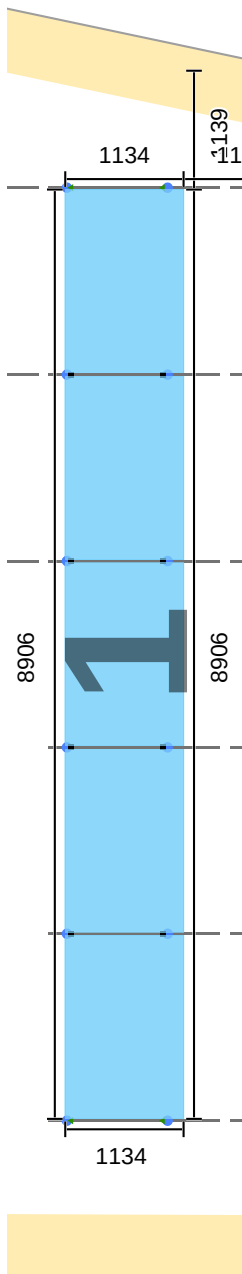


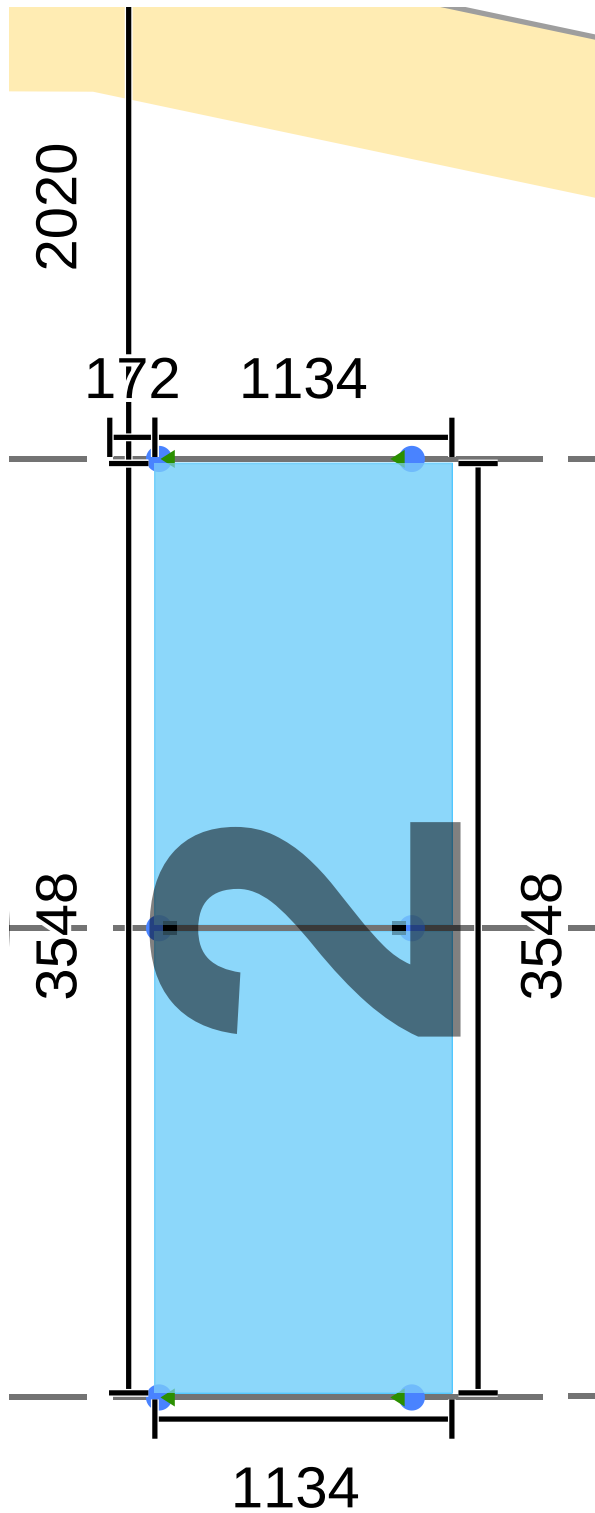


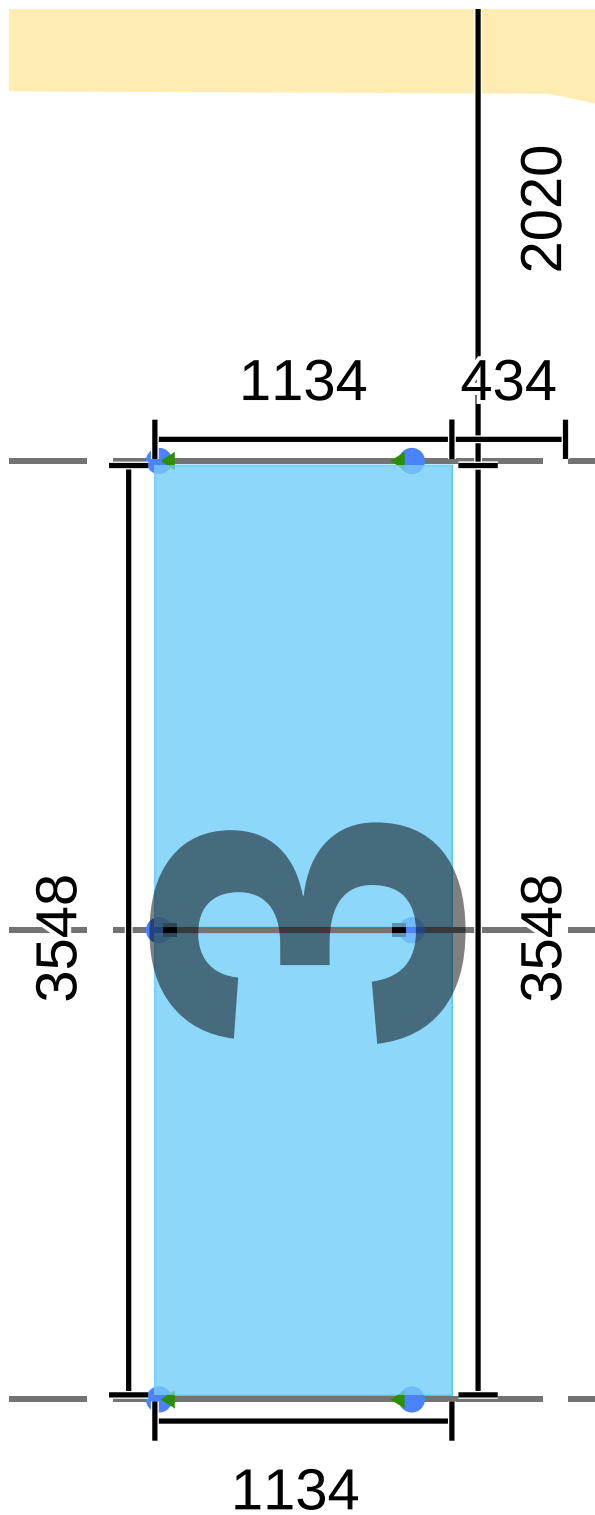


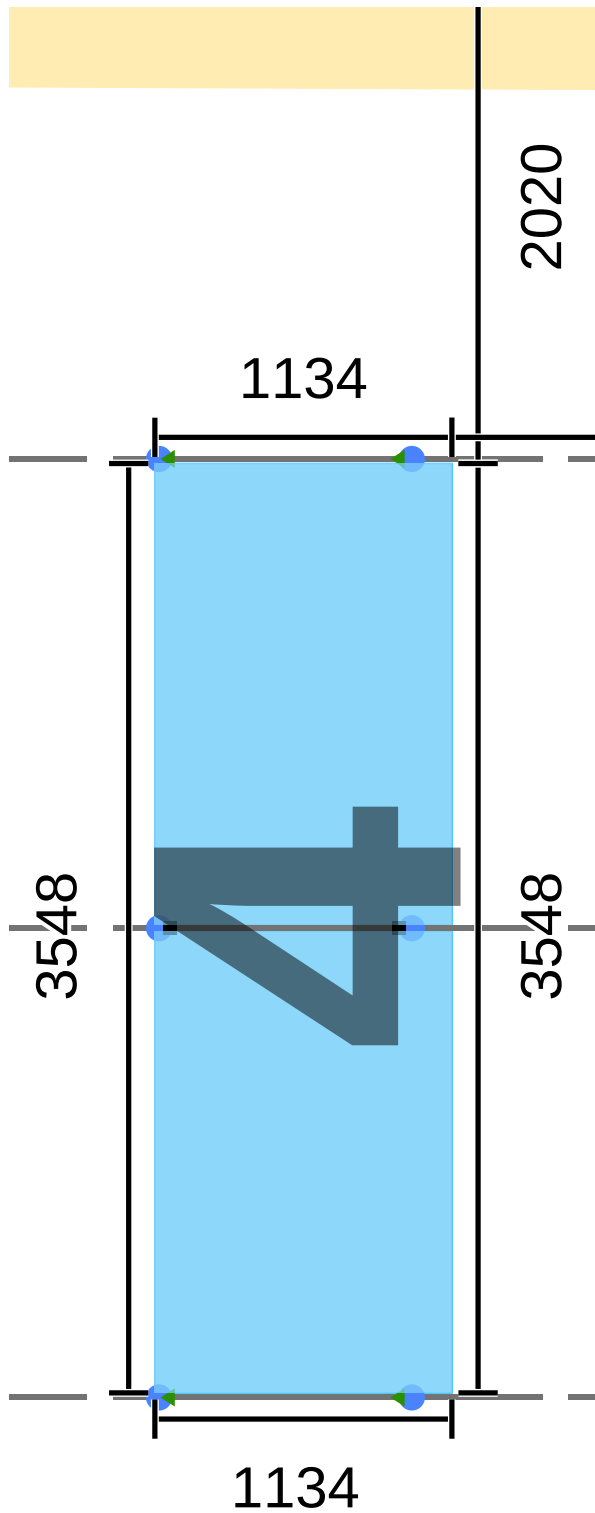


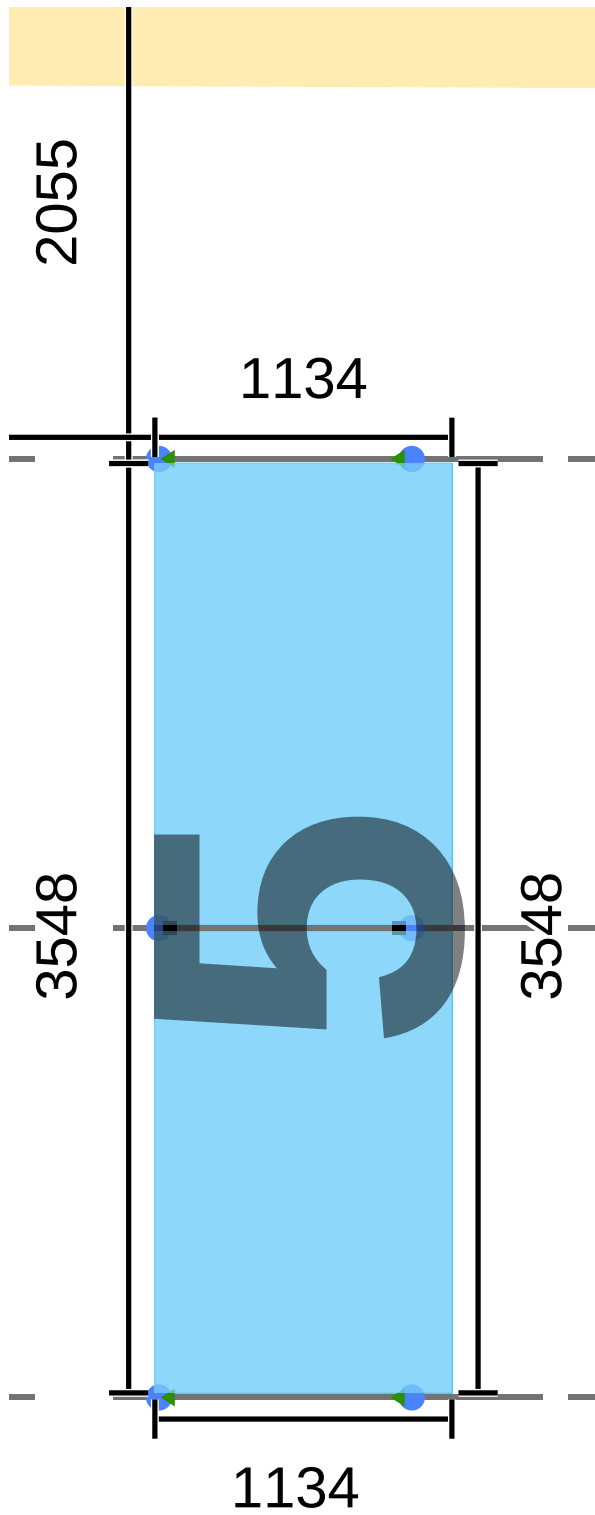


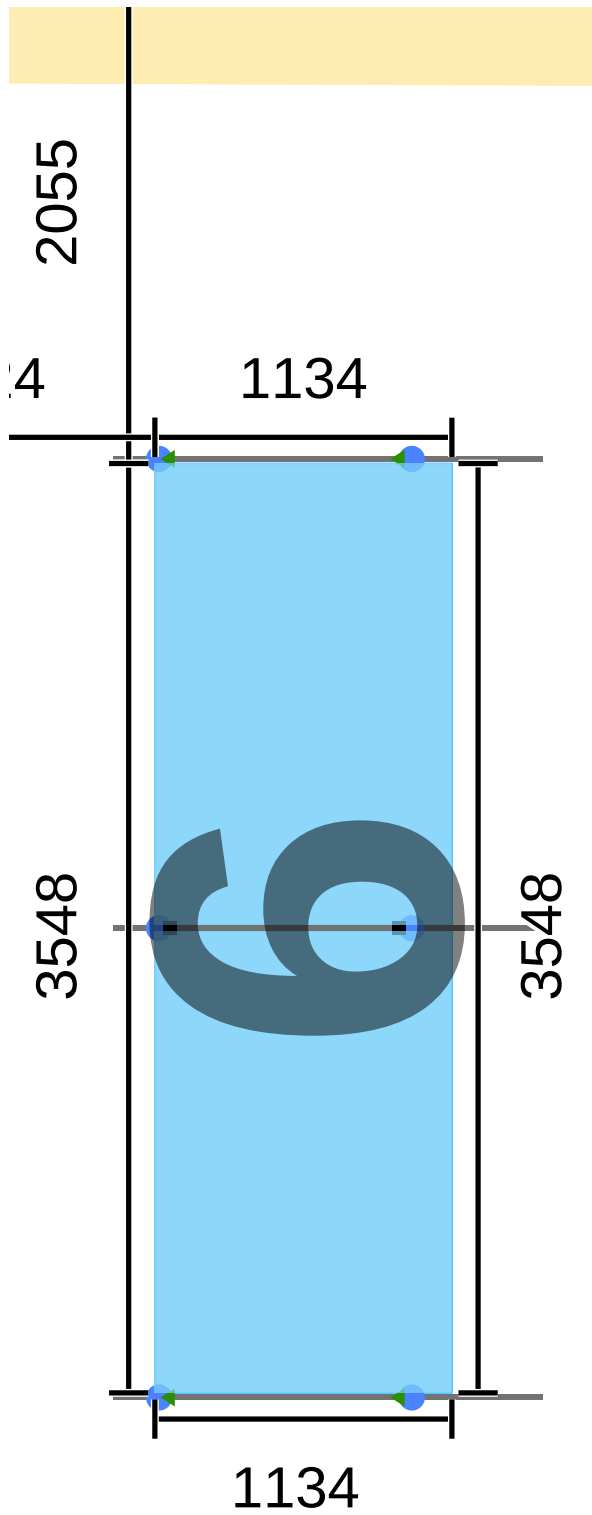


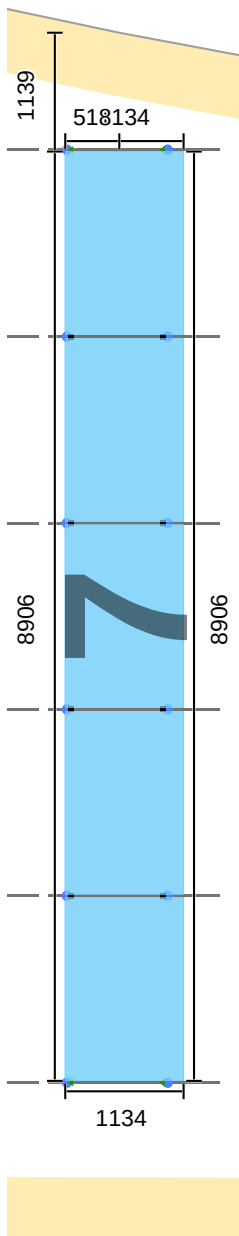












BILL OF MATERIAL

Article No.	Article	Quantity	Ordering Unit	Weight/Piece	Weight
R420081-BE	End clamp+ (black)	28	1	0,064 kg	1,792 kg
R420082-BE	Middle clamp+ (black)	26	1	0,063 kg	1,638 kg
R500409	Base rail FS10-S XL 1639 mm	27	1	1,203 kg	32,481 kg
R500419	Eave support XL	27	1	0,049 kg	1,323 kg
R500423	Ridge support 10° XL	27	1	0,443 kg	11,961 kg
R900314	Socket bolt 6 x 110 mm	54	1	0,009 kg	0,486 kg
R520220	FS Pro 10-S Base rail 1500 (Set)	27	1	1,724 kg	46,548 kg
					Total Weight: 96,229 kg
Third party parts		Quantity			
Rooftrak IFP-HM/MW		54			

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LOAD ASSUMPTIONS

Dead load

Solar modules type JAM54D40-445/LB are used.

The modules are angled horizontally on the roof and are fastened on the larger module edges on the vertical rails with module clamps.

Dimensions: 1762 mm x 1134 mm
Weight: $G = 22.0 \text{ kg}$
 $F_G = 22.0 \text{ kg} \cdot 9.81 \text{ m/s}^2 = 0.216 \text{ kN}$

Snow load

The determination of the snow load is carried out according to BS EN 1991-1-3:2003/NA:2010-06.

Snow-trap formation or snow-load accumulations are not considered in the calculation. Please contact Renusol if necessary.

Height above sea level: 17 m
Snow load zone: 3
Roof pitch: $\alpha = 2^\circ$
Module elevation: $\beta = 10^\circ$
total pitch: 12.0°

Period of use: 25 Year
Snow load: $s_k = s_{k,50} \cdot f_s = 0.50 \text{ kN/m}^2 \cdot 0.93 = 0.46 \text{ kN/m}^2$
 $\mu_1 = 0.800$
 $s_t = \mu_1 \cdot s_k = 0.8 \cdot 0.46 \text{ kN/m}^2 = 0.371 \text{ kN/m}^2$
 $s_{t,12^\circ} = 0.371 \text{ kN/m}^2 \cdot \cos(12.0^\circ) = 0.371 \text{ kN/m}^2$
 $F_{S,k} = 0.371 \text{ kN/m}^2 \cdot 1.76 \text{ m} \cdot 1.13 \text{ m} = 0.725 \text{ kN}$

Wind load

The determination of the wind load is carried out according to BS EN 1991-1-4:2005/NA:2011-01.

Building height roof ridge: 34 m
