CompactPITCH

PROJECT REPORT

SE DU Gradišče_rev02

Overall Report

16/06/2025





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PROJECT DEPENDING INFORMATIONS

Due to missing information, assumptions have been made. Check all data carefully. The project report may need to be adjusted, as other parameters may result in a change in the statics.

MASTER DATA

Project Name	**SE DU Gradišče_rev02**
Project Number:	**1012254_00020**
Comment	**VIŠINC d.o.o.**
Planning Responsible	**AG**
Software v.:	**11.0.43.7426**

Roof_1

Amount Modules	**23**
System Size	**10.35 kWp**
Orientation [°]	**132.38**
Roofpitch [°]	**21 °**
Deadload on Allocated Roof Area	**12.24 kg/m²**

Roof_10

Amount Modules	**17**
System Size	**7.65 kWp**
Orientation [°]	**278.02**
Roofpitch [°]	**16 °**
Deadload on Allocated Roof Area	**12.43 kg/m²**

Roof_11

Amount Modules	**3**
System Size	**1.35 kWp**
Orientation [°]	**278.02**
Roofpitch [°]	**16 °**
Deadload on Allocated Roof Area	**13.3 kg/m²**

Roof_12

Amount Modules	**16**
System Size	**7.2 kWp**
Orientation [°]	**278.02**
Roofpitch [°]	**16 °**
Deadload on Allocated Roof Area	**12.39 kg/m²**

Roof_13

Amount Modules	**19**
System Size	**8.55 kWp**
Orientation [°]	**278.02**
Roofpitch [°]	**16 °**
Deadload on Allocated Roof Area	**12.43 kg/m²**

Roof_14

Amount Modules	**10**
System Size	**4.5 kWp**
Orientation [°]	**312.38**
Roofpitch [°]	**21 °**
Deadload on Allocated Roof Area	**12.64 kg/m²**

Roof_2

Amount Modules	**15**
System Size	**6.75 kWp**
Orientation [°]	**132.38**
Roofpitch [°]	**21 °**
Deadload on Allocated Roof Area	**12.21 kg/m²**

Roof_3

Amount Modules	**11**
System Size	**4.95 kWp**
Orientation [°]	**132.38**
Roofpitch [°]	**21 °**
Deadload on Allocated Roof Area	**12.53 kg/m²**

Roof_4

Amount Modules	**29**
System Size	**13.05 kWp**
Orientation [°]	**98.02**
Roofpitch [°]	**16 °**
Deadload on Allocated Roof Area	**12.31 kg/m²**

Roof_5

Amount Modules	**8**
System Size	**3.6 kWp**
Orientation [°]	**98.02**
Roofpitch [°]	**16 °**
Deadload on Allocated Roof Area	**12.83 kg/m²**

Roof_6

Amount Modules	**3**
System Size	**1.35 kWp**
Orientation [°]	**98.02**
Roofpitch [°]	**16 °**
Deadload on Allocated Roof Area	**13.3 kg/m²**

Roof_7

Amount Modules	**18**
System Size	**8.1 kWp**
Orientation [°]	**98.02**
Roofpitch [°]	**16 °**
Deadload on Allocated Roof Area	**12.16 kg/m²**

Roof_8

Amount Modules	**4**
System Size	**1.8 kWp**
Orientation [°]	**98.02**
Roofpitch [°]	**16 °**
Deadload on Allocated Roof Area	**12.35 kg/m²**

Roof_9

Amount Modules	**6**
System Size	**2.7 kWp**

Orientation [°]	**278.02**
Roofpitch [°]	**16 °**
Deadload on Allocated Roof Area	**13.92 kg/m²**
Amount ModulesSum	**182**
System Size Sum	**81.9 kWp**
StaticStrings.TotalAreaAllRoofs	**910.3 m²**
Available roof area	**864.64 m²**
Allocated Roof Area	**363.66 m²**

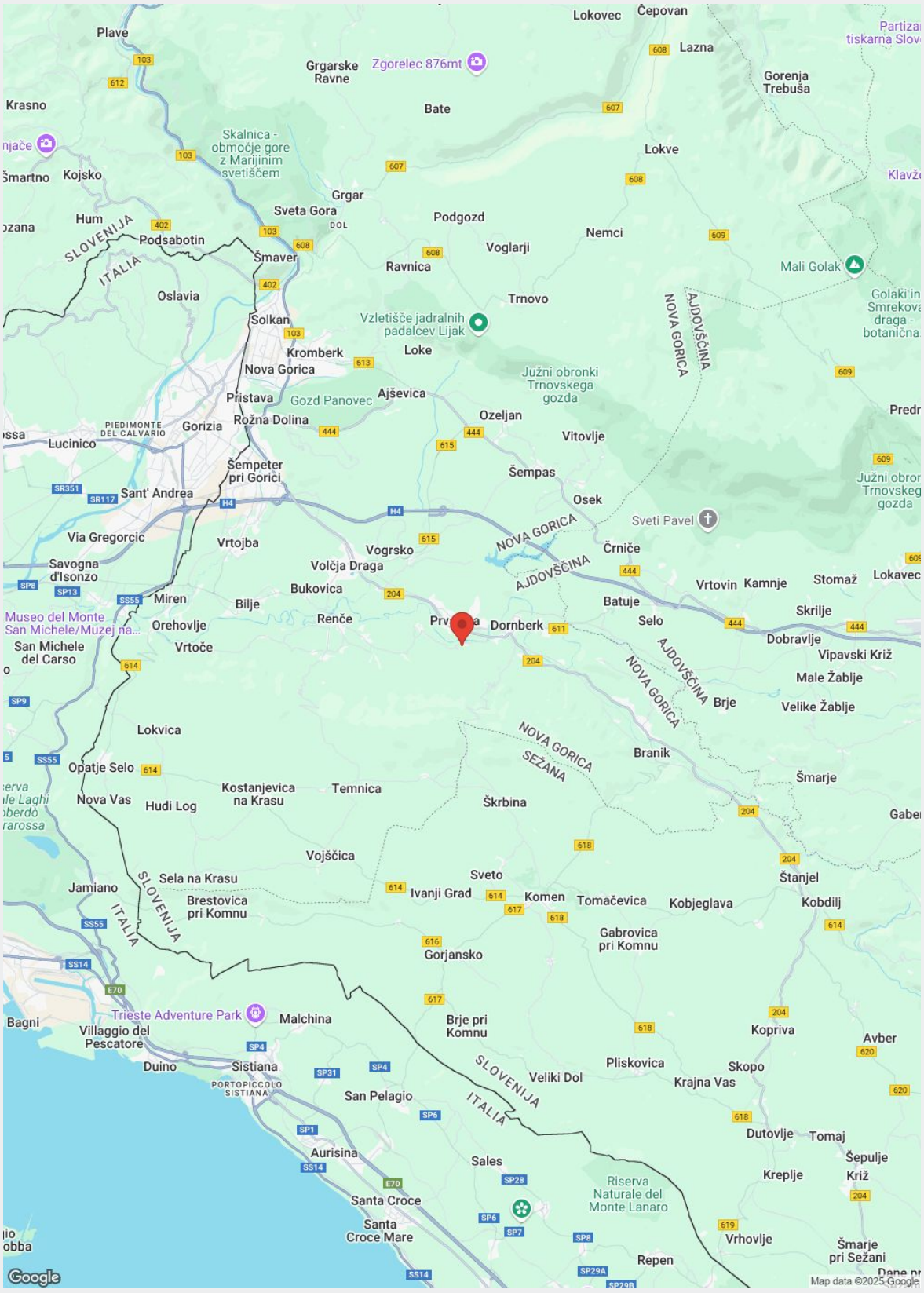
CUSTOMER DETAILS

Customer Number	**1012254**
Company	**VIŠINC d.o.o.**
Name	
Street Address	**Žlebe 127**
Postal code	
City	**Medvode**
Phone	
Email	**stef@delanavisini.si**
Notes	

PROJECT ADDRESS

Name	
Company	**VIŠINC d.o.o.**
Street Address	**Gradišče nad Prvačino 4**
Postal code	**5294**
City	**Dornberk**
Phone	
Email	
Notes	
Country	**Slovenia**
Latitude [°]	**45.88287**
Longitude [°]	**13.71753**
Altitude [m]	**49**

PROJECT LOCATION - GOOGLE MAPS

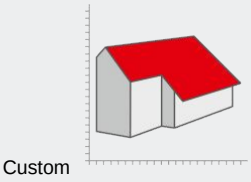


3D IMAGE - FROM SCREENSHOT



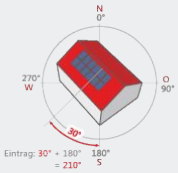
ROOF [ROOF_1]

Building height h [mm]	**10000**
Slope of roof [°]	**21**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**132.38**



Custom

System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

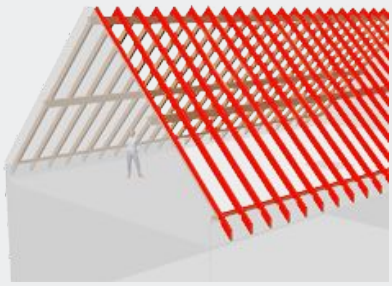
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**21**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

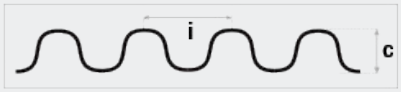
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

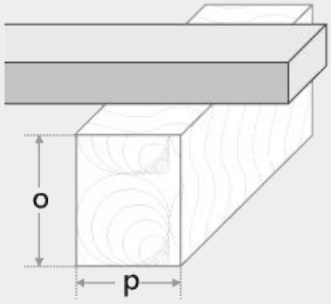
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_1]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**602**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





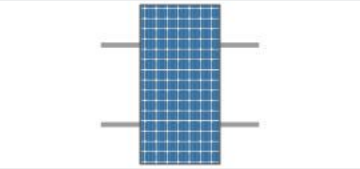


PV-MODULE [ROOF_1]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_1]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**39**
Max. Utilization of fixation points	**74 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_1]

Module rail	**Rail X60**
Max. utilization Module Profile	**93.2 %**

CLAMPS [ROOF_1]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**35.98 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**28.35 %**

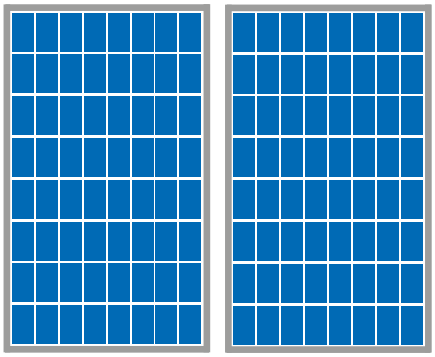
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_1]

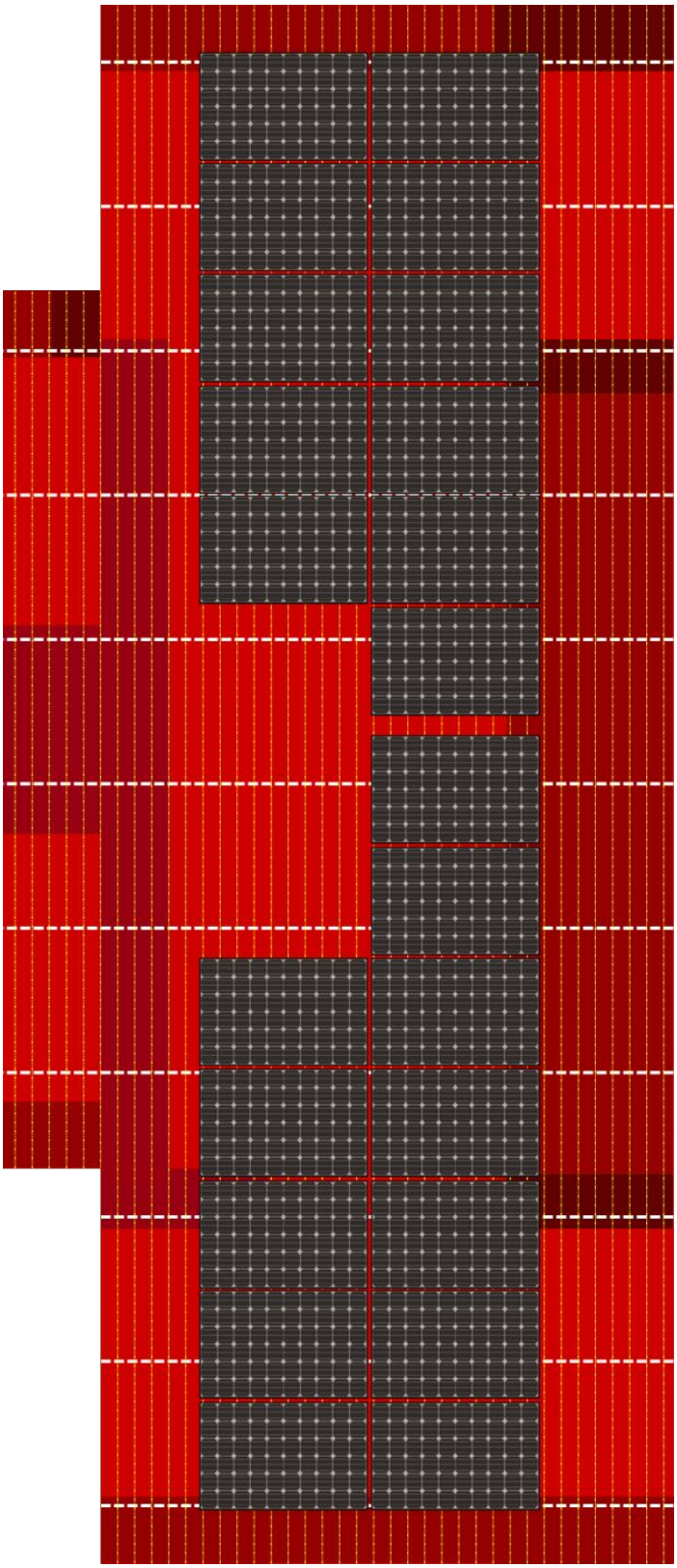
Allocated Roof Area	**45.96 m²**
Load on Allocated Area	**48.61 kN**
Max. Pressure (design):	**0.9 kN/m²**
Max. Tension (design):	**-1.44 kN/m²**
Total System weight	**566.15 kg**
Pressure on allocated Area	**0.12 kN/m²**

MODULE LAYOUT PLAN [ROOF_1]

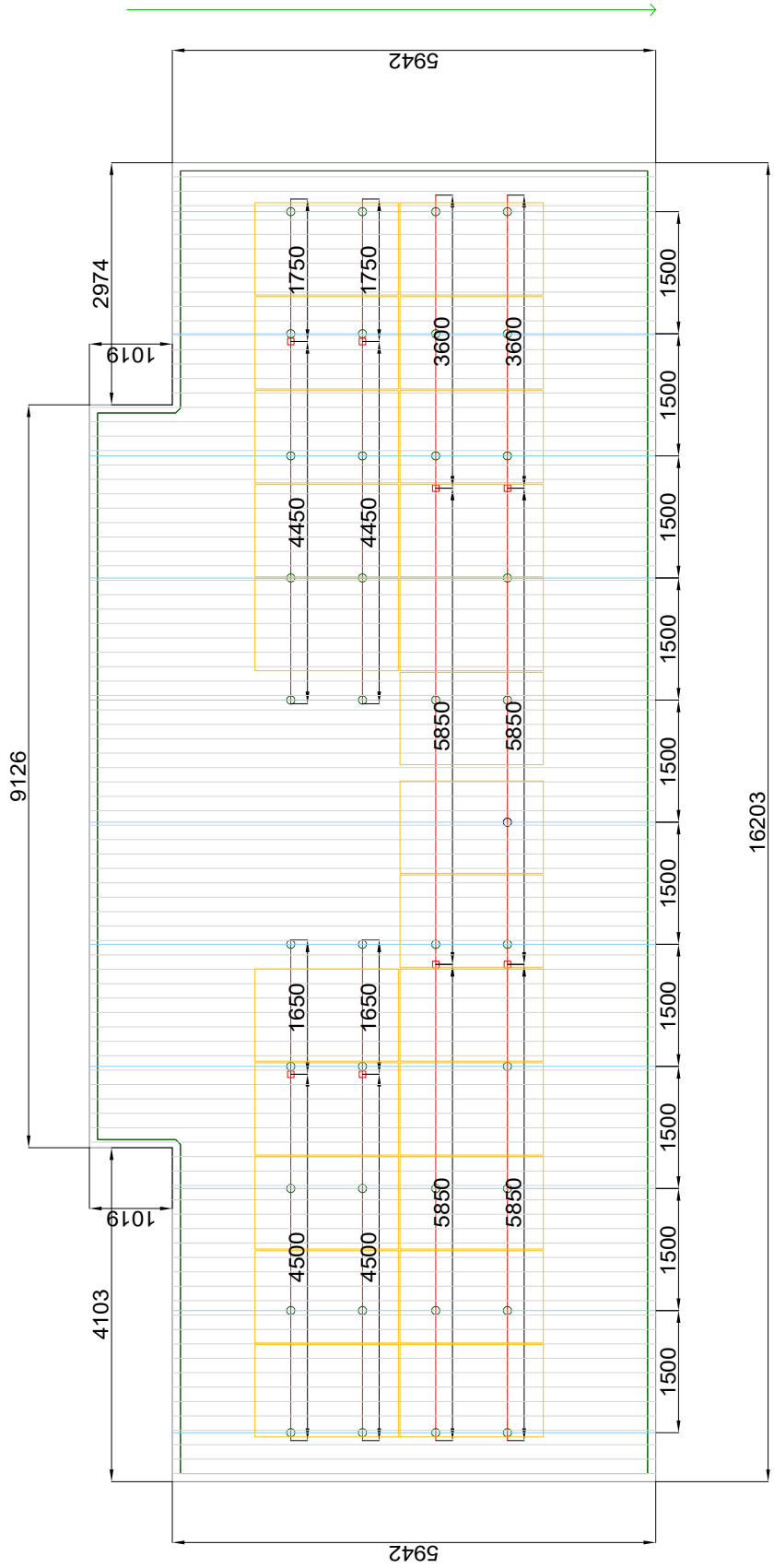
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



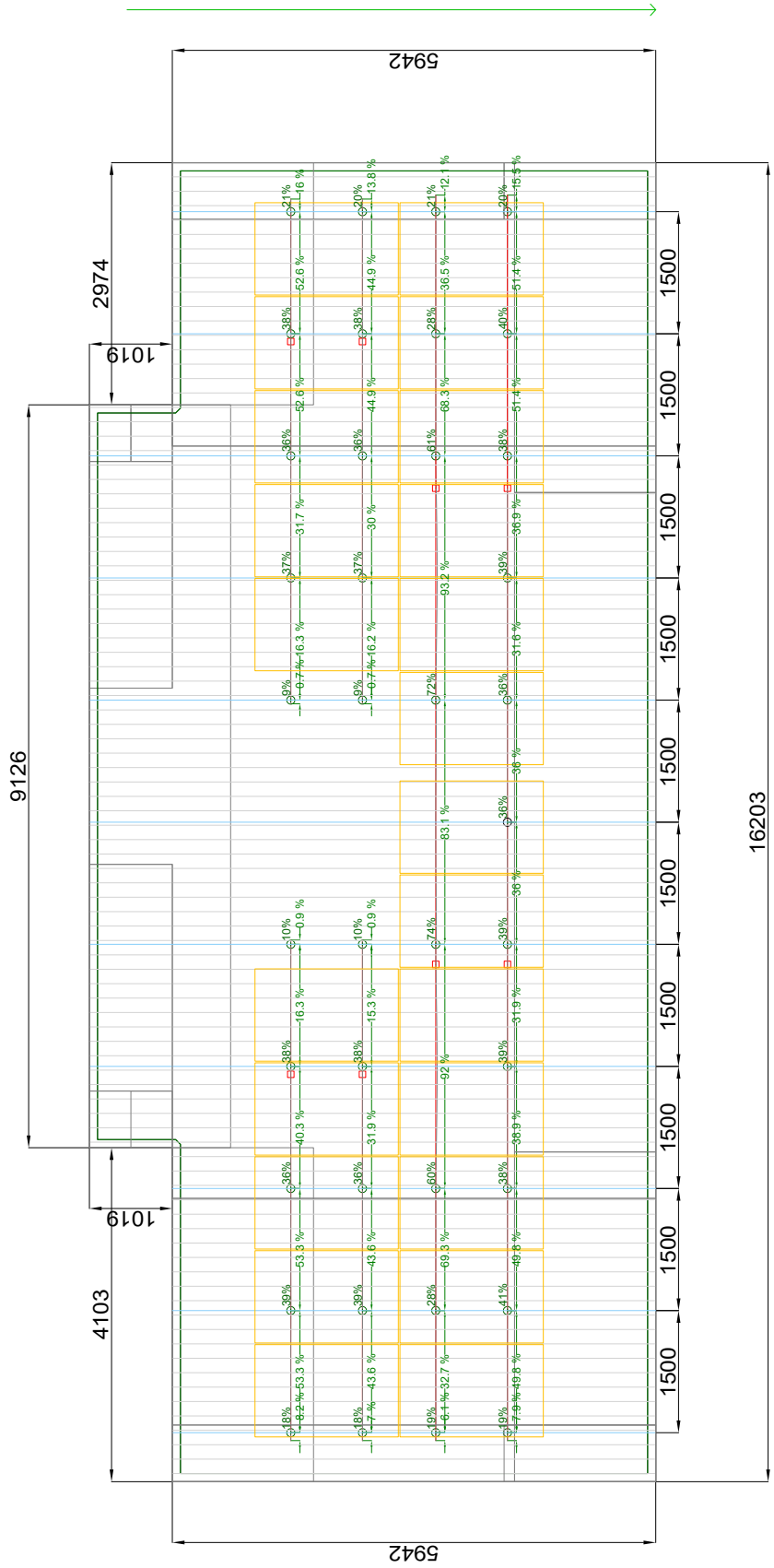
POSITION [ROOF_1]



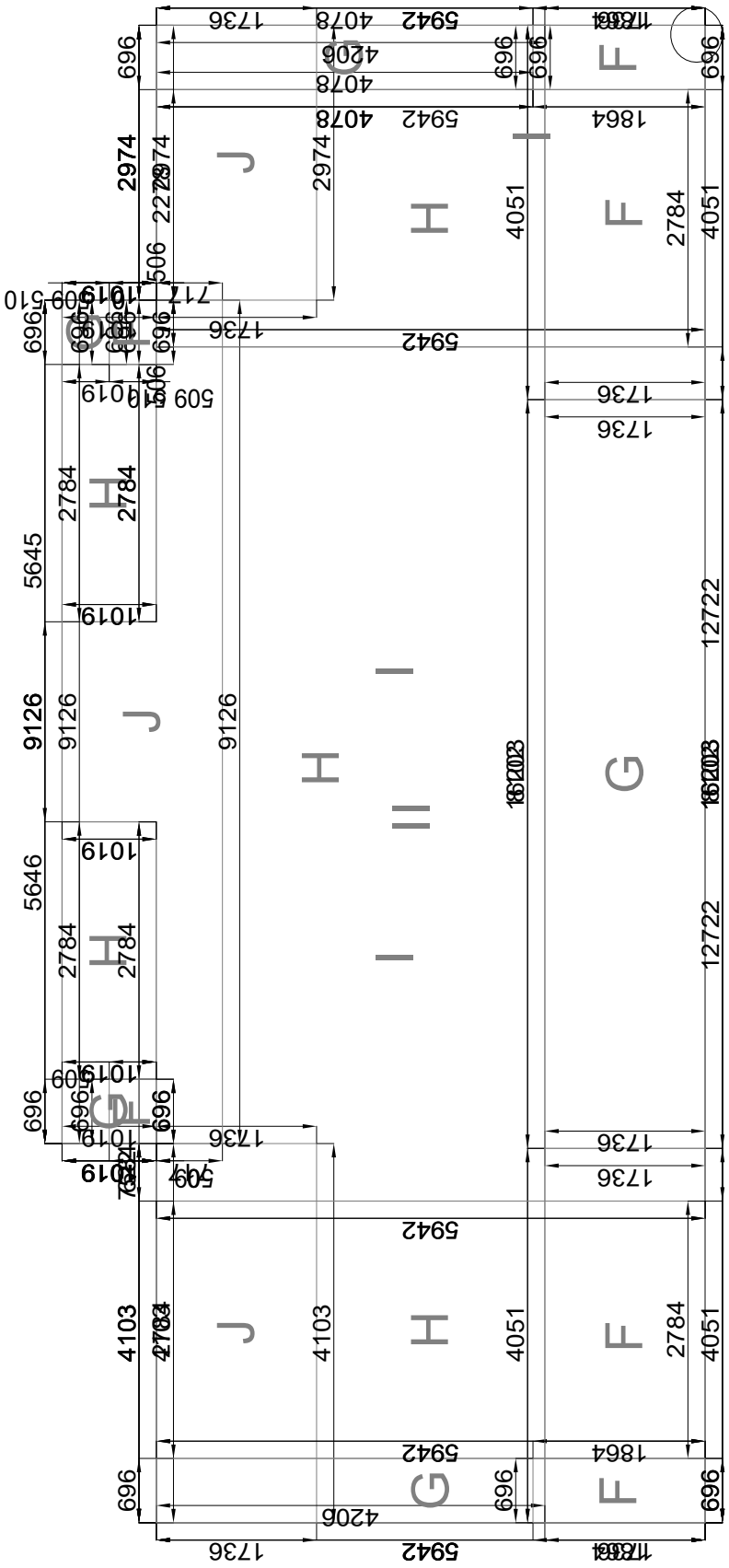
INSTALLATION-PLAN [ROOF_1]



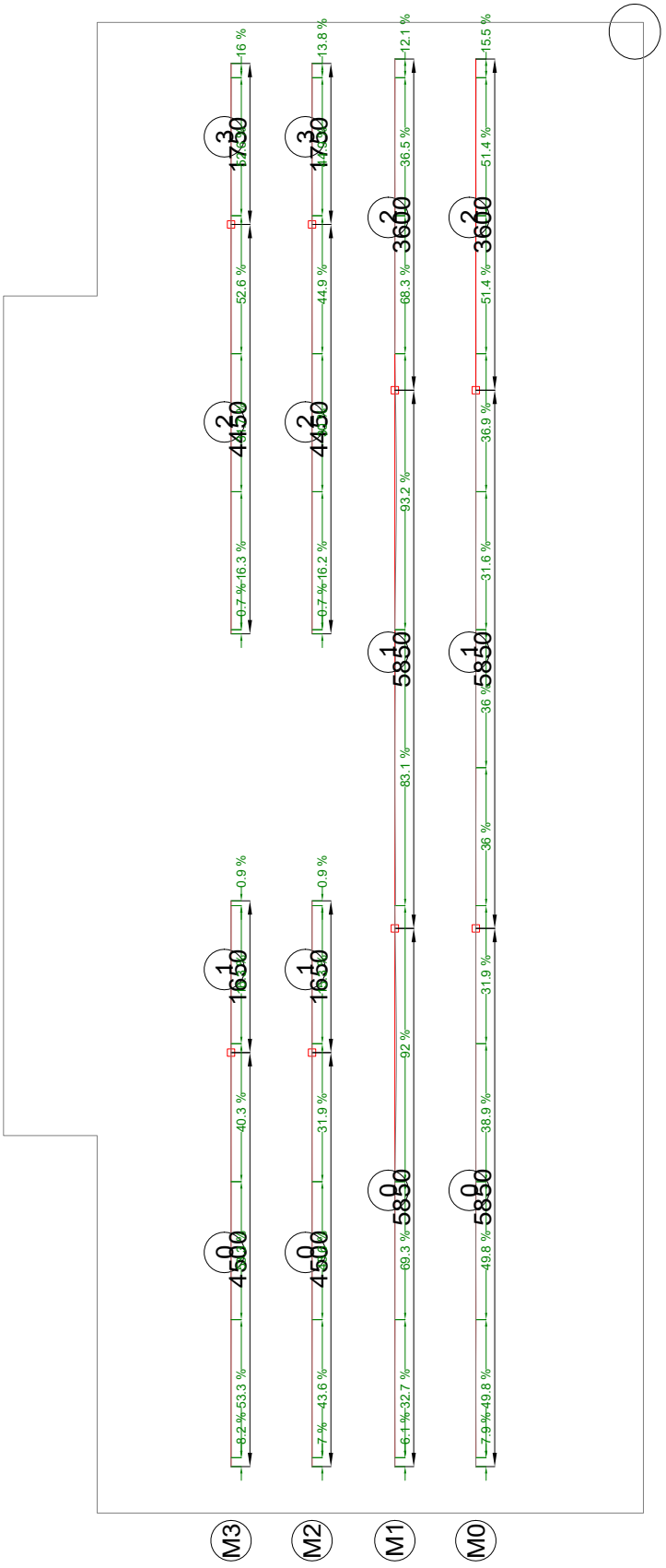
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_1]



STATIC INFORMATION: AREAS [ROOF_1]



RAIL CAPACITY [ROOF_1]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	21 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.15 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.14 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.054 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.2 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.078 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_1]

AREA F 0

Tributary area	**10 m²**
Cpe Suction	**-0.74**
Max. Suction	**1.23 kN/m²**
Cpe Pressure	**0.4**
Max. downward load	**1.08 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.93 kN/m²	0.19 kN/m²	0.95 kN/m²	11.5 °
LC 2	1.07 kN/m²	0.13 kN/m²	1.08 kN/m²	6.97 °
LC 3	-1.23 kN/m²	0.048 kN/m²	1.23 kN/m²	182.26 °

AREA G 0

Tributary area	**10 m²**
Cpe Suction	**-0.68**
Max. Suction	**1.12 kN/m²**
Cpe Pressure	**0.4**
Max. downward load	**1.08 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.93 kN/m²	0.19 kN/m²	0.95 kN/m²	11.5 °
LC 2	1.07 kN/m²	0.13 kN/m²	1.08 kN/m²	6.97 °
LC 3	-1.12 kN/m²	0.048 kN/m²	1.12 kN/m²	182.48 °