Terrain category: Country terrain
Basic wind velocity: 22.00 m/s
Distance to shoreline: 8.910 km
Period of use: 25 Year
Pressure of the gusts velocity: $q(z) = 0.945 \text{ kN/m}^2$

ANALYSIS

Load cases and load case combinations

Load cases

The respective loads are taken from the load assumptions and converted to a reference system perpendicular to the roof area.

LC 1	Dead load
LC 2	Snow load
LC 3	Wind pressure
LC 4	Wind suction

Significant load case combinations
according to: EN 1990:2012

Ultimate state of load-bearing capacity

LCC 1	Predominant action wind pressure
$E_{d,LCC 1} = 1.35 \cdot E_{GK,LC 1} + 1.50 \cdot (E_{QK,LC 3} + 0.5 \cdot E_{QK,LC 2})$	

LCC 2	Predominant action snow
$E_{d,LCC 2} = 1.35 \cdot E_{GK,LC 1} + 1.50 \cdot (E_{QK,LC 2} + 0.6 \cdot E_{QK,LC 3})$	

LCC 3	Predominant action wind suction (lifting)
$E_{d,LCC 3} = 1.00 \cdot E_{GK,LC 1} + 1.50 \cdot (E_{QK,LC 4})$	

Ultimate state of serviceability

LCC 4	Predominant action wind pressure
$E_{d,LCC 4} = 1.00 \cdot E_{GK,LC 1} + 1.00 \cdot (E_{QK,LC 3} + 0.5 \cdot E_{QK,LC 2})$	

LCC 5	Predominant action snow
$E_{d,LCC 5} = 1.00 \cdot E_{GK,LC 1} + 1.00 \cdot (E_{QK,LC 2} + 0.6 \cdot E_{QK,LC 3})$	

LCC 6	Predominant action wind suction
$E_{d,LCC 6} = 1.00 \cdot E_{GK,LC 1} + 1.00 \cdot (E_{QK,LC 4})$	

ANALYSIS

Middle clamp

General

The module clamps consist of extruded aluminium sheaths material grade EN-AW 6063 T66. The lower part of the module clamps consists of a click profile made of S500 MC, EN 10149-2, which is attached to the module carrying profile and transfers the loads by form closure. On it the module end clamp or module middle clamp is fastened by a screw. When tightening the screw the module clamp presses the module to the rail.

Sketch



Static analysis

The maximum loads established in the load combinations of the tension loads perpendicular to the roof area and the respective shear loads parallel to the roof area or the maximum shear loads in combination with the corresponding tensile loads perpendicular to the roof area are significant for the analysis. Pressure loads perpendicular to the roof area are transferred by contact bearing.