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.34**
Max. Suction	**0.5 kN/m²**
Cpe Pressure	**0.28**
Max. downward load	**0.86 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.8 kN/m²	0.19 kN/m²	0.82 kN/m²	13.32 °
LC 2	0.85 kN/m²	0.13 kN/m²	0.86 kN/m²	8.73 °
LC 3	-0.5 kN/m²	0.048 kN/m²	0.5 kN/m²	185.57 °

RESULTING SURFACE STRESSES [ROOF_1]

AREA J 180

Tributary area	**10 m²**
Cpe Suction	**-0.88**
Max. Suction	**1.49 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.53 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.49 kN/m²	0.19 kN/m²	0.53 kN/m²	21 °
LC 2	0.34 kN/m²	0.13 kN/m²	0.37 kN/m²	21 °
LC 3	-1.48 kN/m²	0.048 kN/m²	1.49 kN/m²	181.87 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.79 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.53 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.49 kN/m²	0.19 kN/m²	0.53 kN/m²	21 °
LC 2	0.34 kN/m²	0.13 kN/m²	0.37 kN/m²	21 °
LC 3	-0.79 kN/m²	0.048 kN/m²	0.79 kN/m²	183.51 °

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.22**
Max. Suction	**2.11 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.53 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.49 kN/m²	0.19 kN/m²	0.53 kN/m²	21 °
LC 2	0.34 kN/m²	0.13 kN/m²	0.37 kN/m²	21 °
LC 3	-2.11 kN/m²	0.048 kN/m²	2.11 kN/m²	181.32 °

RESULTING SURFACE STRESSES [ROOF_1]

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.28**
Max. Suction	**2.22 kN/m²**
Cpe Pressure	**0.28**
Max. downward load	**0.86 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.8 kN/m²	0.19 kN/m²	0.82 kN/m²	13.32 °
LC 2	0.85 kN/m²	0.13 kN/m²	0.86 kN/m²	8.73 °
LC 3	-2.22 kN/m²	0.048 kN/m²	2.22 kN/m²	181.25 °

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.68**
Max. Suction	**1.12 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.53 kN/m²**

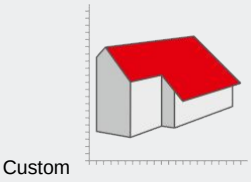
LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.49 kN/m²	0.19 kN/m²	0.53 kN/m²	21 °
LC 2	0.34 kN/m²	0.13 kN/m²	0.37 kN/m²	21 °
LC 3	-1.12 kN/m²	0.048 kN/m²	1.12 kN/m²	182.48 °

MATERIAL LIST [ROOF_1]

Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**23**	0.046
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**11**	**11**	58.025
	705225	XPCN60 rail connector X60	1	**8**	**8**	1.368
	705226	XCL60 side-lid left for rail X60	1	**6**	**6**	0.030
	705227	XCR60 side-lid right for rail X60	1	**6**	**6**	0.030
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**39**	**39**	19.929
	706457	CLP-R cable clip rail	1	**150**	**23**	0.092
	707003	CLE10 End clamp Click 30-46	1	**20**	**16**	1.200
	707011	CLM10 Middle clamp Click 30-46	1	**40**	**38**	2.432
						83.15

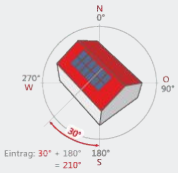
ROOF [ROOF_10]

Building height h [mm]	**10000**
Slope of roof [°]	**16**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**278.02**



Custom

System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

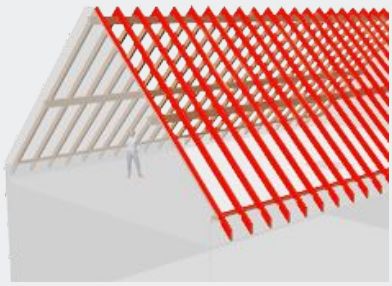
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**16**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

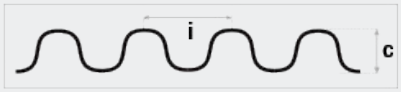
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

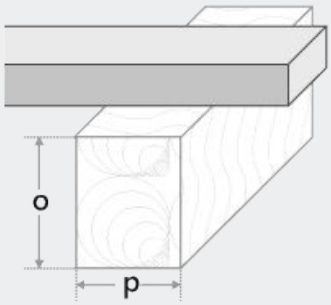
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_10]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**700**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





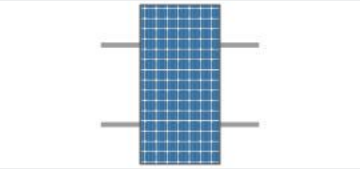


PV-MODULE [ROOF_10]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_10]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**34**
Max. Utilization of fixation points	**63 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_10]

Module rail	**Rail X60**
Max. utilization Module Profile	**98.47 %**

CLAMPS [ROOF_10]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**74.79 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**69.07 %**

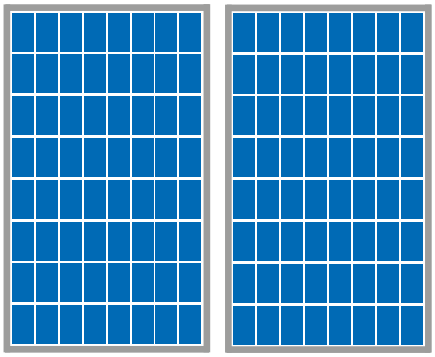
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_10]

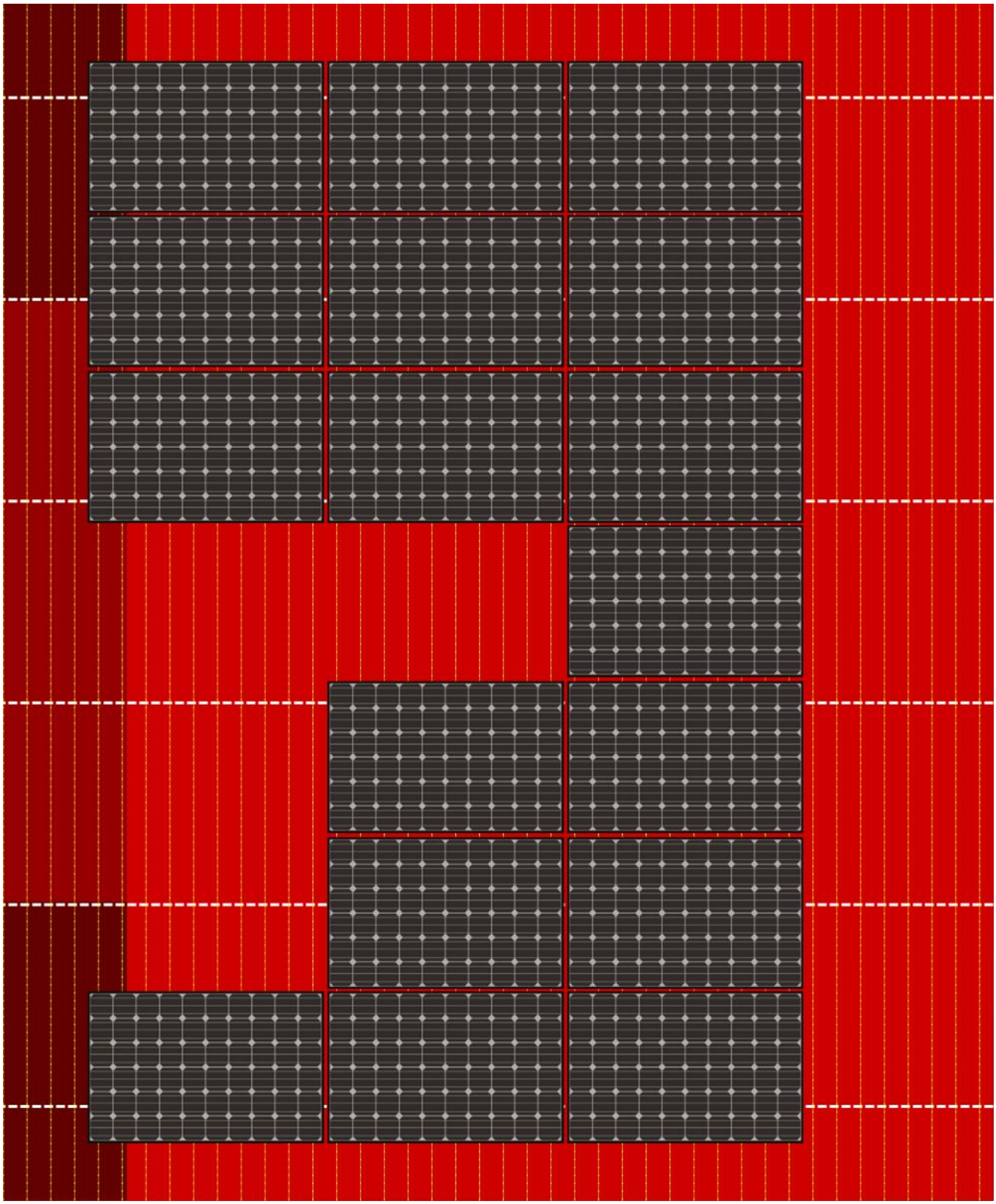
Allocated Roof Area	**33.97 m²**
Load on Allocated Area	**74.26 kN**
Max. Pressure (design):	**0.75 kN/m²**
Max. Tension (design):	**-3.95 kN/m²**
Total System weight	**425.43 kg**
Pressure on allocated Area	**0.12 kN/m²**

MODULE LAYOUT PLAN [ROOF_10]

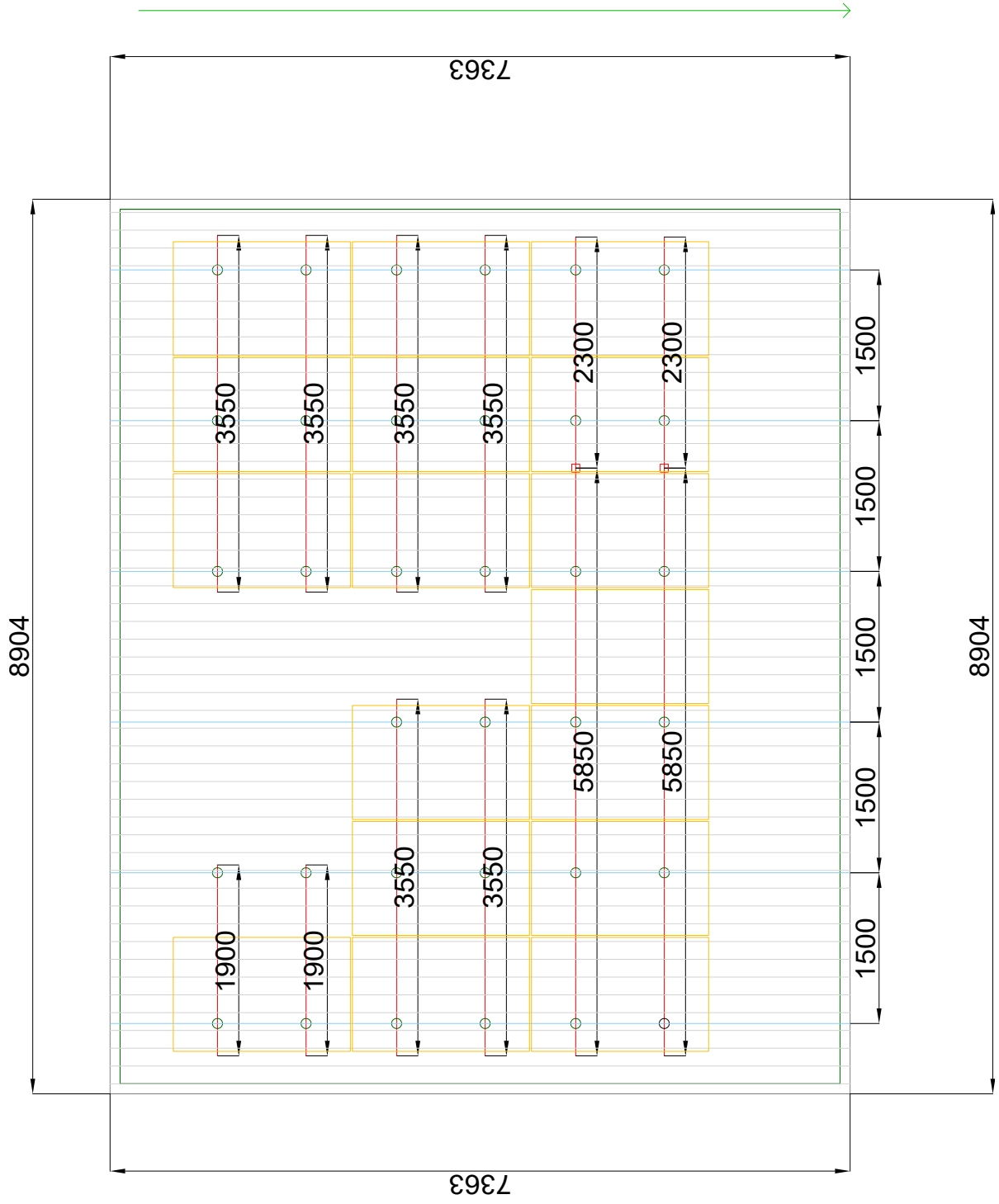
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



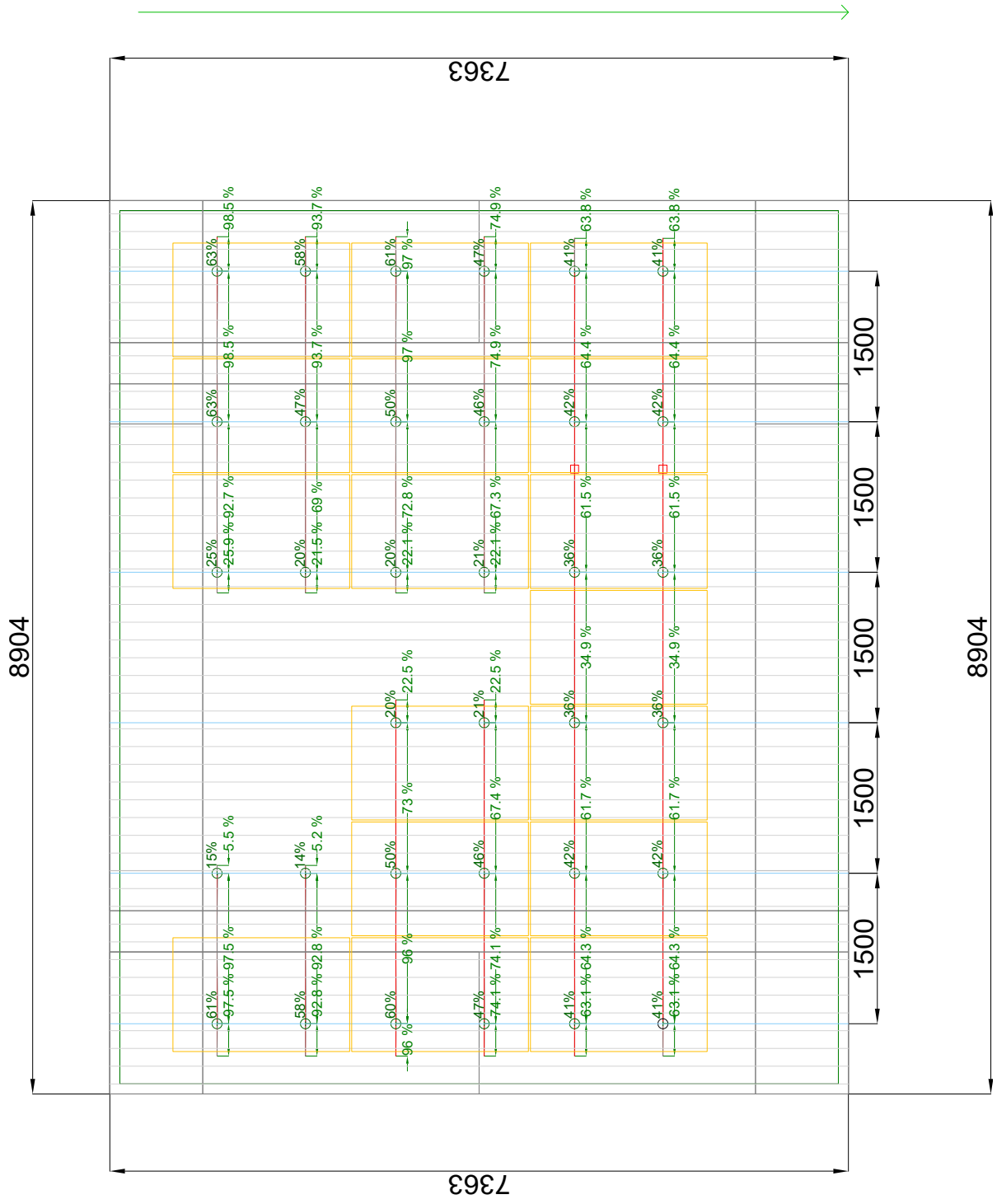
POSITION [ROOF_10]



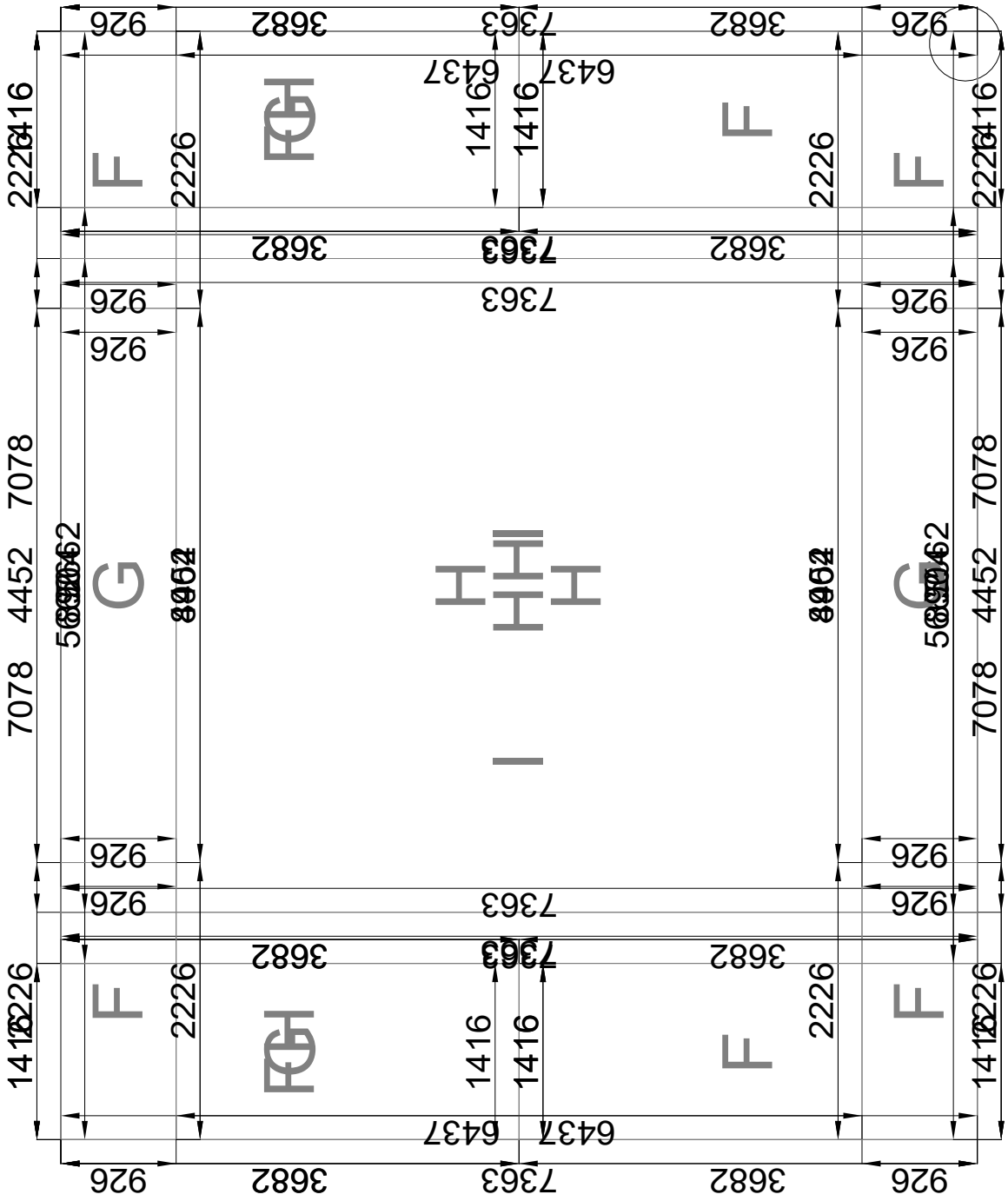
INSTALLATION-PLAN [ROOF_10]



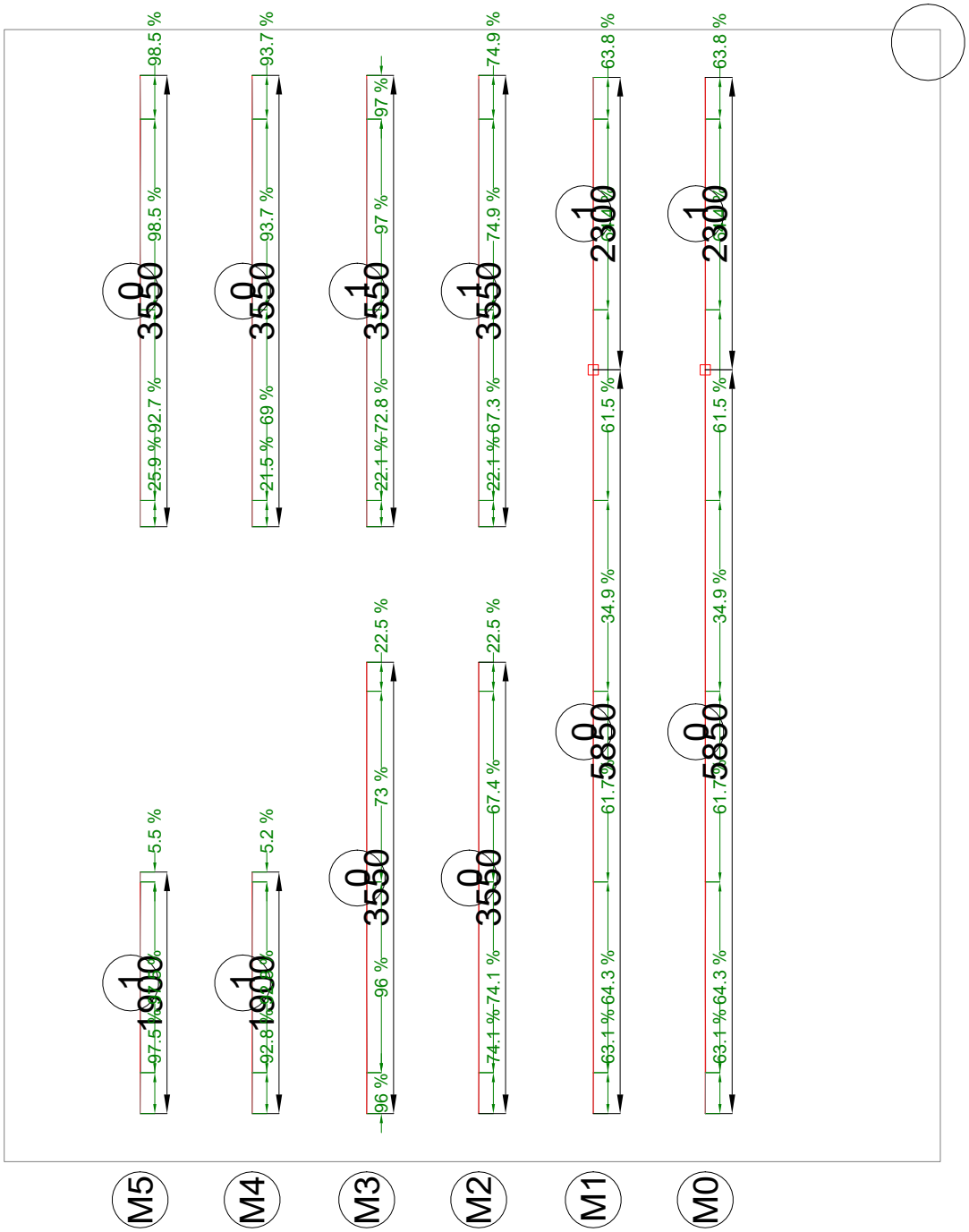
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_10]



STATIC INFORMATION: AREAS [ROOF_10]



RAIL CAPACITY [ROOF_10]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	16 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.15 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.14 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.041 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.22 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.062 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_10]

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.58**
Max. Suction	**2.76 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-2.76 kN/m²	0.037 kN/m²	2.76 kN/m²	180.77 °

AREA FH 90

Tributary area	**10 m²**
Cpe Suction	**-2.38**
Max. Suction	**4.23 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-4.23 kN/m²	0.037 kN/m²	4.23 kN/m²	180.5 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.873**
Max. Suction	**3.3 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-3.3 kN/m²	0.037 kN/m²	3.3 kN/m²	180.65 °

RESULTING SURFACE STRESSES [ROOF_10]

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.813**
Max. Suction	**1.36 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.36 kN/m²	0.037 kN/m²	1.36 kN/m²	181.57 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.707**
Max. Suction	**1.16 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.16 kN/m²	0.037 kN/m²	1.16 kN/m²	181.83 °

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.293**
Max. Suction	**0.41 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.77 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.75 kN/m²	0.15 kN/m²	0.77 kN/m²	11.18 °
LC 2	0.75 kN/m²	0.1 kN/m²	0.75 kN/m²	7.8 °
LC 3	-0.41 kN/m²	0.037 kN/m²	0.41 kN/m²	185.22 °

RESULTING SURFACE STRESSES [ROOF_10]

AREA F 180

Tributary area	**10 m²**
Cpe Suction	**-2.407**
Max. Suction	**4.27 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-4.27 kN/m²	0.037 kN/m²	4.27 kN/m²	180.5 °

AREA G 180

Tributary area	**10 m²**
Cpe Suction	**-1.267**
Max. Suction	**2.19 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-2.19 kN/m²	0.037 kN/m²	2.19 kN/m²	180.97 °

AREA H 180

Tributary area	**10 m²**
Cpe Suction	**-0.893**
Max. Suction	**1.51 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

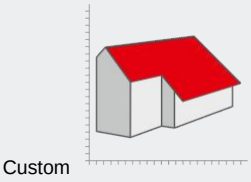
LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.5 kN/m²	0.037 kN/m²	1.51 kN/m²	181.42 °

MATERIAL LIST [ROOF_10]

Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**17**	0.034
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**9**	**9**	47.475
	705225	XPCN60 rail connector X60	1	**2**	**2**	0.342
	705226	XCL60 side-lid left for rail X60	1	**10**	**10**	0.050
	705227	XCR60 side-lid right for rail X60	1	**10**	**10**	0.050
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**34**	**34**	17.374
	706457	CLP-R cable clip rail	1	**150**	**17**	0.068
	707003	CLE10 End clamp Click 30-46	1	**20**	**20**	1.500
	707011	CLM10 Middle clamp Click 30-46	1	**30**	**24**	1.536
						68.43

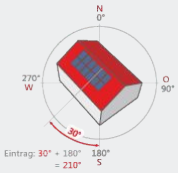
ROOF [ROOF_11]

Building height h [mm]	**10000**
Slope of roof [°]	**16**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**278.02**



Custom

System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

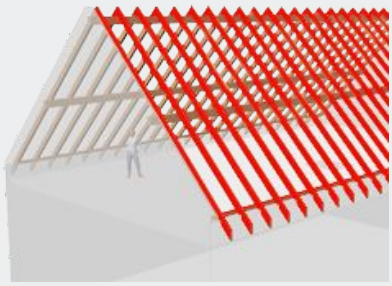
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**16**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

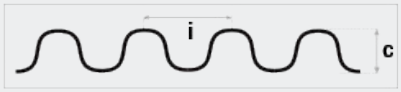
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

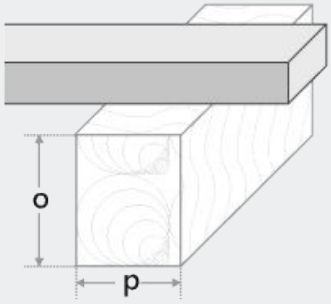
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_11]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**600**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





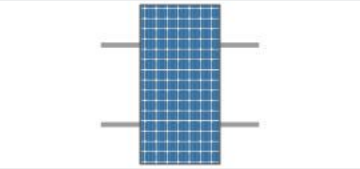


PV-MODULE [ROOF_11]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_11]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**12**
Max. Utilization of fixation points	**47 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_11]

Module rail	**Rail X60**
Max. utilization Module Profile	**91.93 %**

CLAMPS [ROOF_11]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**72.05 %**

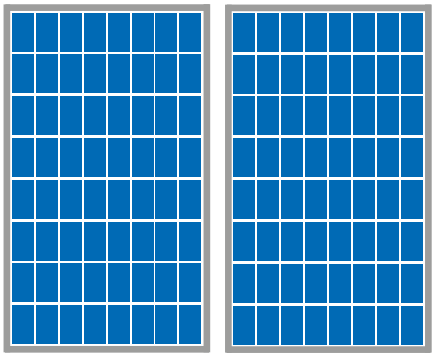
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_11]