Analysis

LCC 1

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 10291 \text{ mm}$ $y = 7401 \text{ mm}$
 Loads: $V_{x,d} = -0.34 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.34/1.05 = 0.33 < 1$

LCC 2

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 10291 \text{ mm}$ $y = 7401 \text{ mm}$
 Loads: $V_{x,d} = -0.11 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.11/1.05 = 0.11 < 1$

LCC 3

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 10291 \text{ mm}$ $y = 7401 \text{ mm}$
 Loads: $N_d = -0.62 \text{ kN}$
 $V_{x,d} = -0.55 \text{ kN}$
 Comparison stress: $N_d/F_{R,d,x} + V_{x,d}/F_{R,d,y} = 0.62/3.22 + 0.55/0.91 = 0.79 < 1$

ANALYSIS

End clamp

General

The module clamps consist of extruded aluminium sheaths material grade EN-AW 6063 T66. The lower part of the module clamps consists of a click profile made of S500 MC, EN 10149-2, which is attached to the module carrying profile and transfers the loads by form closure. On it the module end clamp or module middle clamp is fastened by a screw. When tightening the screw the module clamp presses the module to the rail.

Sketch



Static analysis

The maximum loads established in the load combinations of the tension loads perpendicular to the roof area and the respective shear loads parallel to the roof area or the maximum shear loads in combination with the corresponding tensile loads perpendicular to the roof area are significant for the analysis. Pressure loads perpendicular to the roof area are transferred by contact bearing.

Analysis

LCC 1

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 10291 \text{ mm}$ $y = 10978 \text{ mm}$
 Loads: $V_{x,d} = -0.17 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.17/0.81 = 0.21 < 1$

LCC 2

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 10291 \text{ mm}$ $y = 10978 \text{ mm}$
 Loads: $V_{x,d} = -0.06 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.06/0.81 = 0.07 < 1$

LCC 3

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 10291 \text{ mm}$ $y = 10978 \text{ mm}$
 Loads: $N_d = -0.31 \text{ kN}$
 $V_{x,d} = -0.27 \text{ kN}$
 Comparison stress: $N_d/F_{R,d,x} + V_{x,d}/F_{R,d,y} = 0.31/1.75 + 0.27/0.79 = 0.53 < 1$

ANALYSIS

Fastener

General

The resistances were determined on the user's own responsibility.

Design values of load capacity

$$F_{R,d,x} = 5.00 \text{ kN}$$

$$F_{R,d,-x} = 3.50 \text{ kN}$$

$$F_{R,d,y} = 2.50 \text{ kN}$$

LCC 1

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 6710 \text{ mm}$ $y = 3829 \text{ mm}$

Loads: $N_d = 0.44 \text{ kN}$

$$V_{x,d} = -0.40 \text{ kN}$$

Comparison stress: $N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.44/5.00 + 0.40/2.50 = 0.25 < 1$

LCC 2

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 6710 \text{ mm}$ $y = 3829 \text{ mm}$

Loads: $N_d = 0.71 \text{ kN}$

$$V_{x,d} = -0.23 \text{ kN}$$

Comparison stress: $N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.71/5.00 + 0.23/2.50 = 0.23 < 1$

LCC 3

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 6710 \text{ mm}$ $y = 3829 \text{ mm}$

Loads: $N_d = -0.65 \text{ kN}$

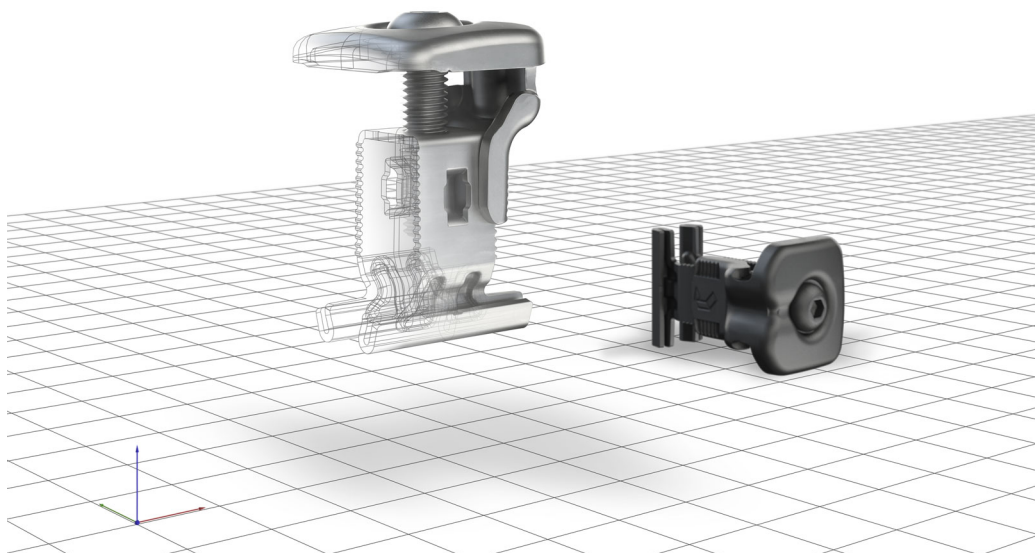
$$V_{x,d} = -0.41 \text{ kN}$$

Comparison stress: $N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.65/3.50 + 0.41/2.50 = 0.35 < 1$

Technical project overview

The Charter House

Building project	The Charter House
Address	High Street 35a, DA11 0AZ
Country	United Kingdom
Module Type	Shanghai JA Solar Technology Co. Ltd. - JAM54D40-445/LB
Number of modules	48
Rated output	21.36 kWp
Mounting system	FixedFS10S
Editor	Renusol Europe GmbH



LOCATION

Street	High Street 35a
City	DA11 0AZ
Country	United Kingdom

SURROUNDINGS

Code	Eurocode NA GB
Terrain height above sealevel	17,00 m
Snow load zone	Zone 3
Use Pressure coefficients from BRE 489 2014 roof pitch 0 -45°	yes
Terrain category	Country
Distance to coast	8,91 km
Surroundings	normal
Service life of PV system	25 years
Failure consequence class	2

LOAD CALCULATION RESULT

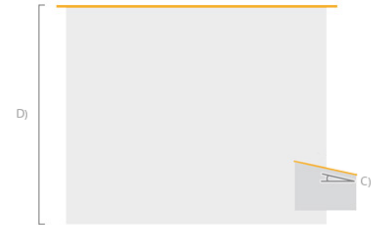
Peak velocity pressure	0,95 kN/m ²
Snow load	0,46 kN/m ²
Snow load on roof	0,36 kN/m ²
Base wind speed ($V_{b,0}$)	22,00 m/s

TOPOGRAPHY

Topography	Not exposed
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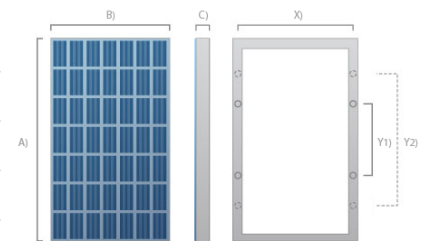
ROOF PROPERTIES

Roof type	Free-form Flat roof
Coverage type	Foil
C) Roof pitch	2,00 °
D) Building height	34,20 m
Parapet height	0,00 mm
Parapet width	0,00 mm



MODULE PARAMETERS

Manufacturer	Shanghai JA Solar Technology Co. Ltd.
Name	JAM54D40-445/LB
Length	1762 mm
Width	1134 mm
Height	30 mm
Weight	22 kg
Rated output	445 W _{peak}
Datasheet	Open datasheet



Please check the compatibility of clamping positions with module manufacturer advice.

The module data was taken from a database. Please check whether this data corresponds to your actual module order. If necessary, please correct the data using the editing function.

FASTENER PARAMETERS

Name	Rooftrak IFP-HM/MW
Manufacturer	Nicholson
Pressure load capacity	5,00 kN
Tensile load capacity	3,50 kN
Lateral force	2,50 kN
Interaction	Linear

The third party product(s) listed above, is (are) not (a) product of Renusol but, from third party Manufacturer(s) (Manufacturer). The PV-Configurator uses static properties of this fastener provided by this Manufacturer. The Manufacturer is responsible for the accurateness and correctness of the static values provided by him, Renusol does not assume any liability regarding the product of the Manufacturer and its static properties.

SYSTEM

System type	Fixed
System	FixedFS10S



Please check the entered row distance for an ideal yield calculation with a correct calculation including consideration of the shading.

FASTENER DETAILS

Mounting rotation	Eave (0°)
Fastener type	Custom fastener
X) Row distance	1740mm

CLAMPS

Clamp type	Mid clamps+ / End clamps+
Clamp colour	black
Max value middle clamps	90 %
Max value end clamps	66 %

STATIC VALIDATION

Your project was validated by our statics check successfully.