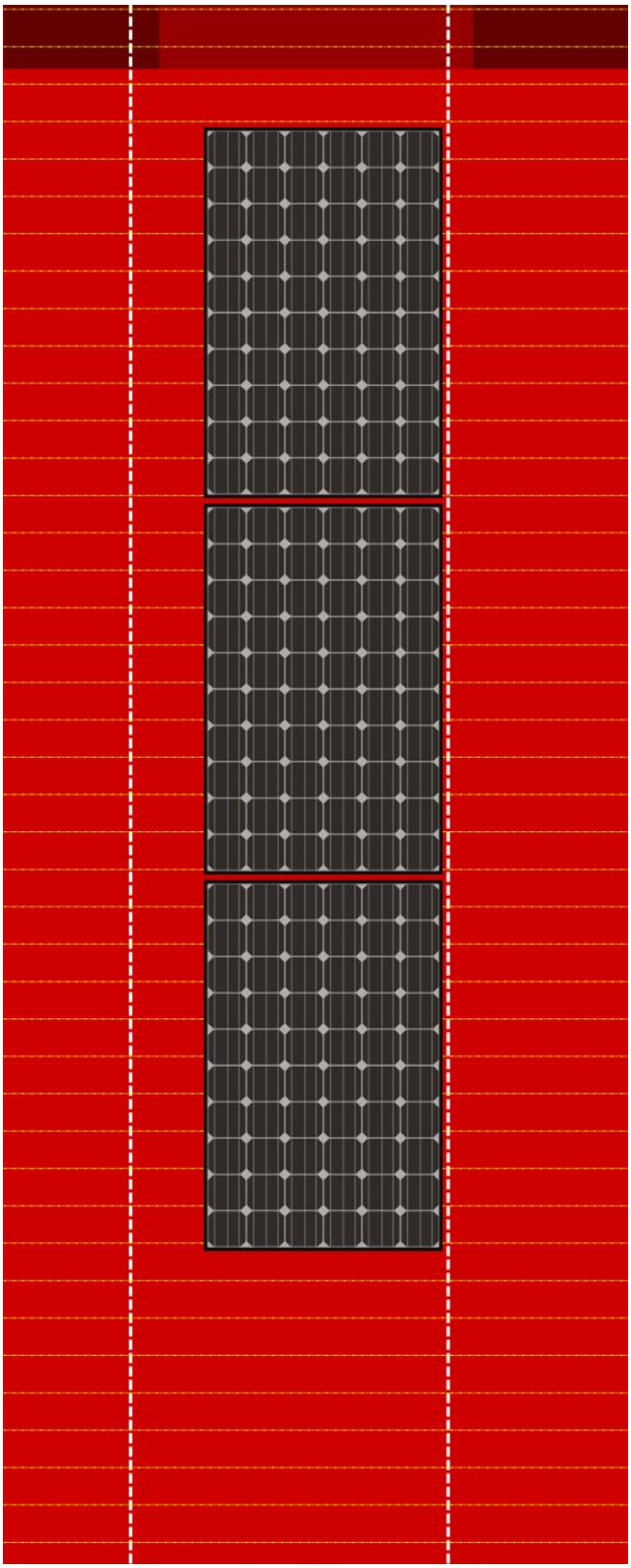
Allocated Roof Area	**5.99 m²**
Load on Allocated Area	**21.78 kN**
Max. Pressure (design):	**0.75 kN/m²**
Max. Tension (design):	**-4.14 kN/m²**
Total System weight	**80.66 kg**
Pressure on allocated Area	**0.13 kN/m²**

MODULE LAYOUT PLAN [ROOF_11]

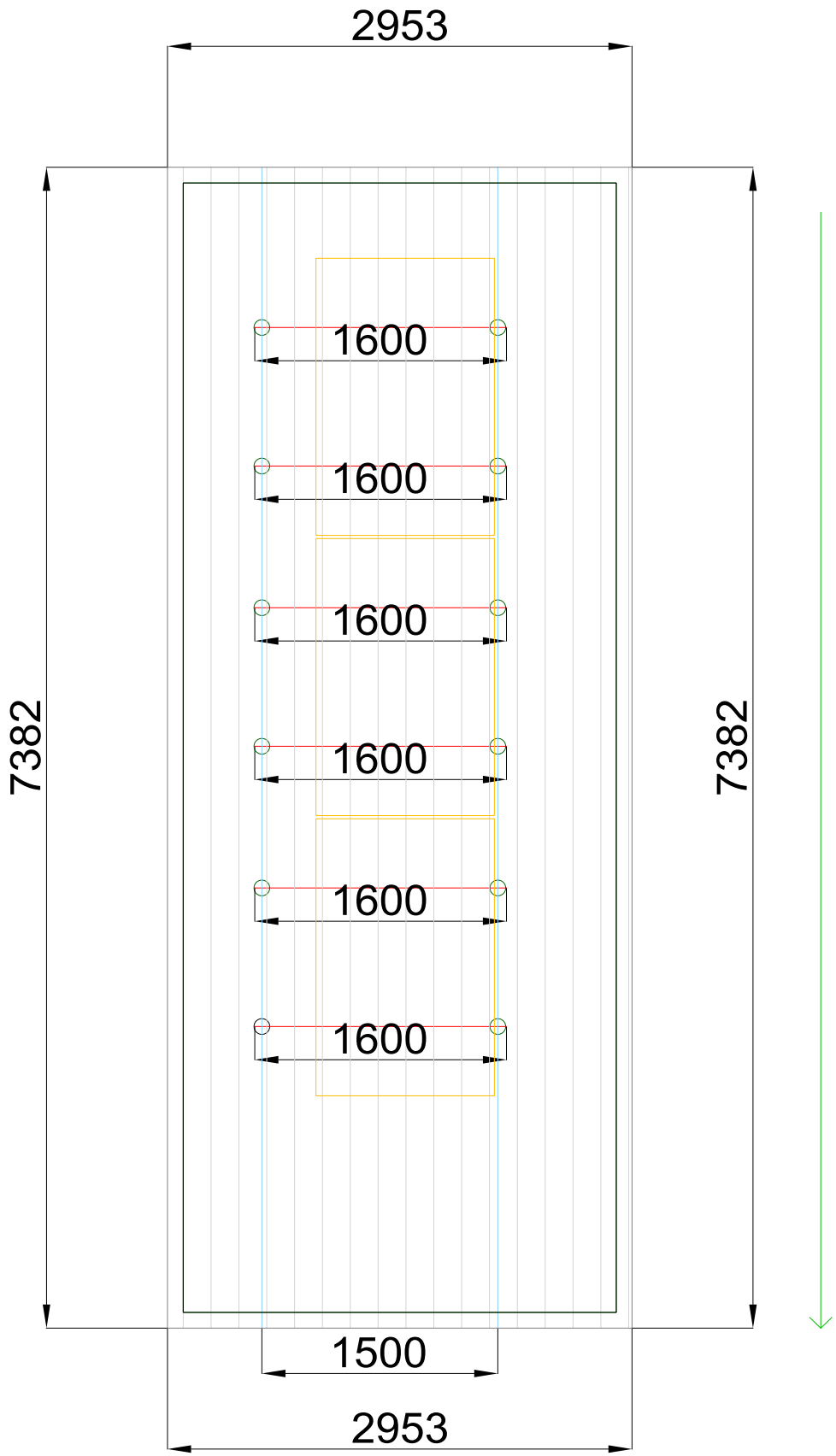
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



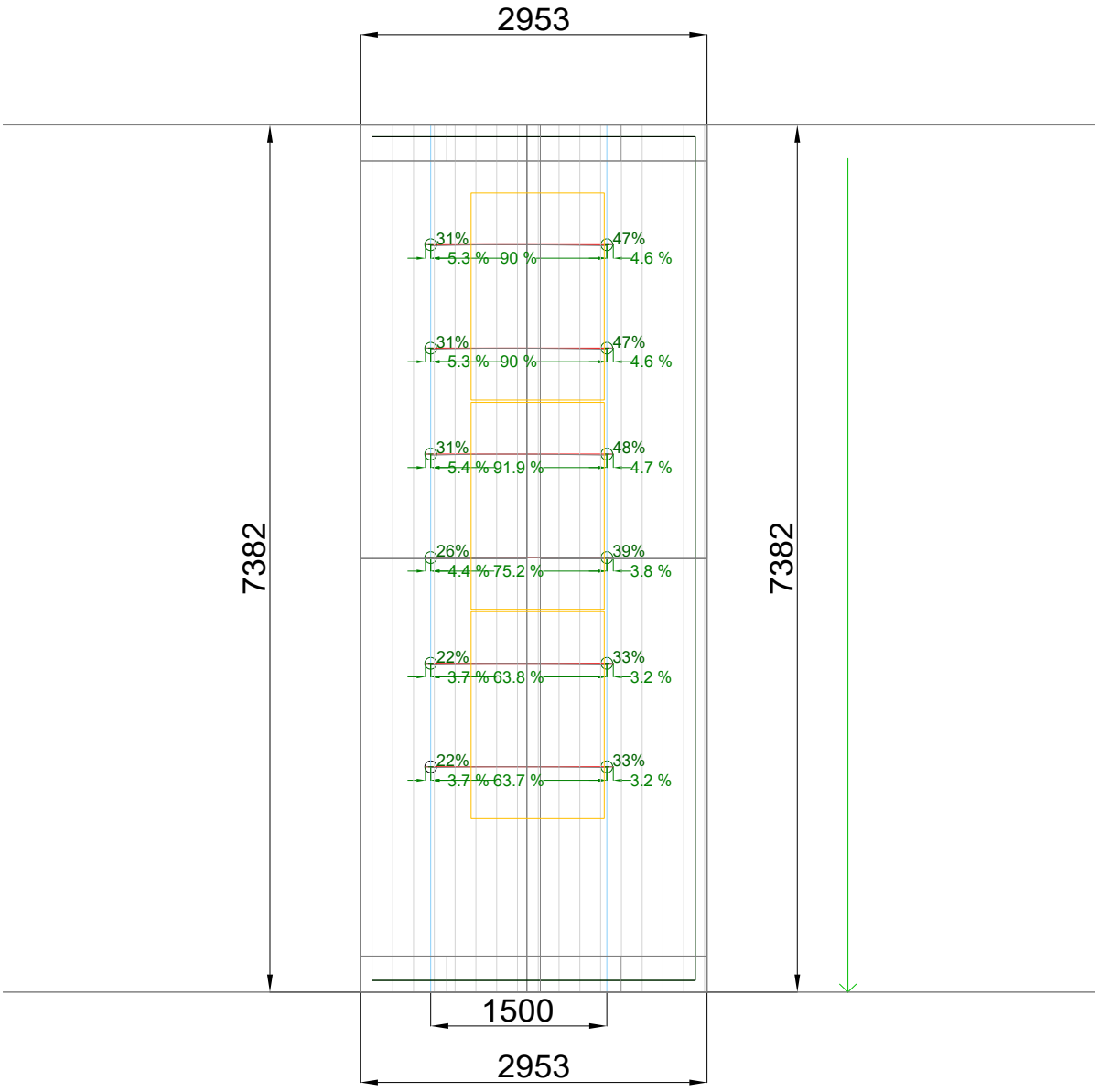
POSITION [ROOF_11]



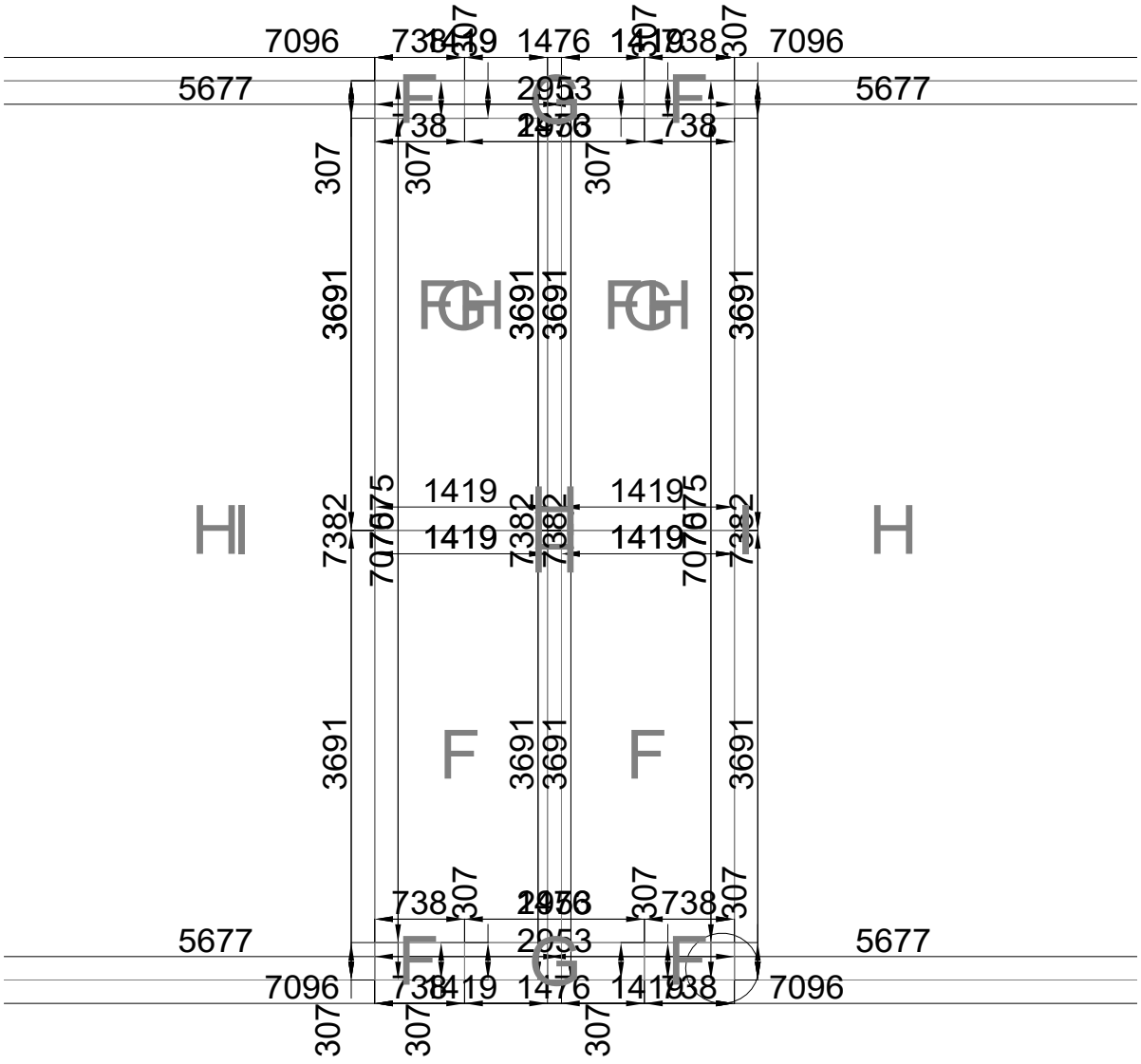
INSTALLATION-PLAN [ROOF_11]



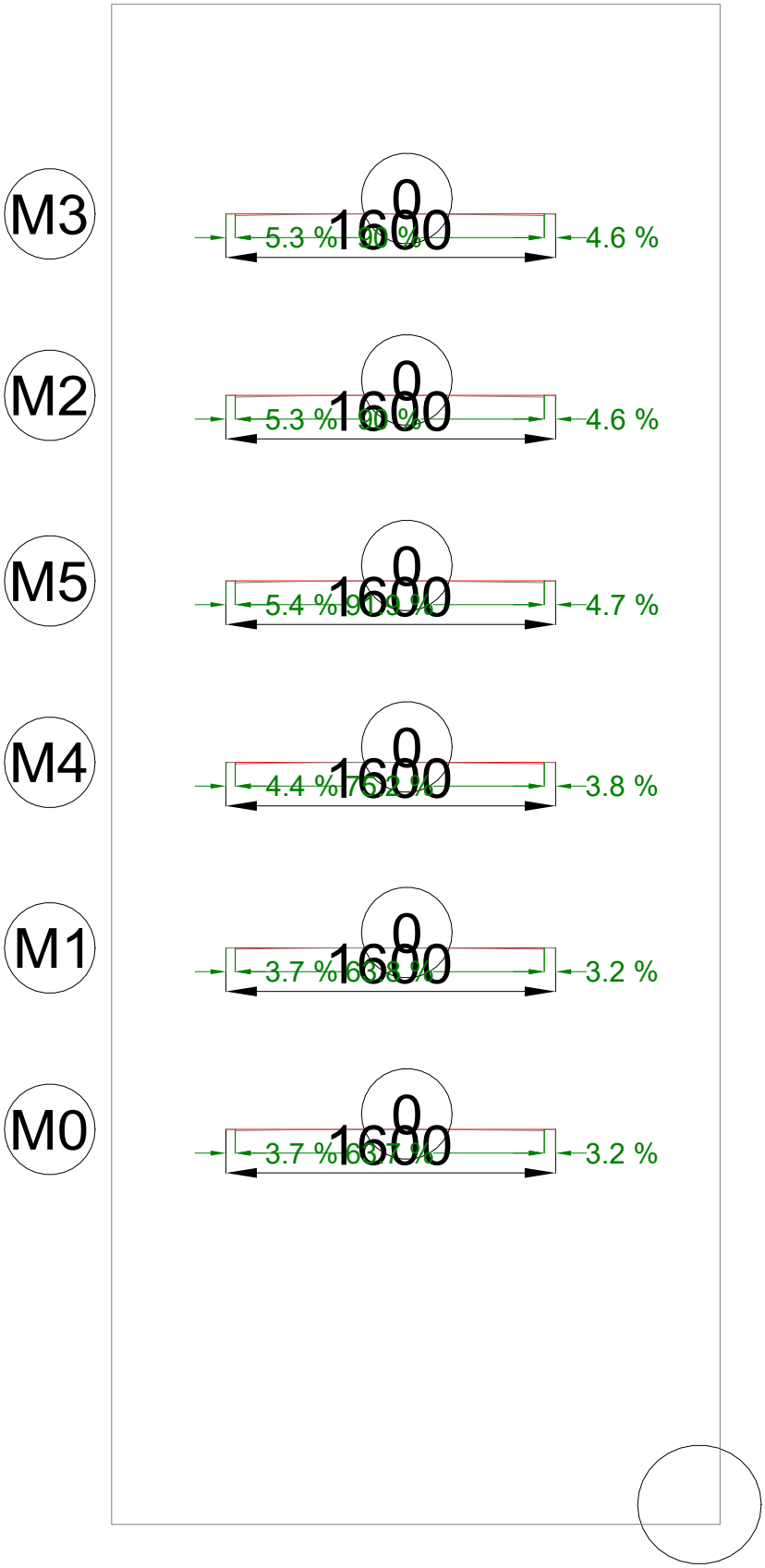
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_11]



STATIC INFORMATION: AREAS [ROOF_11]



RAIL CAPACITY [ROOF_11]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	16 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.15 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.14 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.041 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.22 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.062 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_11]

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.58**
Max. Suction	**2.76 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-2.76 kN/m²	0.037 kN/m²	2.76 kN/m²	180.77 °

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.58**
Max. Suction	**2.76 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-2.76 kN/m²	0.037 kN/m²	2.76 kN/m²	180.77 °

AREA FH 90

Tributary area	**10 m²**
Cpe Suction	**-2.38**
Max. Suction	**4.23 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-4.23 kN/m²	0.037 kN/m²	4.23 kN/m²	180.5 °

RESULTING SURFACE STRESSES [ROOF_11]

AREA FH 90

Tributary area	**10 m²**
Cpe Suction	**-2.38**
Max. Suction	**4.23 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-4.23 kN/m²	0.037 kN/m²	4.23 kN/m²	180.5 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.873**
Max. Suction	**3.3 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-3.3 kN/m²	0.037 kN/m²	3.3 kN/m²	180.65 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.873**
Max. Suction	**3.3 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-3.3 kN/m²	0.037 kN/m²	3.3 kN/m²	180.65 °

RESULTING SURFACE STRESSES [ROOF_11]

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.813**
Max. Suction	**1.36 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.36 kN/m²	0.037 kN/m²	1.36 kN/m²	181.57 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.707**
Max. Suction	**1.16 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.16 kN/m²	0.037 kN/m²	1.16 kN/m²	181.83 °

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.813**
Max. Suction	**1.36 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.36 kN/m²	0.037 kN/m²	1.36 kN/m²	181.57 °

RESULTING SURFACE STRESSES [ROOF_11]

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.707**
Max. Suction	**1.16 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.16 kN/m²	0.037 kN/m²	1.16 kN/m²	181.83 °

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.293**
Max. Suction	**0.41 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.77 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.75 kN/m²	0.15 kN/m²	0.77 kN/m²	11.18 °
LC 2	0.75 kN/m²	0.1 kN/m²	0.75 kN/m²	7.8 °
LC 3	-0.41 kN/m²	0.037 kN/m²	0.41 kN/m²	185.22 °

AREA H 180

Tributary area	**10 m²**
Cpe Suction	**-0.893**
Max. Suction	**1.51 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

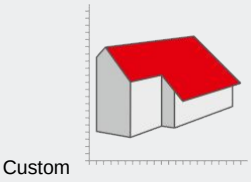
LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.5 kN/m²	0.037 kN/m²	1.51 kN/m²	181.42 °

MATERIAL LIST [ROOF_11]

Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**3**	0.006
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**2**	**2**	10.550
	705226	XCL60 side-lid left for rail X60	1	**6**	**6**	0.030
	705227	XCR60 side-lid right for rail X60	1	**6**	**6**	0.030
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**12**	**12**	6.132
	706457	CLP-R cable clip rail	1	**150**	**3**	0.012
	707003	CLE10 End clamp Click 30-46	1	**20**	**12**	0.900
						17.66

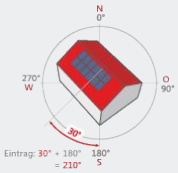
ROOF [ROOF_12]

Building height h [mm]	**10000**
Slope of roof [°]	**16**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**278.02**



Custom

System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

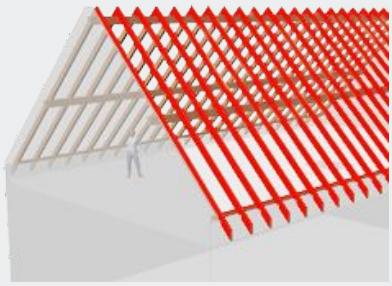
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**16**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

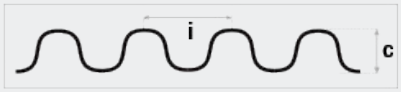
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

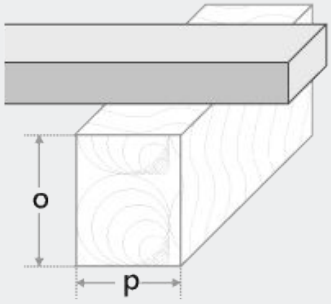
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_12]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**200**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





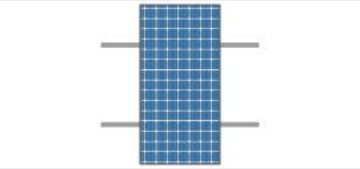


PV-MODULE [ROOF_12]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_12]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**34**
Max. Utilization of fixation points	**36 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_12]

Module rail	**Rail X60**
Max. utilization Module Profile	**53.81 %**

CLAMPS [ROOF_12]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**34.14 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**43.34 %**

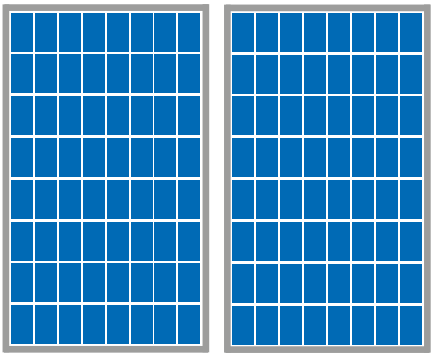
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_12]

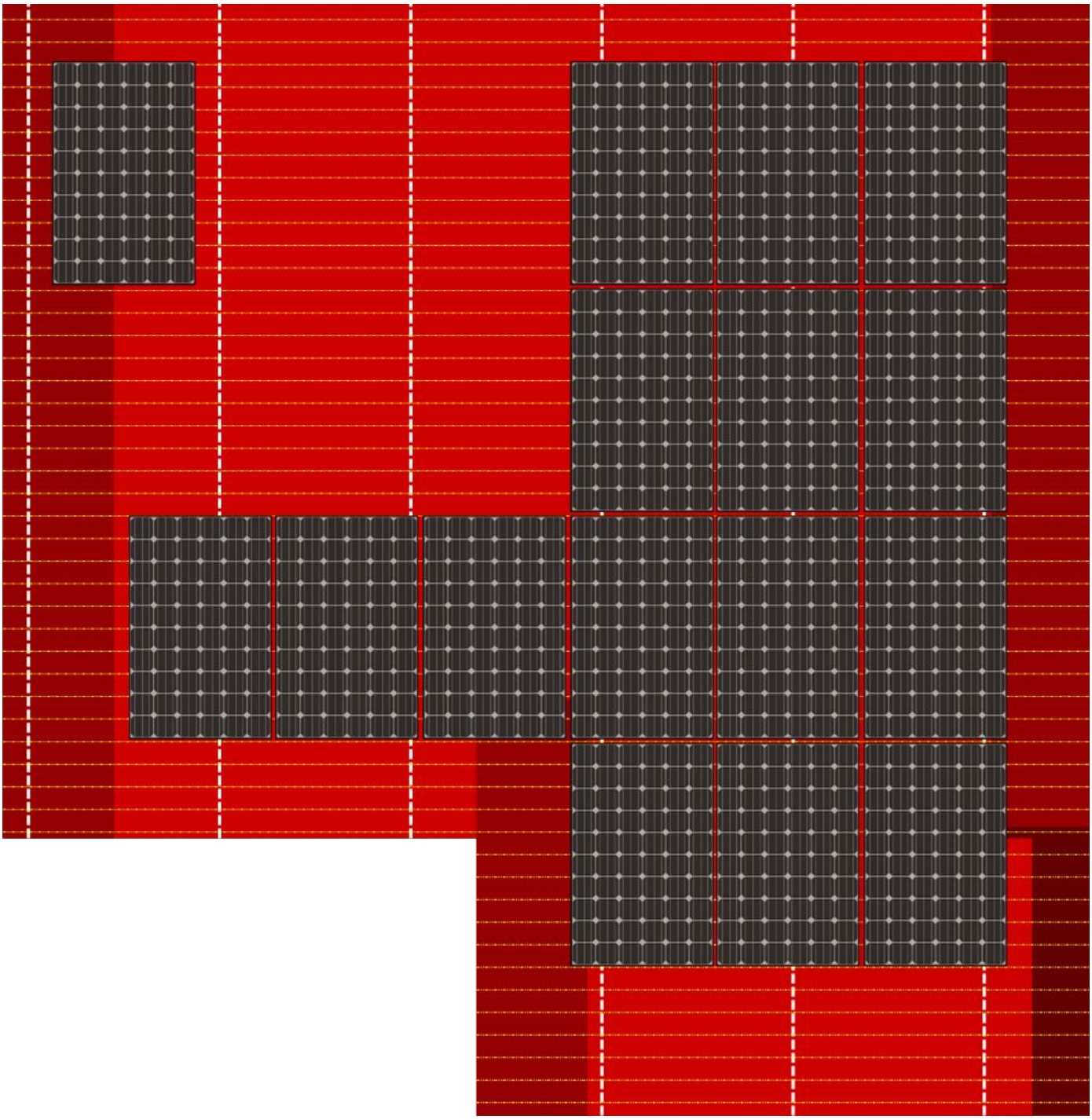
Allocated Roof Area	**31.97 m²**
Load on Allocated Area	**38.17 kN**
Max. Pressure (design):	**0.71 kN/m²**
Max. Tension (design):	**-2.42 kN/m²**
Total System weight	**399.02 kg**
Pressure on allocated Area	**0.12 kN/m²**

MODULE LAYOUT PLAN [ROOF_12]

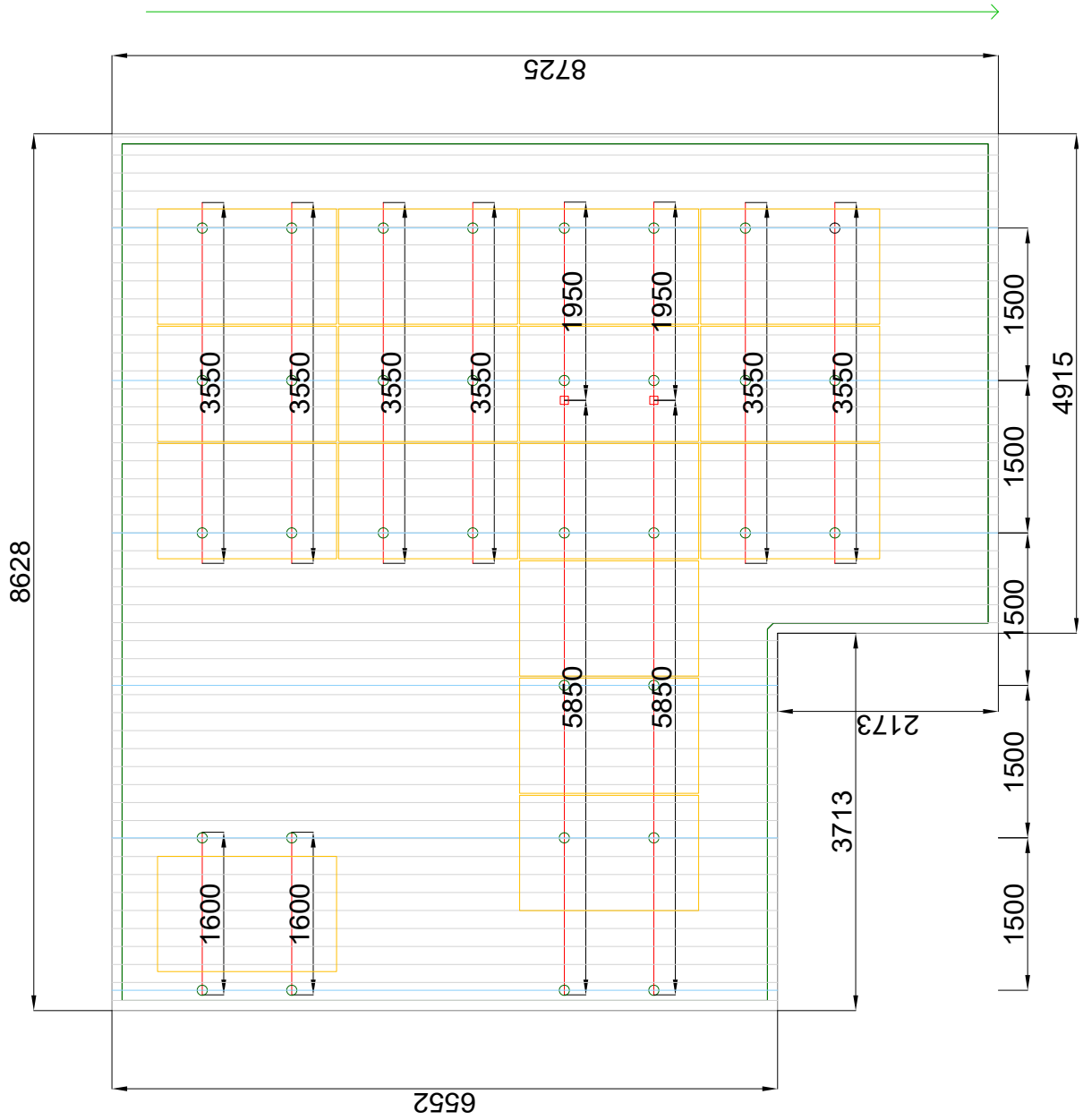
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