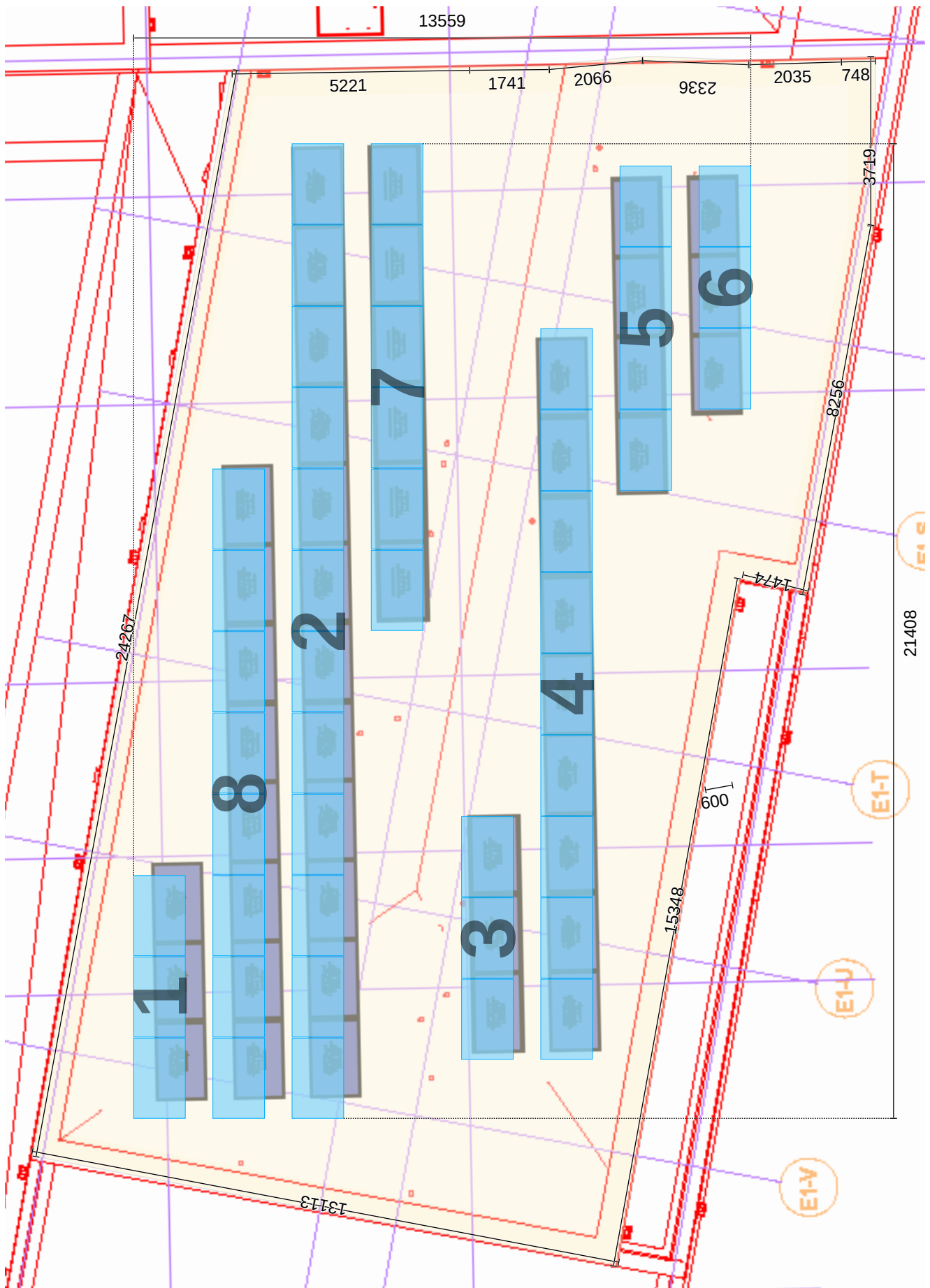
Static utilization factor: 90%

Static utilization fastener: 37%

Static utilization clamp: 90%

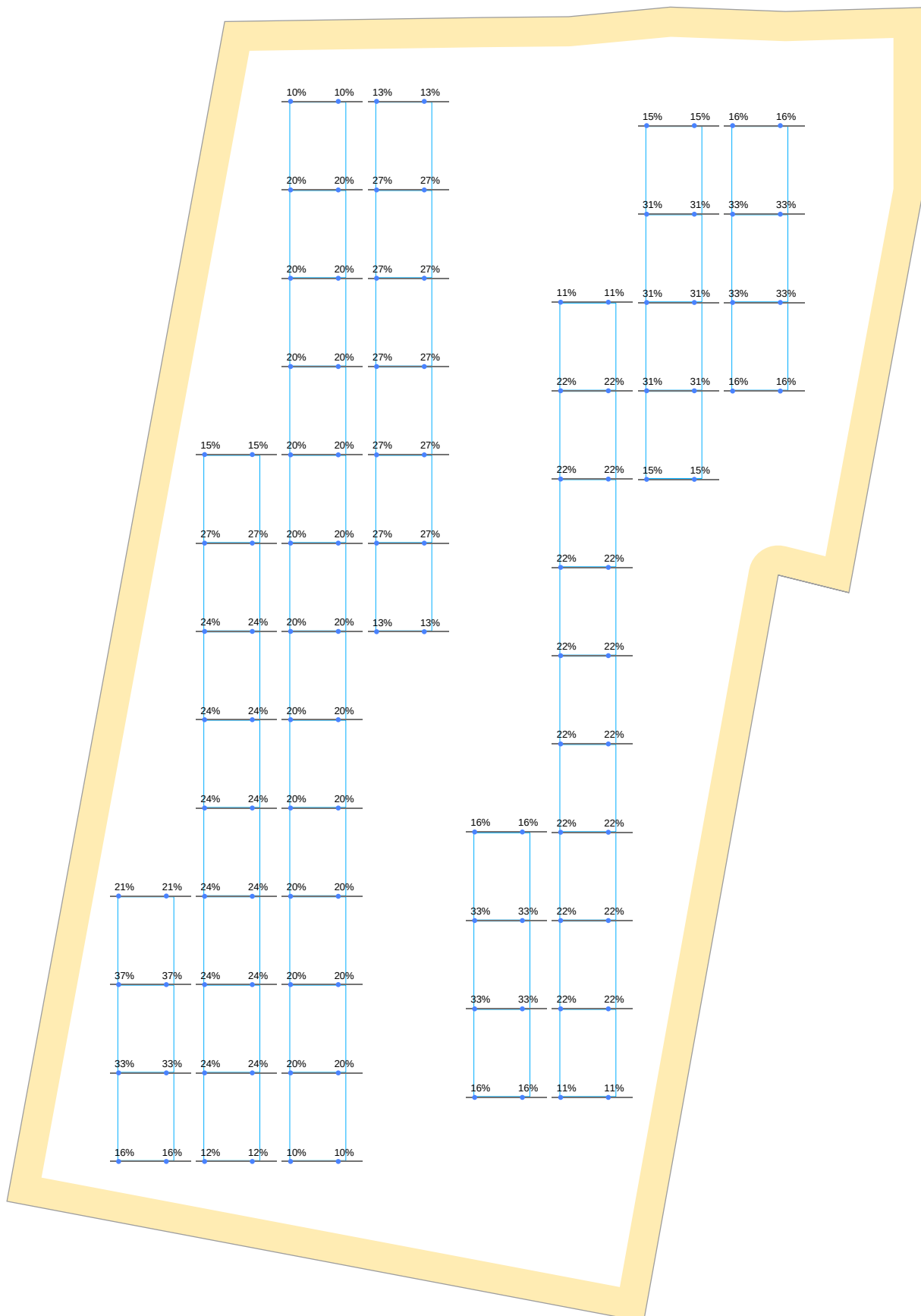
The predefined default values for input fields have to be compared with the conditions of the project. Necessary changes to adapt to local conditions must be carried out. The following relevant input fields contain their default value:

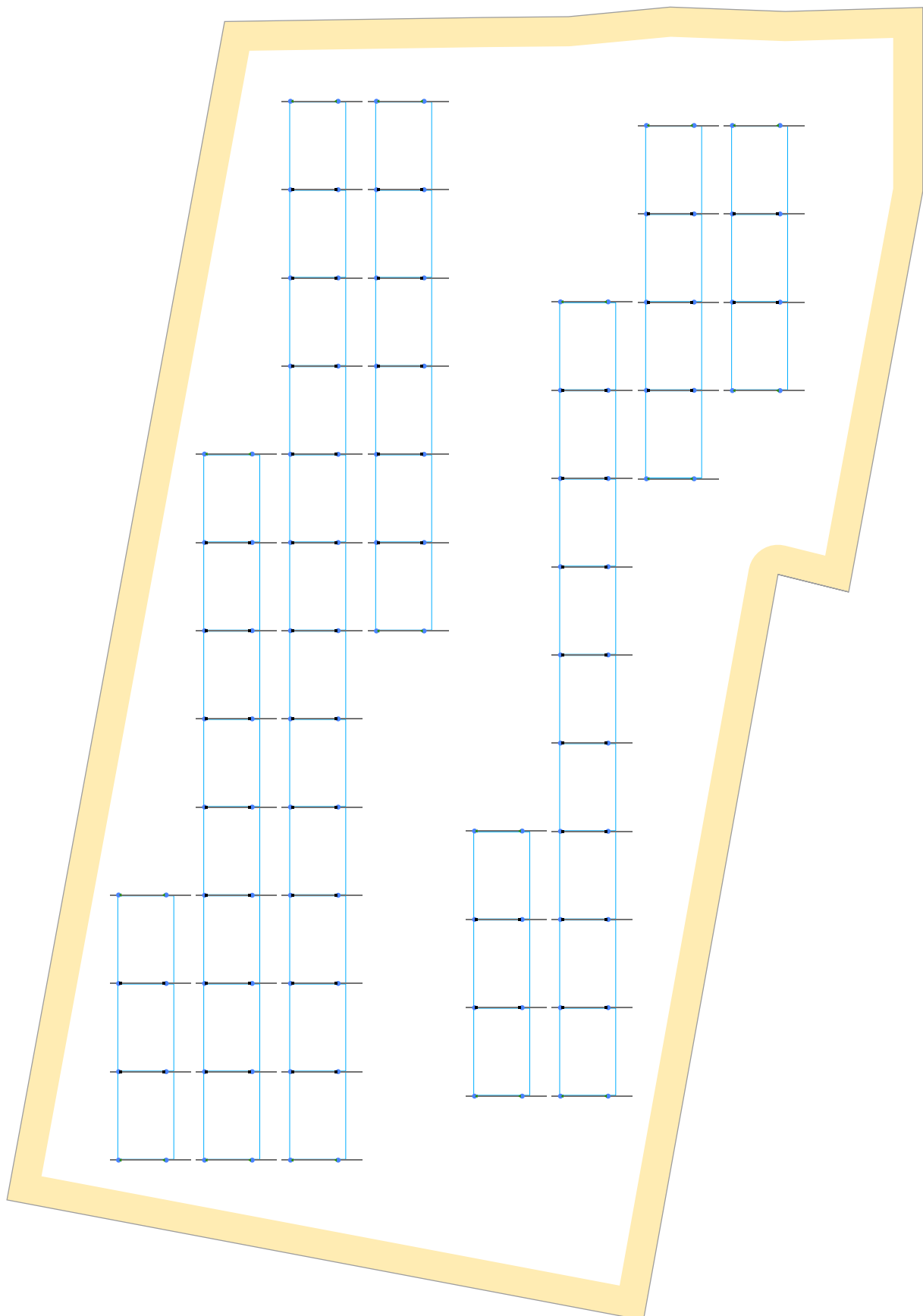
- Service life of PV system: 25 years
- Failure consequence class: 2

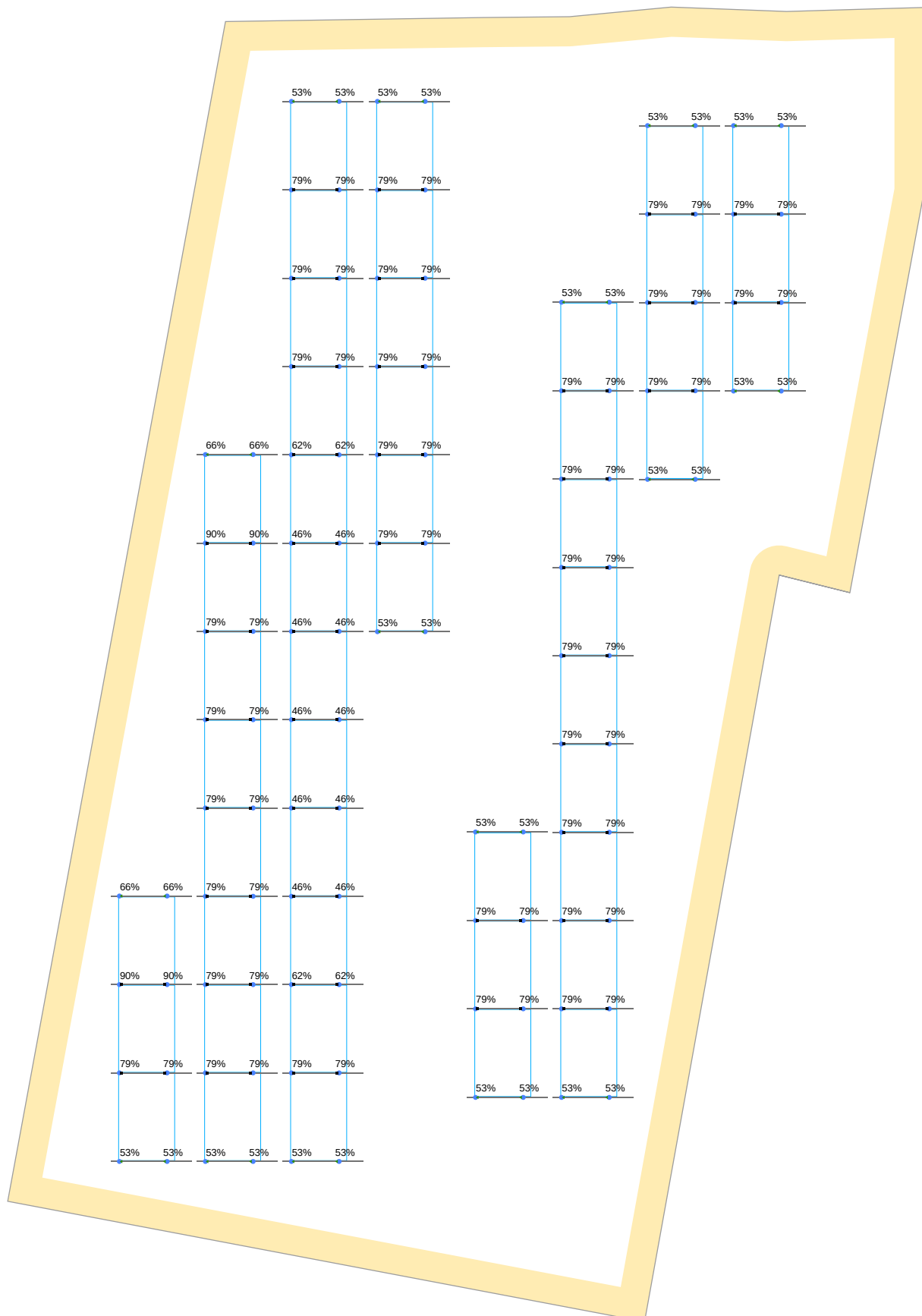


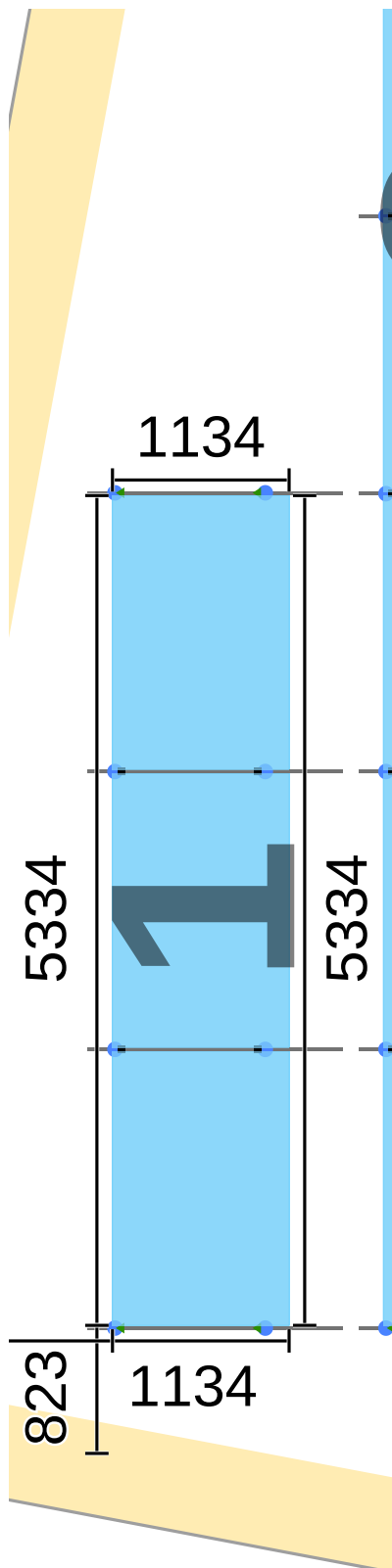


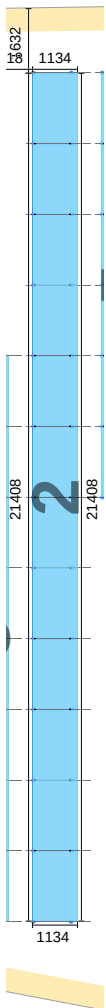


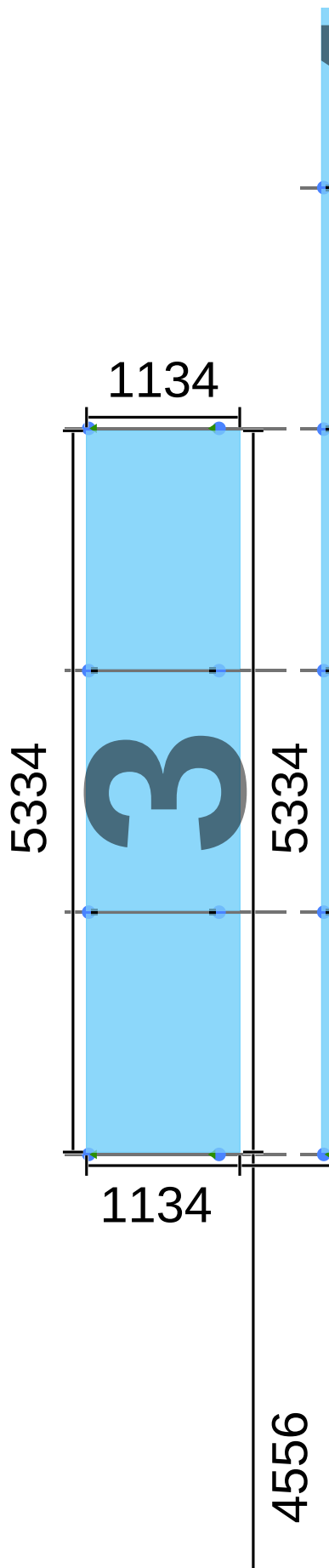


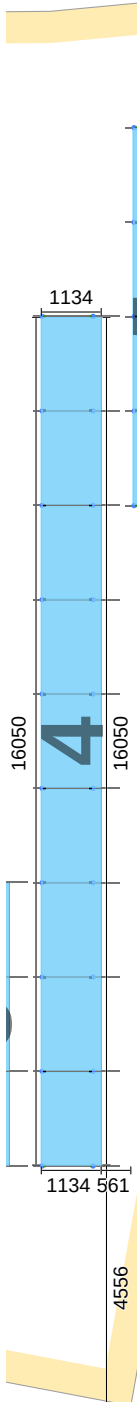


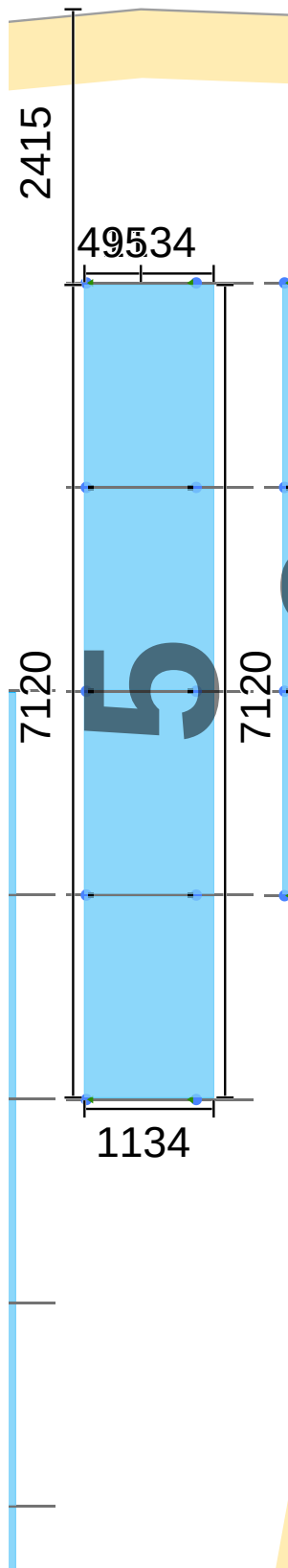


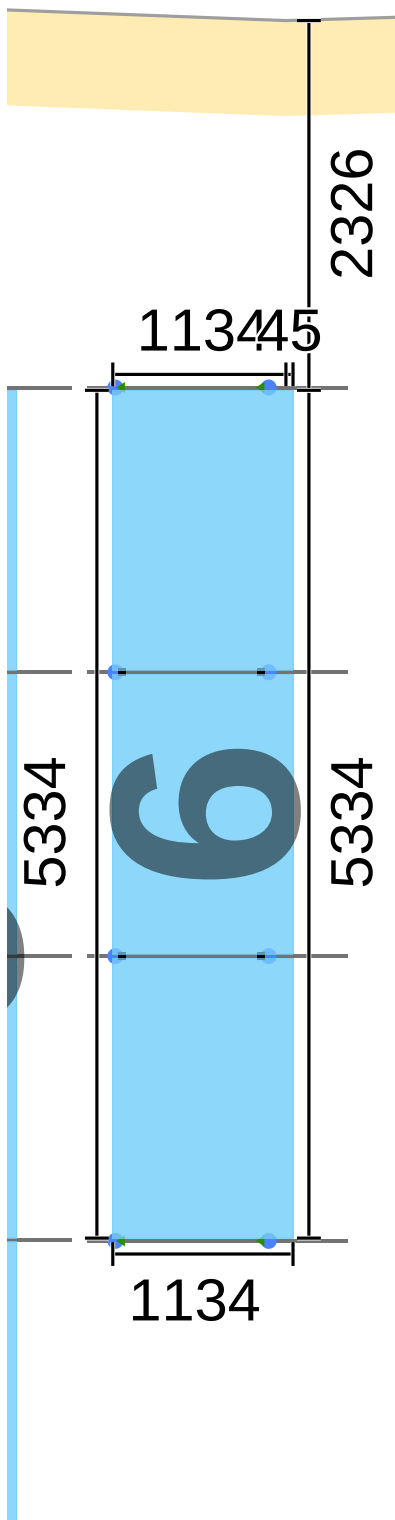


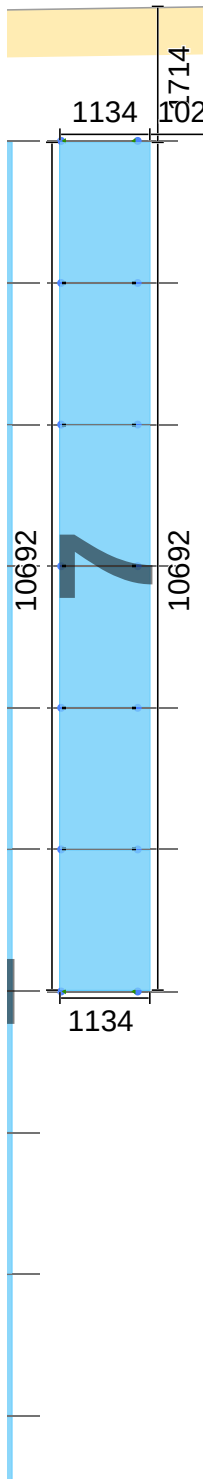


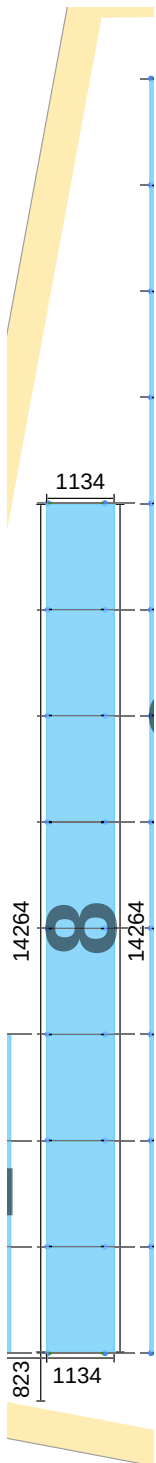












BILL OF MATERIAL

Article No.	Article	Quantity	Ordering Unit	Weight/Piece	Weight
R420081-BE	End clamp+ (black)	32	1	0,064 kg	2,048 kg
R420082-BE	Middle clamp+ (black)	80	1	0,063 kg	5,040 kg
R500409	Base rail FS10-S XL 1639 mm	56	1	1,203 kg	67,368 kg
R500419	Eave support XL	56	1	0,049 kg	2,744 kg
R500423	Ridge support 10° XL	56	1	0,443 kg	24,808 kg
R900314	Socket bolt 6 x 110 mm	112	1	0,009 kg	1,008 kg
R520220	FS Pro 10-S Base rail 1500 (Set)	56	1	1,724 kg	96,544 kg
Total Weight: 199,560 kg					
Third party parts		Quantity			
Rooftrak IFP-HM/MW		112			

The third party product(s) listed above, is (are) not (a) product of Renusol but, from third party Manufacturer(s) (Manufacturer). The PV-Configurator uses static properties of this fastener provided by this Manufacturer. The Manufacturer is responsible for the accurateness and correctness of the static values provided by him, Renusol does not assume any liability regarding the product of the Manufacturer and its static properties.

LOAD ASSUMPTIONS

Dead load

Solar modules type JAM54D40-445/LB are used.

The modules are angled horizontally on the roof and are fastened on the larger module edges on the vertical rails with module clamps.

Dimensions: 1762 mm x 1134 mm
Weight: $G = 22.0 \text{ kg}$
 $F_G = 22.0 \text{ kg} \cdot 9.81 \text{ m/s}^2 = 0.216 \text{ kN}$

Snow load

The determination of the snow load is carried out according to BS EN 1991-1-3:2003/NA:2010-06.

Snow-trap formation or snow-load accumulations are not considered in the calculation. Please contact Renusol if necessary.

Height above sea level: 17 m
Snow load zone: 3
Roof pitch: $\alpha = 2^\circ$
Module elevation: $\beta = 10^\circ$
total pitch: 12.0°

Period of use: 25 Year
Snow load: $s_k = s_{k,50} \cdot f_s = 0.50 \text{ kN/m}^2 \cdot 0.93 = 0.46 \text{ kN/m}^2$
 $\mu_1 = 0.800$
 $s_t = \mu_1 \cdot s_k = 0.8 \cdot 0.46 \text{ kN/m}^2 = 0.371 \text{ kN/m}^2$
 $s_{t,12^\circ} = 0.371 \text{ kN/m}^2 \cdot \cos(12.0^\circ) = 0.371 \text{ kN/m}^2$
 $F_{S,k} = 0.371 \text{ kN/m}^2 \cdot 1.76 \text{ m} \cdot 1.13 \text{ m} = 0.725 \text{ kN}$

Wind load

The determination of the wind load is carried out according to BS EN 1991-1-4:2005/NA:2011-01.

Building height roof ridge: 34 m
Terrain category: Country terrain
Basic wind velocity: 22.00 m/s
Distance to shoreline: 8.910 km
Period of use: 25 Year
Pressure of the gusts velocity: $q(z) = 0.945 \text{ kN/m}^2$

ANALYSIS

Load cases and load case combinations

Load cases

The respective loads are taken from the load assumptions and converted to a reference system perpendicular to the roof area.

LC 1	Dead load
LC 2	Snow load
LC 3	Wind pressure
LC 4	Wind suction

Significant load case combinations
according to: EN 1990:2012

Ultimate state of load-bearing capacity

LCC 1	Predominant action wind pressure
$E_{d,LCC 1} = 1.35 \cdot E_{GK,LC 1} + 1.50 \cdot (E_{QK,LC 3} + 0.5 \cdot E_{QK,LC 2})$	

LCC 2	Predominant action snow
$E_{d,LCC 2} = 1.35 \cdot E_{GK,LC 1} + 1.50 \cdot (E_{QK,LC 2} + 0.6 \cdot E_{QK,LC 3})$	

LCC 3	Predominant action wind suction (lifting)
$E_{d,LCC 3} = 1.00 \cdot E_{GK,LC 1} + 1.50 \cdot (E_{QK,LC 4})$	

Ultimate state of serviceability

LCC 4	Predominant action wind pressure
$E_{d,LCC 4} = 1.00 \cdot E_{GK,LC 1} + 1.00 \cdot (E_{QK,LC 3} + 0.5 \cdot E_{QK,LC 2})$	

LCC 5	Predominant action snow
$E_{d,LCC 5} = 1.00 \cdot E_{GK,LC 1} + 1.00 \cdot (E_{QK,LC 2} + 0.6 \cdot E_{QK,LC 3})$	

LCC 6	Predominant action wind suction
$E_{d,LCC 6} = 1.00 \cdot E_{GK,LC 1} + 1.00 \cdot (E_{QK,LC 4})$	

ANALYSIS

Middle clamp

General

The module clamps consist of extruded aluminium sheaths material grade EN-AW 6063 T66. The lower part of the module clamps consists of a click profile made of S500 MC, EN 10149-2, which is attached to the module carrying profile and transfers the loads by form closure. On it the module end clamp or module middle clamp is fastened by a screw. When tightening the screw the module clamp presses the module to the rail.

Sketch



Static analysis

The maximum loads established in the load combinations of the tension loads perpendicular to the roof area and the respective shear loads parallel to the roof area or the maximum shear loads in combination with the corresponding tensile loads perpendicular to the roof area are significant for the analysis. Pressure loads perpendicular to the roof area are transferred by contact bearing.