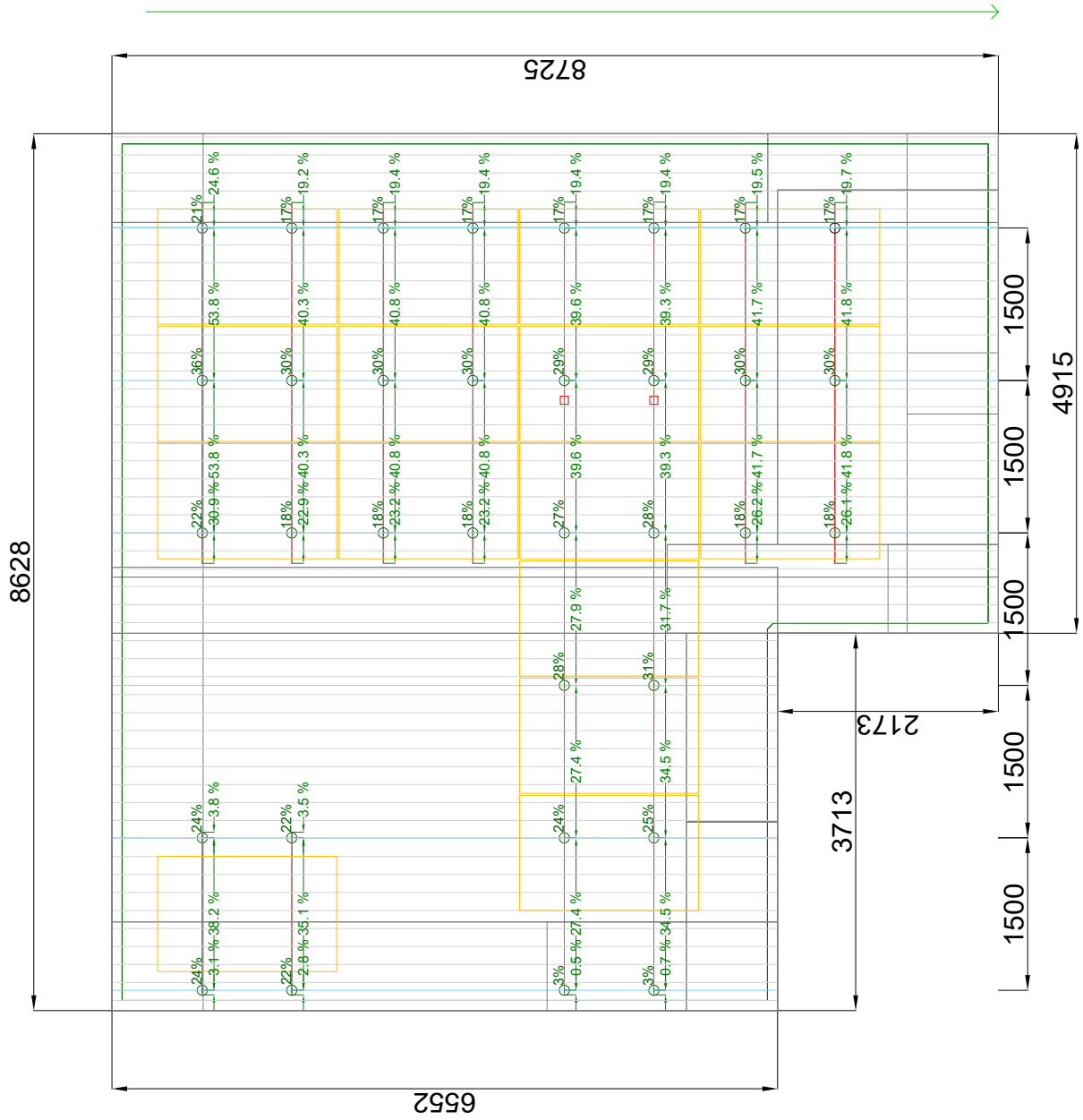
POSITION [ROOF_12]



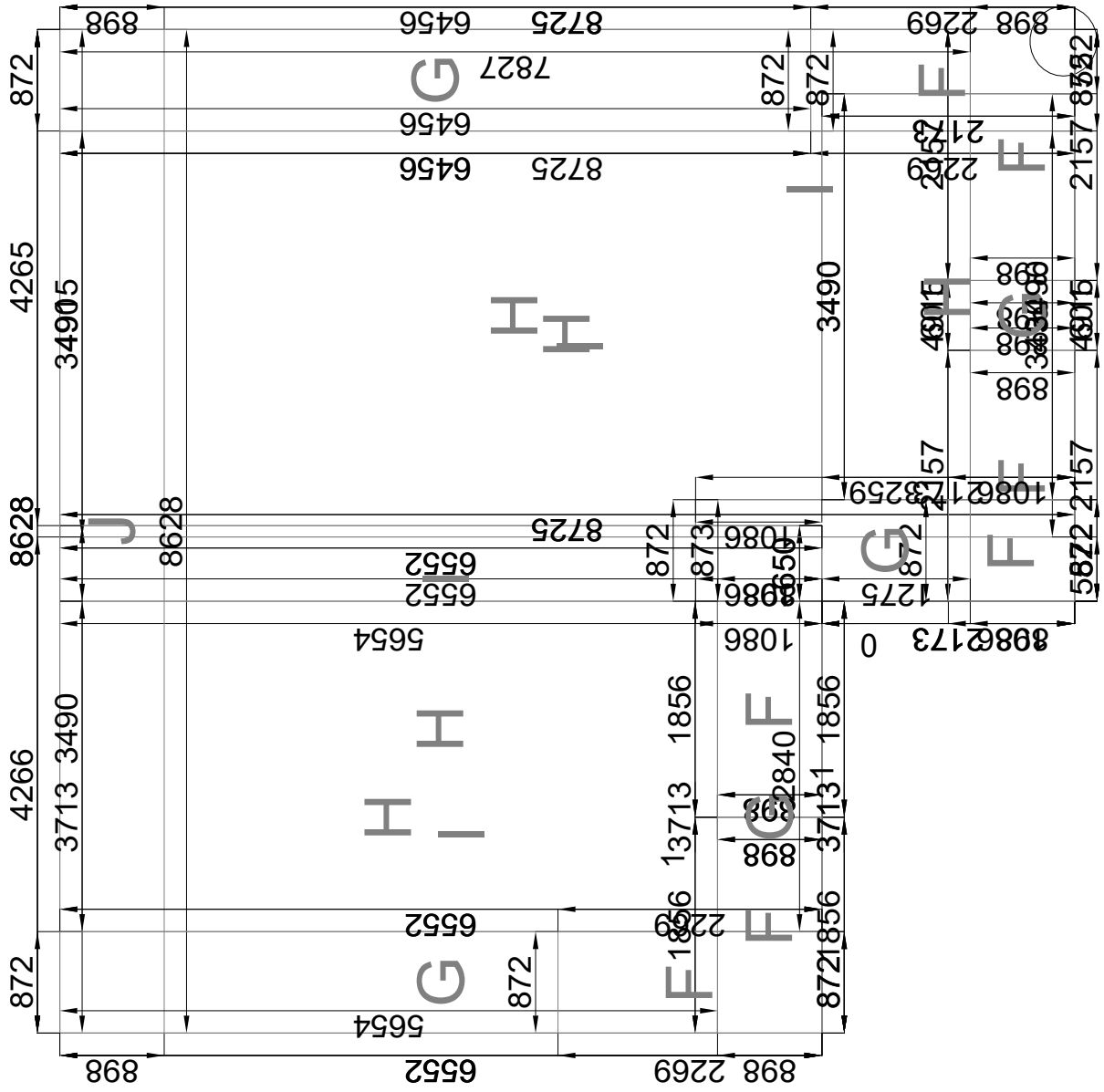
INSTALLATION-PLAN [ROOF_12]



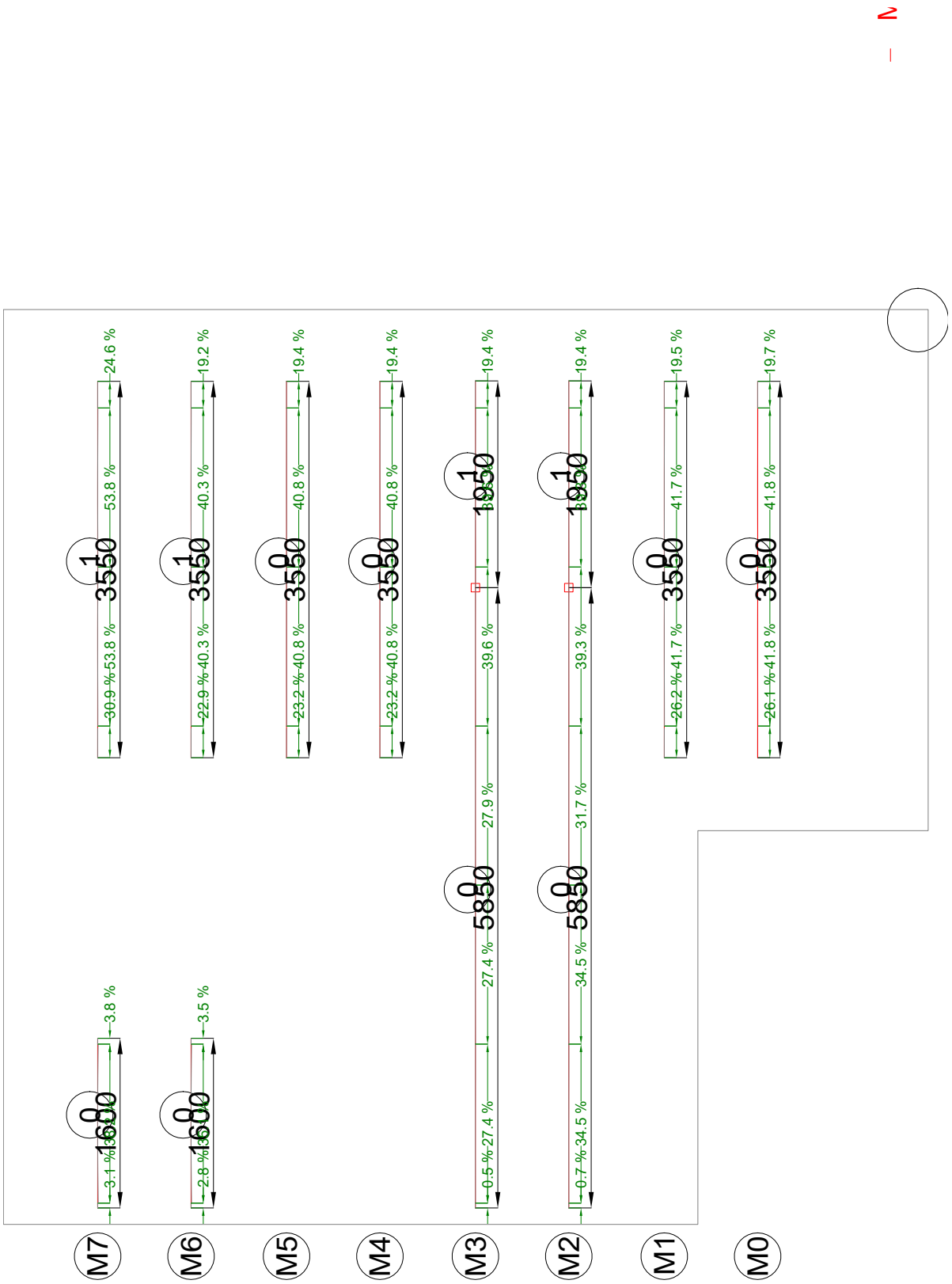
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_12]



STATIC INFORMATION: AREAS [ROOF_12]



RAIL CAPACITY [ROOF_12]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	16 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.12 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.11 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.032 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.22 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.062 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_12]

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.307**
Max. Suction	**0.46 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-0.46 kN/m²	0.029 kN/m²	0.46 kN/m²	183.64 °

AREA F 0

Tributary area	**10 m²**
Cpe Suction	**-0.873**
Max. Suction	**1.5 kN/m²**
Cpe Pressure	**0.233**
Max. downward load	**0.75 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.73 kN/m²	0.14 kN/m²	0.75 kN/m²	10.57 °
LC 2	0.74 kN/m²	0.09 kN/m²	0.75 kN/m²	6.94 °
LC 3	-1.5 kN/m²	0.029 kN/m²	1.5 kN/m²	181.12 °

AREA G 0

Tributary area	**10 m²**
Cpe Suction	**-0.78**
Max. Suction	**1.33 kN/m²**
Cpe Pressure	**0.233**
Max. downward load	**0.75 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.73 kN/m²	0.14 kN/m²	0.75 kN/m²	10.57 °
LC 2	0.74 kN/m²	0.09 kN/m²	0.75 kN/m²	6.94 °
LC 3	-1.33 kN/m²	0.029 kN/m²	1.33 kN/m²	181.26 °

RESULTING SURFACE STRESSES [ROOF_12]

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.307**
Max. Suction	**0.46 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-0.46 kN/m²	0.029 kN/m²	0.46 kN/m²	183.64 °

AREA J 180

Tributary area	**10 m²**
Cpe Suction	**-0.98**
Max. Suction	**1.69 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.69 kN/m²	0.029 kN/m²	1.69 kN/m²	180.99 °

AREA J 180

Tributary area	**10 m²**
Cpe Suction	**-0.98**
Max. Suction	**1.69 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.69 kN/m²	0.029 kN/m²	1.69 kN/m²	180.99 °

RESULTING SURFACE STRESSES [ROOF_12]

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.81 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-0.81 kN/m²	0.029 kN/m²	0.81 kN/m²	182.06 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.81 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-0.81 kN/m²	0.029 kN/m²	0.81 kN/m²	182.06 °

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.287**
Max. Suction	**2.25 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-2.25 kN/m²	0.029 kN/m²	2.25 kN/m²	180.74 °

RESULTING SURFACE STRESSES [ROOF_12]

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.213**
Max. Suction	**2.12 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-2.12 kN/m²	0.029 kN/m²	2.12 kN/m²	180.79 °

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.613**
Max. Suction	**1.02 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.02 kN/m²	0.029 kN/m²	1.02 kN/m²	181.64 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.213**
Max. Suction	**2.12 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-2.12 kN/m²	0.029 kN/m²	2.12 kN/m²	180.79 °