Analysis

LCC 1

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 2310 \text{ mm}$ $y = 19773 \text{ mm}$
 Loads: $V_{x,d} = -0.39 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.39/1.05 = 0.37 < 1$

LCC 2

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 2310 \text{ mm}$ $y = 19773 \text{ mm}$
 Loads: $V_{x,d} = -0.14 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.14/1.05 = 0.14 < 1$

LCC 3

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 2310 \text{ mm}$ $y = 19773 \text{ mm}$
 Loads: $N_d = -0.70 \text{ kN}$
 $V_{x,d} = -0.61 \text{ kN}$
 Comparison stress: $N_d/F_{R,d,x} + V_{x,d}/F_{R,d,y} = 0.70/3.22 + 0.61/0.90 = 0.90 < 1$

ANALYSIS

End clamp

General

The module clamps consist of extruded aluminium sheaths material grade EN-AW 6063 T66. The lower part of the module clamps consists of a click profile made of S500 MC, EN 10149-2, which is attached to the module carrying profile and transfers the loads by form closure. On it the module end clamp or module middle clamp is fastened by a screw. When tightening the screw the module clamp presses the module to the rail.

Sketch



Static analysis

The maximum loads established in the load combinations of the tension loads perpendicular to the roof area and the respective shear loads parallel to the roof area or the maximum shear loads in combination with the corresponding tensile loads perpendicular to the roof area are significant for the analysis. Pressure loads perpendicular to the roof area are transferred by contact bearing.

Analysis

LCC 1

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 2310 \text{ mm}$ $y = 17981 \text{ mm}$
 Loads: $V_{x,d} = -0.22 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.22/0.81 = 0.27 < 1$

LCC 2

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 2310 \text{ mm}$ $y = 17981 \text{ mm}$
 Loads: $V_{x,d} = -0.09 \text{ kN}$
 Comparison stress: $V_{x,d}/F_{R,d,y} = 0.09/0.81 = 0.11 < 1$

LCC 3

Regarding the calculation the following module clamp at the following position is significant.

Position: $x = 2310 \text{ mm}$ $y = 17981 \text{ mm}$
 Loads: $N_d = -0.39 \text{ kN}$
 $V_{x,d} = -0.34 \text{ kN}$
 Comparison stress: $N_d/F_{R,d,x} + V_{x,d}/F_{R,d,y} = 0.39/1.75 + 0.34/0.78 = 0.66 < 1$

ANALYSIS

Fastener

General

The resistances were determined on the user's own responsibility.

Design values of load capacity

$$F_{R,d,x} = 5.00 \text{ kN}$$

$$F_{R,d,-x} = 3.50 \text{ kN}$$

$$F_{R,d,y} = 2.50 \text{ kN}$$

LCC 1

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 2210 \text{ mm}$ $y = 19773 \text{ mm}$

Loads: $N_d = 0.44 \text{ kN}$

$$V_{x,d} = -0.43 \text{ kN}$$

$$\text{Comparison stress: } N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.44/5.00 + 0.43/2.50 = 0.26 < 1$$

LCC 2

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 2210 \text{ mm}$ $y = 19773 \text{ mm}$

Loads: $N_d = 0.71 \text{ kN}$

$$V_{x,d} = -0.24 \text{ kN}$$

$$\text{Comparison stress: } N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.71/5.00 + 0.24/2.50 = 0.24 < 1$$

LCC 3

Regarding the calculation the following fastener at the following position is significant.

Position: $x = 2210 \text{ mm}$ $y = 19773 \text{ mm}$

Loads: $N_d = -0.69 \text{ kN}$

$$V_{x,d} = -0.44 \text{ kN}$$

$$\text{Comparison stress: } N_d/F_{R,d,-x} + V_{x,d}/F_{R,d,y} = 0.69/3.50 + 0.44/2.50 = 0.37 < 1$$

TOTAL BILL OF MATERIAL

Article No.	Article	Quantity	Ordering Unit	Weight/Piece	Weight
R420081-BE	End clamp+ (black)	156	1	0,064 kg	9,984 kg
R420082-BE	Middle clamp+ (black)	260	1	0,063 kg	16,380 kg
R500409	Base rail FS10-S XL 1639 mm	208	1	1,203 kg	250,224 kg
R500419	Eave support XL	208	1	0,049 kg	10,192 kg
R500423	Ridge support 10° XL	208	1	0,443 kg	92,144 kg
R520220	FS Pro 10-S Base rail 1500 (Set)	208	1	1,724 kg	358,592 kg
R900314	Socket bolt 6 x 110 mm	416	1	0,009 kg	3,744 kg
					Total Weight: 741,260 kg
Third party parts		Quantity			
Rooftrak IFP-HM/MW		416			

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IMPORTANT NOTES

The Project Report is a result of information provided by the Customer ("Customer" means customer of Renusol ordering this Project Report from the technical service of Renusol or user of the PV Configurator creating this Project Report himself). Renusol has neither verified the accurateness nor the completeness of the information and data provided by the Customer, which form the basis of this Project Report. It is the responsibility of the Customer to check and verify all input variables (including but not limited to those input variables which had been pre-set with proposed values) and assumptions used in the Project for their accuracy and correctness.

These verifications shall include but not be limited to the following aspects: (a) Wind and snow loads are proposed by the PV Configurator using respective wind and snow load maps. It should be verified that the local conditions do not deviate from the values used in the Configuration (e.g. location on mountain with higher snow load). (b) The Customer shall check and verify the Failure Consequence Class ("CC"). Typical residential and commercial buildings require CC 2. The Customer shall use higher CC in sensitive local environment (e.g. public building, high frequency of visitors, vicinity with potential for severe damages). (c) The service lifetime of the PV installation shall be verified by the Customer depending on the expectation of the ultimate user of the PV installation as well as the lifetime of the other components used in the installation. If the lifetime is expected beyond the service lifetime used for this Project Report, all relevant structural properties as well as input variables and assumptions shall be re-checked using the then expected service lifetime. (d) For flat roof systems: The Customer shall in any case measure and document the friction coefficient of the PV system on the location-specific roof cover it is placed on. The measurement shall be performed in various, at least three roof areas. (e) For flat roof systems: The PV Configurator proposes a ballast calculation. The ballast forms, together with the weight of the PV mounting system itself and the weight of the module, the total weight of the system. The actual ballast applied may in no case be lower than the values proposed by the PV Configurator. The ballast applied shall furthermore be documented. If the ballast applied cannot be precisely determined, a safety factor increasing the ballast is to be applied.

To the extent values of input variables measured or observed by the Customer differ from values used in this Project Report, the configuration of the PV installation shall be re-iterated using the respective correct values.

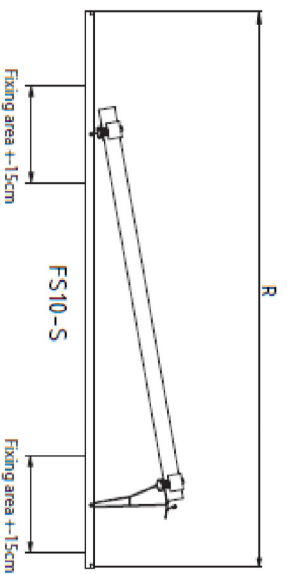
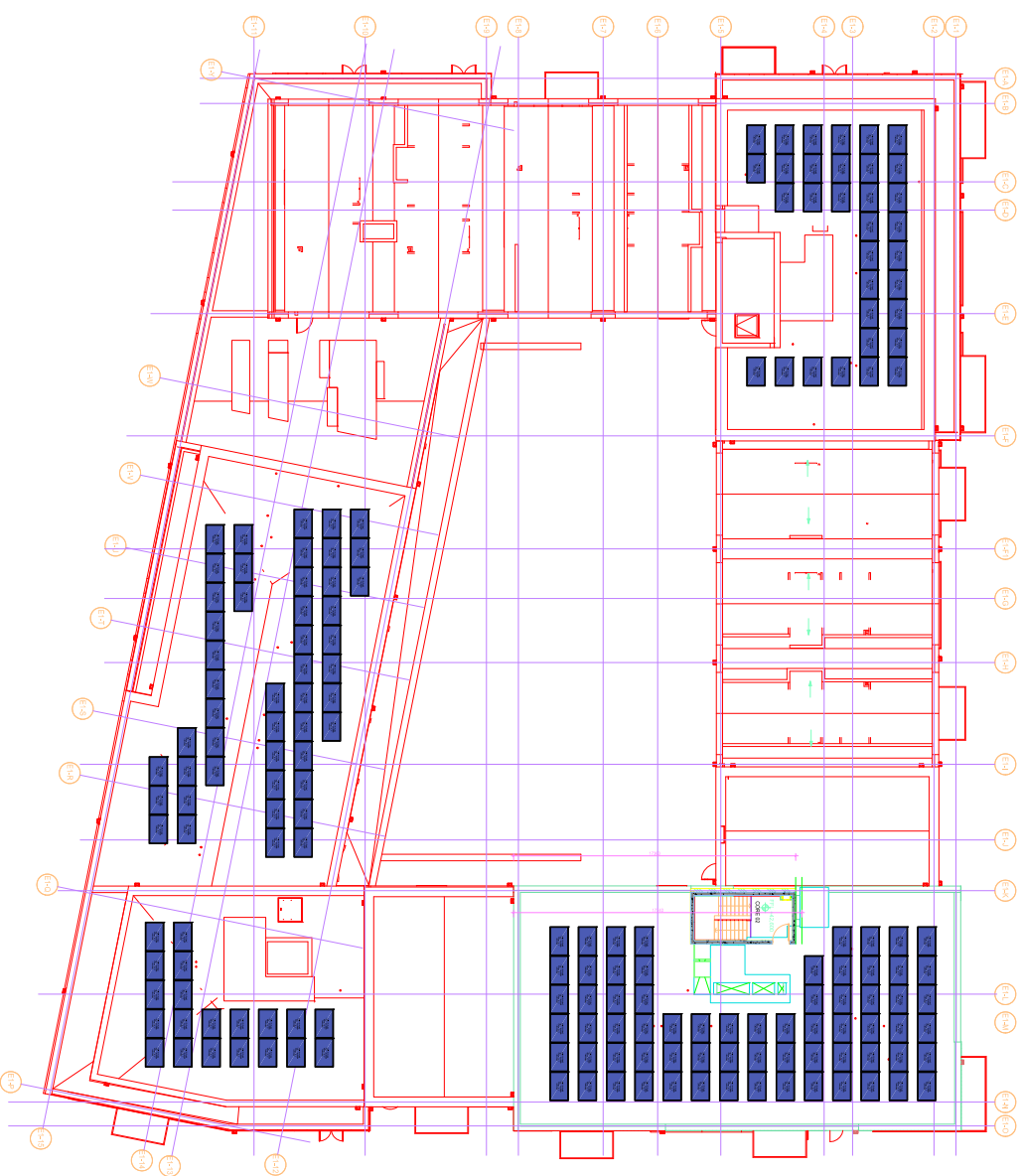
To the extent this Project Report includes a data concerning structural properties, it is the responsibility of the Customer to professionally verify (have verified) the structural data with regards to its compliance with the applicable local laws and properties of the location for which the Project Report has been prepared.

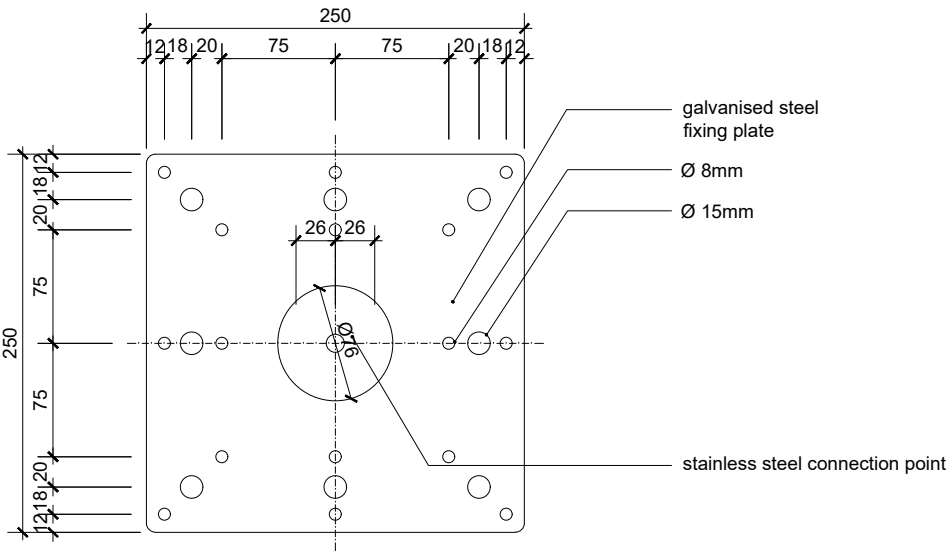
Furthermore the Terms of Use of the Renusol PV Configurator (<https://www.pv-configurator.com/pages/terms>) and the General Terms and Conditions (https://www.renusol.com/files/content/Downloads/Rechtliche%20Dokumente/Renusol_AGB_EN_110406.pdf) apply. The General Installation Guidelines of Renusol as well as the Installation Manuals and Data Sheets of the respective Renusol products, have likewise to be complied to.



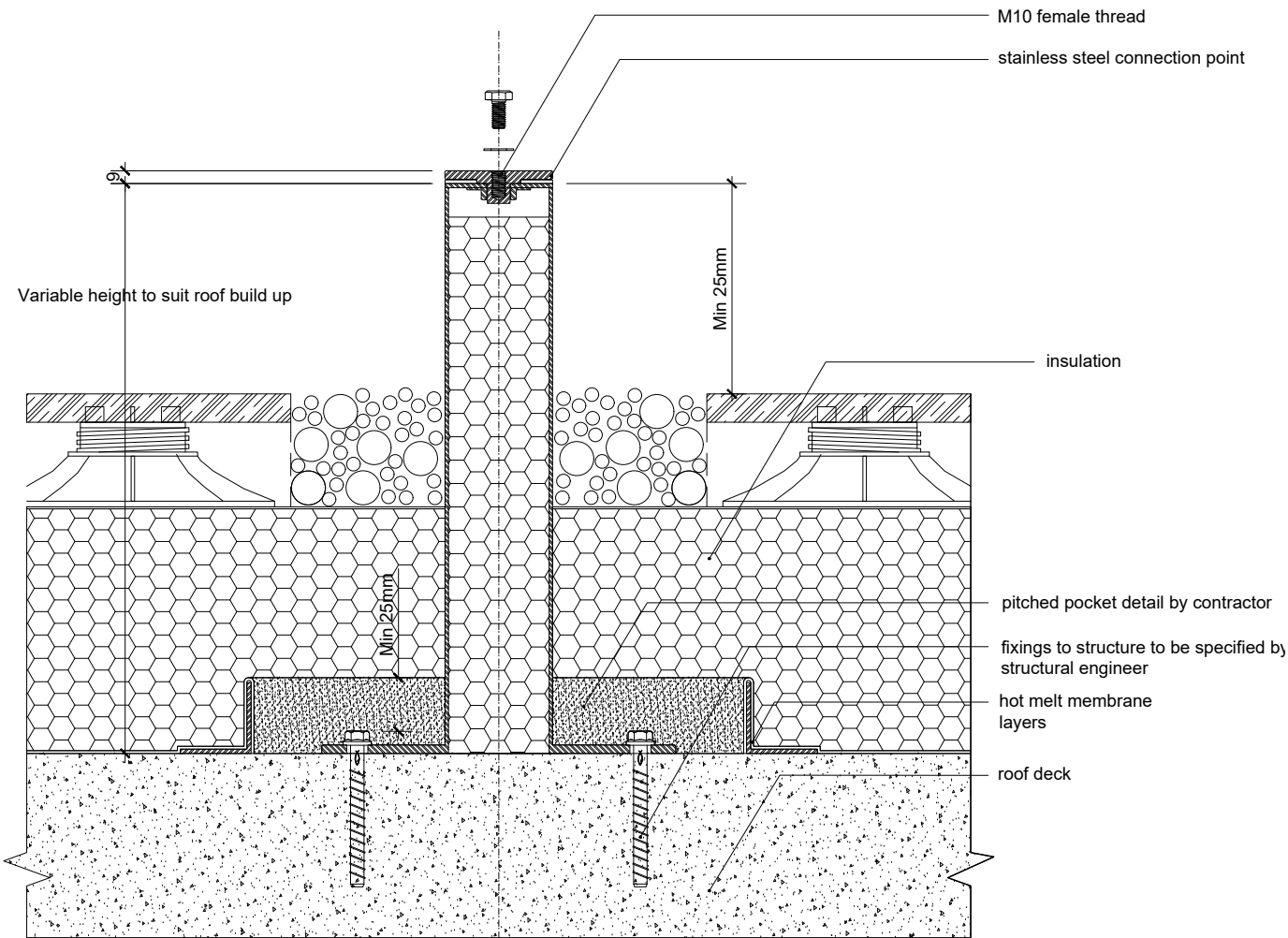
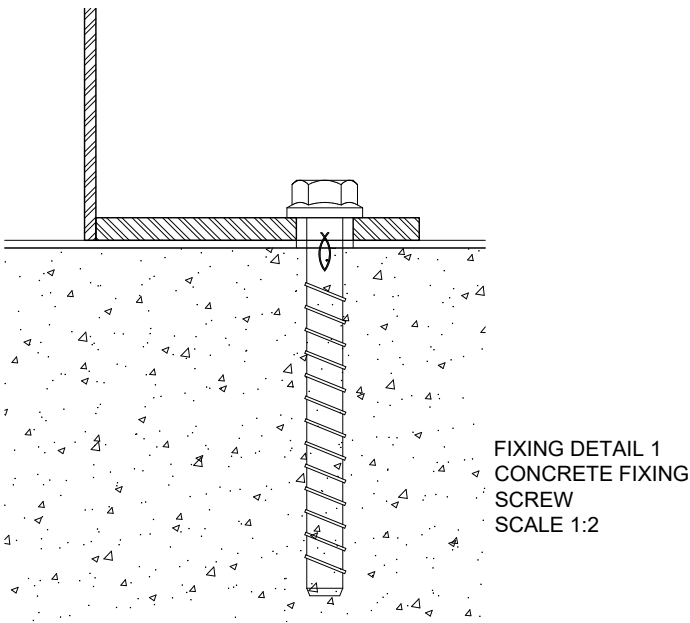
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169 x 445W (1762x1134x30)

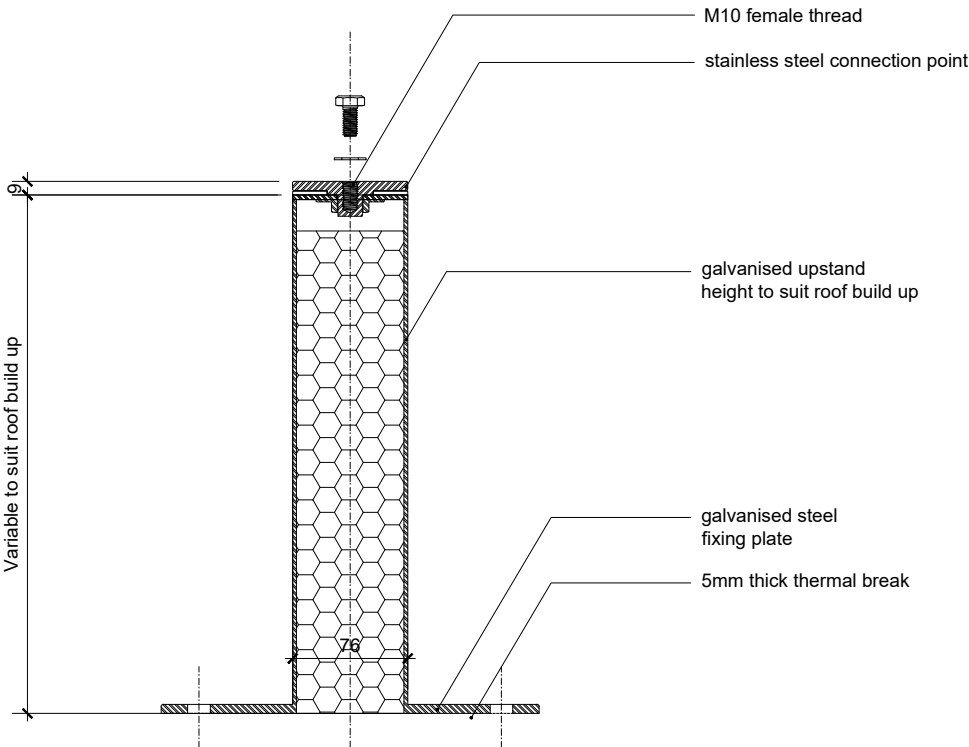




ROOFTRAK IFP-HM FIXING PLATE DIMENSIONS - PLAN VIEW



ROOFTRAK IFP-HM ON INVERTED ROOF - SECTION VIEW



ROOFTRAK IFP-HM FIXING UPSTAND DIMENSIONS - SECTION VIEW

The IFP is protected by European Patent 2855794 and US Patent 9637917

integrated fixing point

ROOFTRAK®

ROOFTRAK IFP-HM

The IFP-HM is a member of the IFP family providing an insulated, thermally broken fixing point for hot melt roofing applications.

Uses

The IFP-HM is designed as a fixing point for use with hot melt roofing systems and can be used in applications where a connection to the building structure is required. This would include uses such as solar pv, solar thermal, rainscreen facsade, roof plant supports and roof mounted signage.

Not for use with

Balustrades or any use which has a non-axial load applied

Compatibility

The IFP-HM is designed for use on concrete roof constructions that are weathered with hot melt systems and use pitch pockets for sealing penetrations.

Materials

304 stainless steel anchor point

machined finish, also available in 316 stainless steel for marine environments

Mild steel fixing plate and post upstand

galvanised finish

Internal insulation

PIR

Dimensions

Baseplate

250mm x 250mm x 6mm

Post

76mm Dia.

OA Height

Variable to suit the roof build up

Max. height

900mm

Single connection point

M10 x 20mm

IFP- HM loading values.

The following values assume that the supporting structure is adequate to support the design values that will be imposed on the IFP-HM

Compressive Load as 'A'

The maximum compressive load as 'A' 5 kN

Shear loading as 'B'

The maximum shear load at 'B' will be determined by structural calculations, but will not exceed

Up to 350mm high - 2.5kN
350-600mm high - 1.5kN
600-900mm high - 1.0kN

Tensile Load as 'C'

The available tensile load as 'C' will depend on the fixings used and the substrate they are fixed into but should not exceed the maximum value of 5 kN
We recommend on-site pullout tests to determine pull out values where the substrate is concrete or an existing roof.

Rotational as 'D'

Configuration of the IFPs should be such that turning motion is not exerted on individual fixing points.

IMPORTANT NOTE:

It is the responsibility of the designer/specifier/purchaser to ensure that the intended use of the IFP in any given application is approved by a competent structural engineer

Installations

The ROOFTRAK IFP-HM is designed to be installed onto roofs where hot-melt waterproofing systems will be used. The IFP-HM unit is ideally fitted to a flat structural surface. Surface preparation of the roof substrate should be completed prior to the installation commencing. Fixings to the substrate should be completed using 8no. fixing opportunities using fixings suitable to the roof construction.

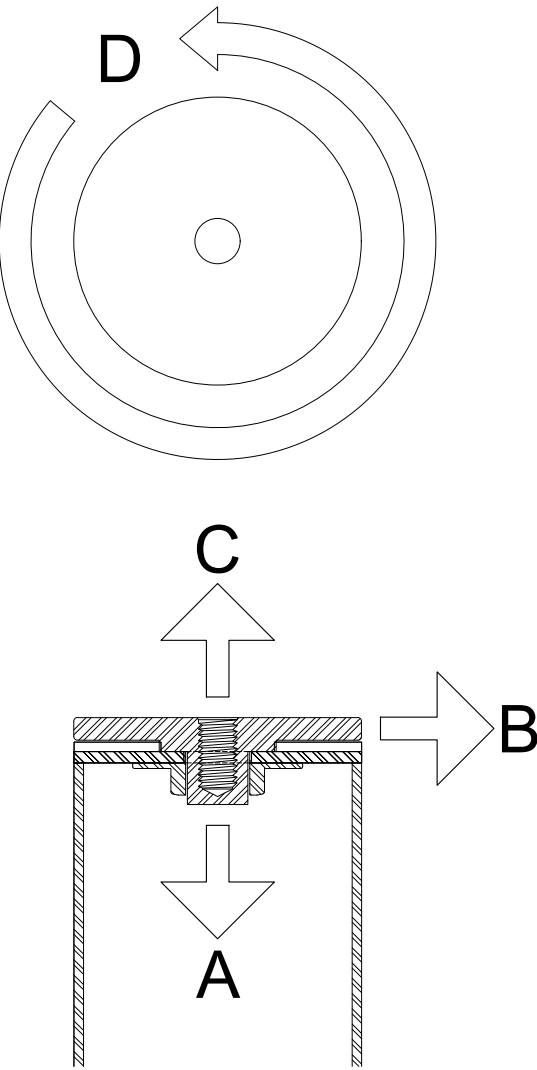
The IFP-HM should be of sufficient height to extend past to top of of the insulation layer and any additional ballast, paving or green roofing layers by a minimum of 50mm.

Waterproofing the unit will be completed using a pitch pocket detail according to the manufacturers guidelines.

M10 bolts of a suitable length can be used to secure the balustrade system to the IFP-HM. A suitable connection bracket or plate may be required. The bolts should be installed with a suitable thread locking adhesive or locking washer to stop potential loosening over time. M10 bolts to the top of the IFP-HM should be tightened to 57.3 Nm.

See separate installation instructions for this product.

The IFP is protected by European Patent 2855794 and US Patent 9637917



IFP-HM- Loading diagram.

Warranty

Rooftrak IFP products are covered by the Nicholson standard warranty - available on the website or by request. Rooftrak IFP components are always supplied as a factory assembled product. Tampering with, or adjustment of the factory finished unit will invalidate the warranty