RESULTING SURFACE STRESSES [ROOF_12]

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.613**
Max. Suction	**1.02 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.02 kN/m²	0.029 kN/m²	1.02 kN/m²	181.64 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.81 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

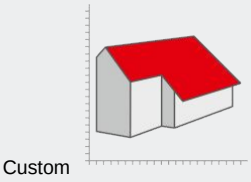
LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-0.81 kN/m²	0.029 kN/m²	0.81 kN/m²	182.06 °

MATERIAL LIST [ROOF_12]

Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**16**	0.032
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**8**	**8**	42.200
	705225	XPCN60 rail connector X60	1	**2**	**2**	0.342
	705226	XCL60 side-lid left for rail X60	1	**10**	**10**	0.050
	705227	XCR60 side-lid right for rail X60	1	**10**	**10**	0.050
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**34**	**34**	17.374
	706457	CLP-R cable clip rail	1	**150**	**16**	0.064
	707003	CLE10 End clamp Click 30-46	1	**20**	**20**	1.500
	707011	CLM10 Middle clamp Click 30-46	1	**30**	**22**	1.408
						63.02

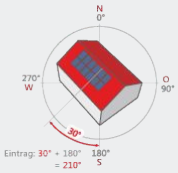
ROOF [ROOF_13]

Building height h [mm]	**10000**
Slope of roof [°]	**16**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**278.02**



Custom

System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

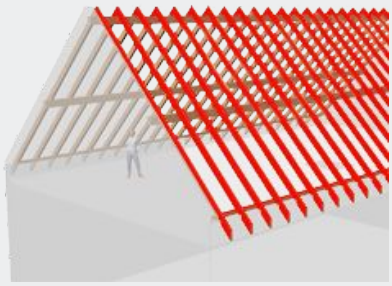
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**16**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

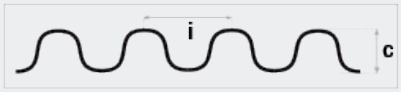
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

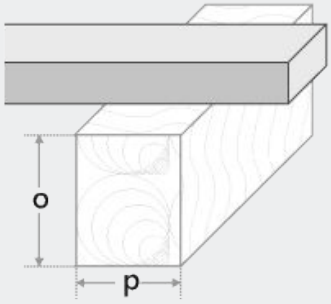
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_13]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**100**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





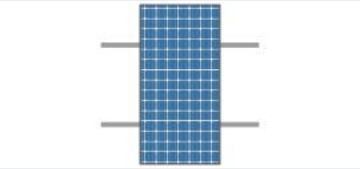


PV-MODULE [ROOF_13]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_13]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**38**
Max. Utilization of fixation points	**35 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_13]

Module rail	**Rail X60**
Max. utilization Module Profile	**67.54 %**

CLAMPS [ROOF_13]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**41.42 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**32.77 %**

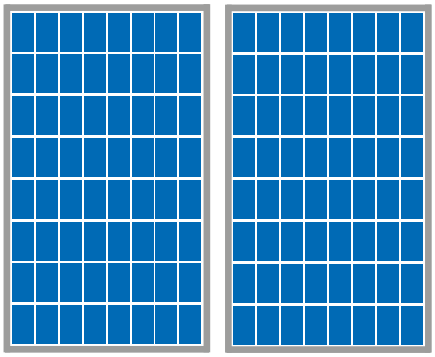
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_13]

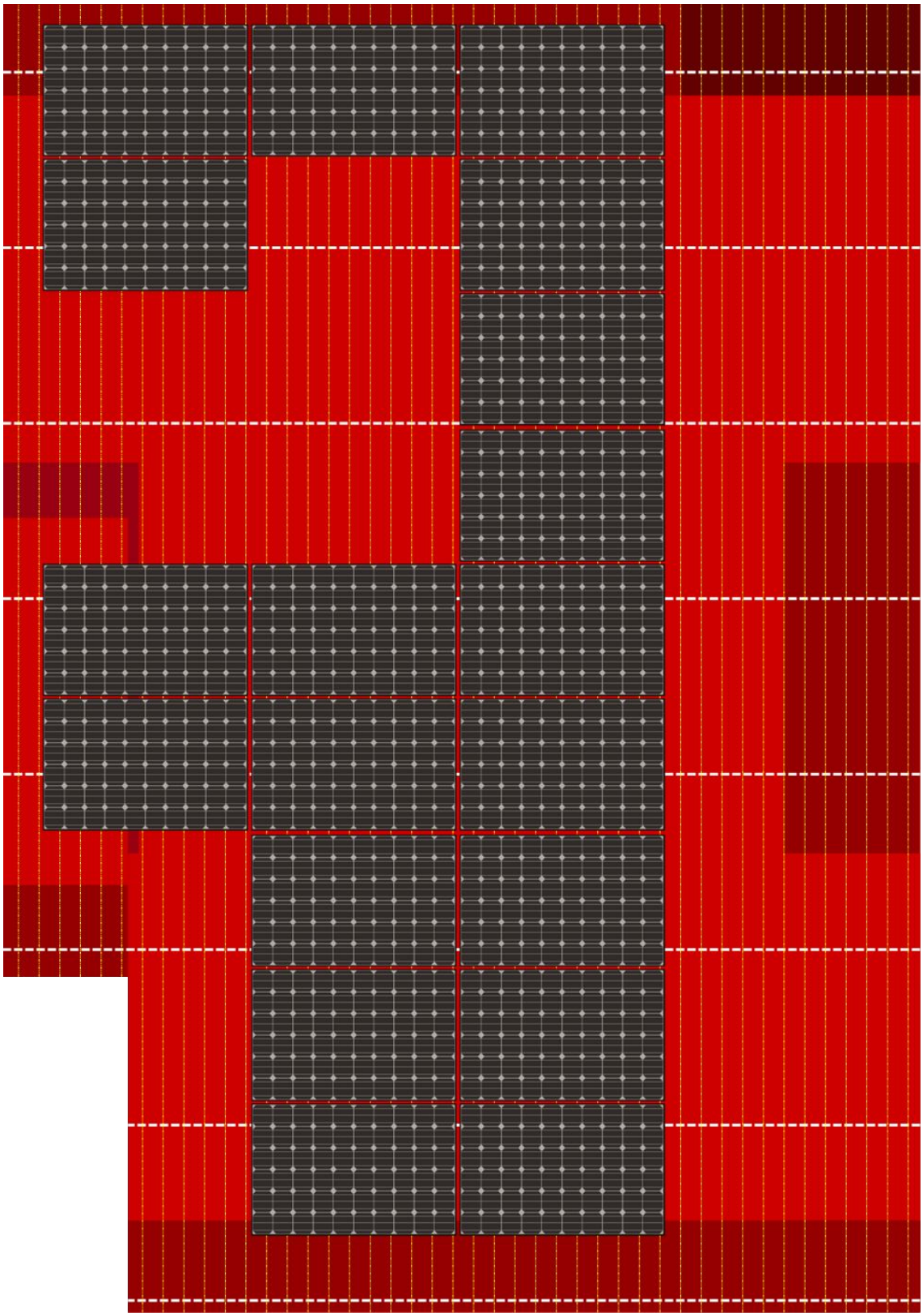
Allocated Roof Area	**37.96 m²**
Load on Allocated Area	**42.65 kN**
Max. Pressure (design):	**0.71 kN/m²**
Max. Tension (design):	**-1.76 kN/m²**
Total System weight	**475.36 kg**
Pressure on allocated Area	**0.12 kN/m²**

MODULE LAYOUT PLAN [ROOF_13]

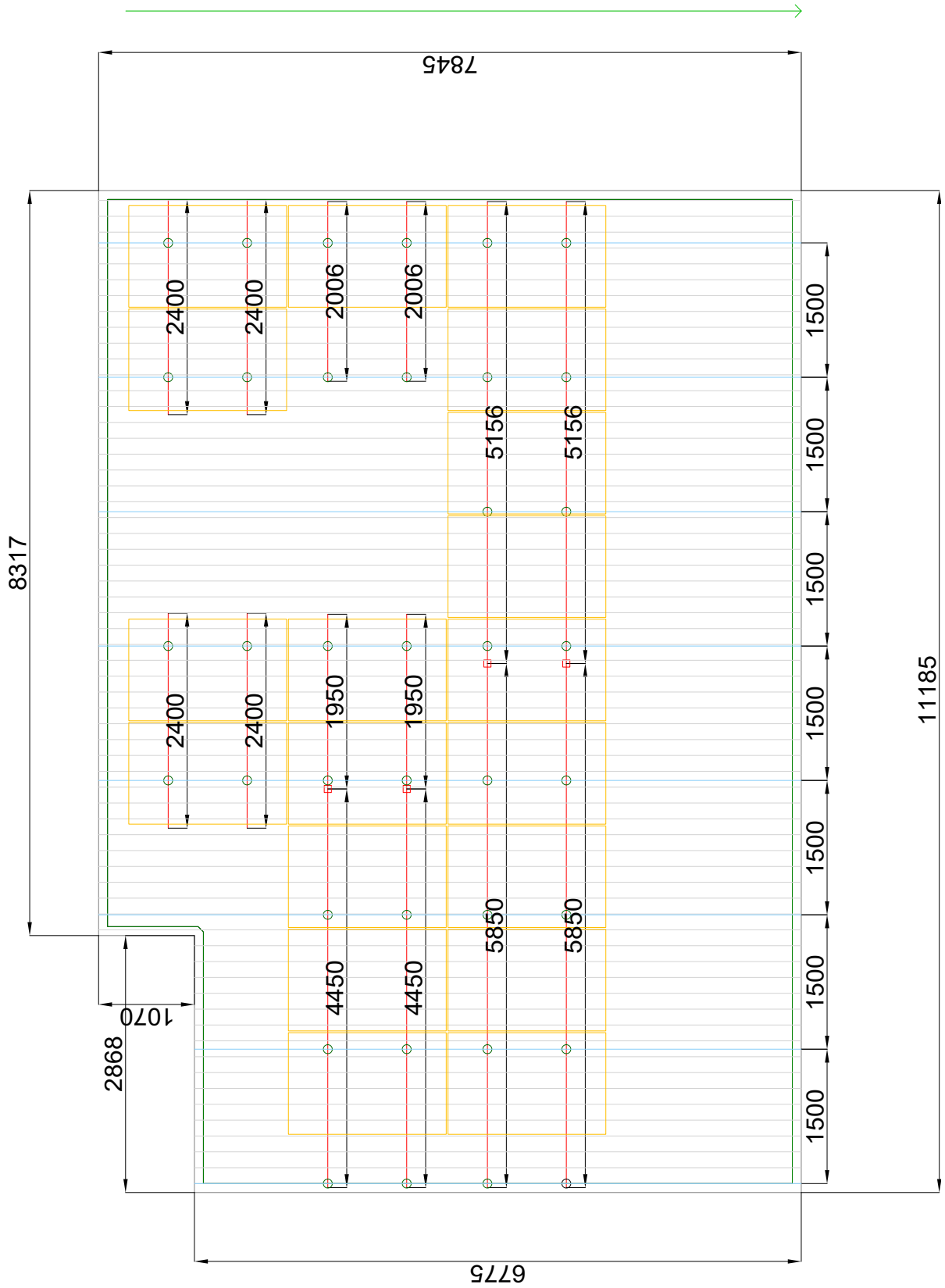
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



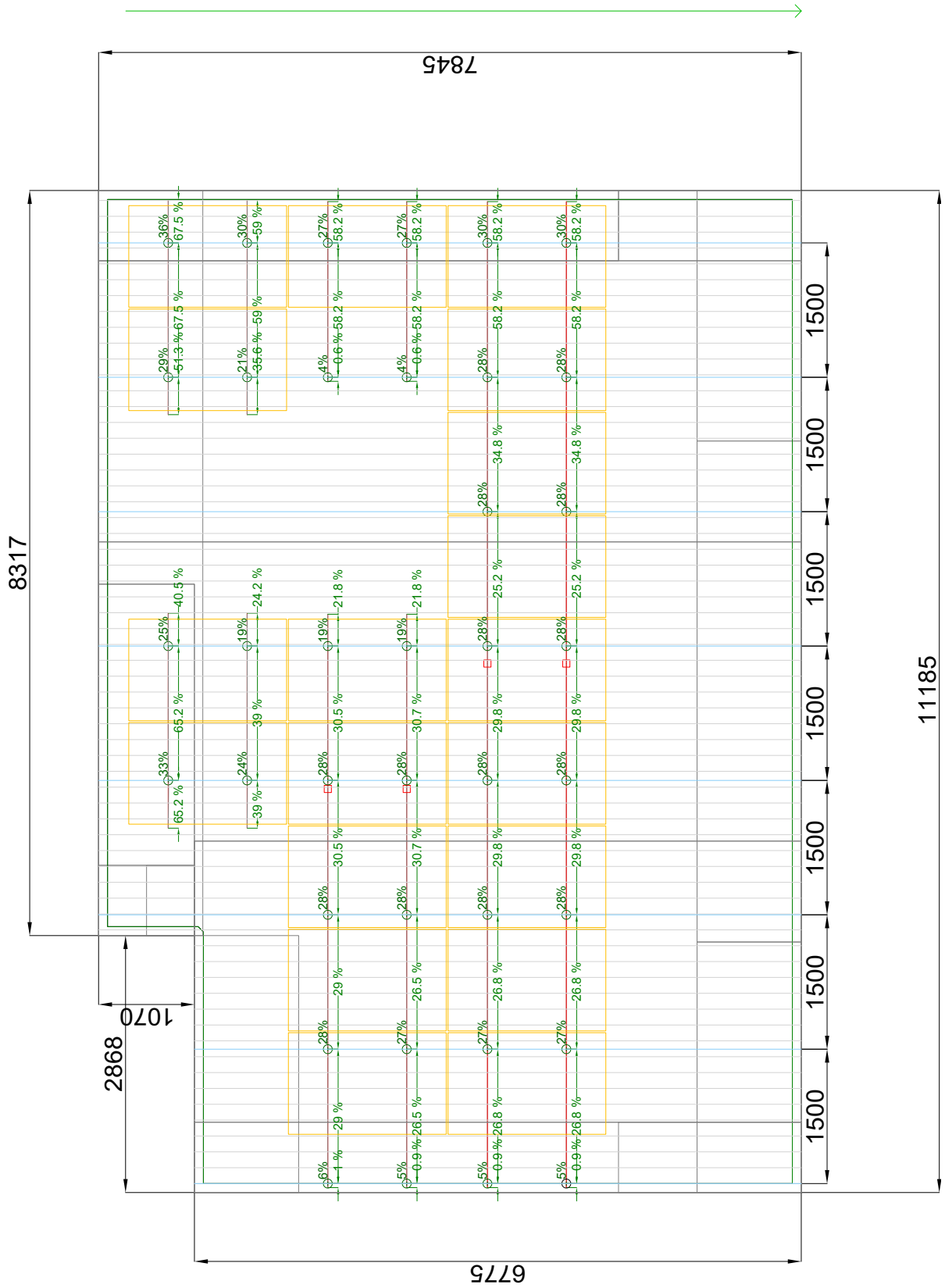
POSITION [ROOF_13]



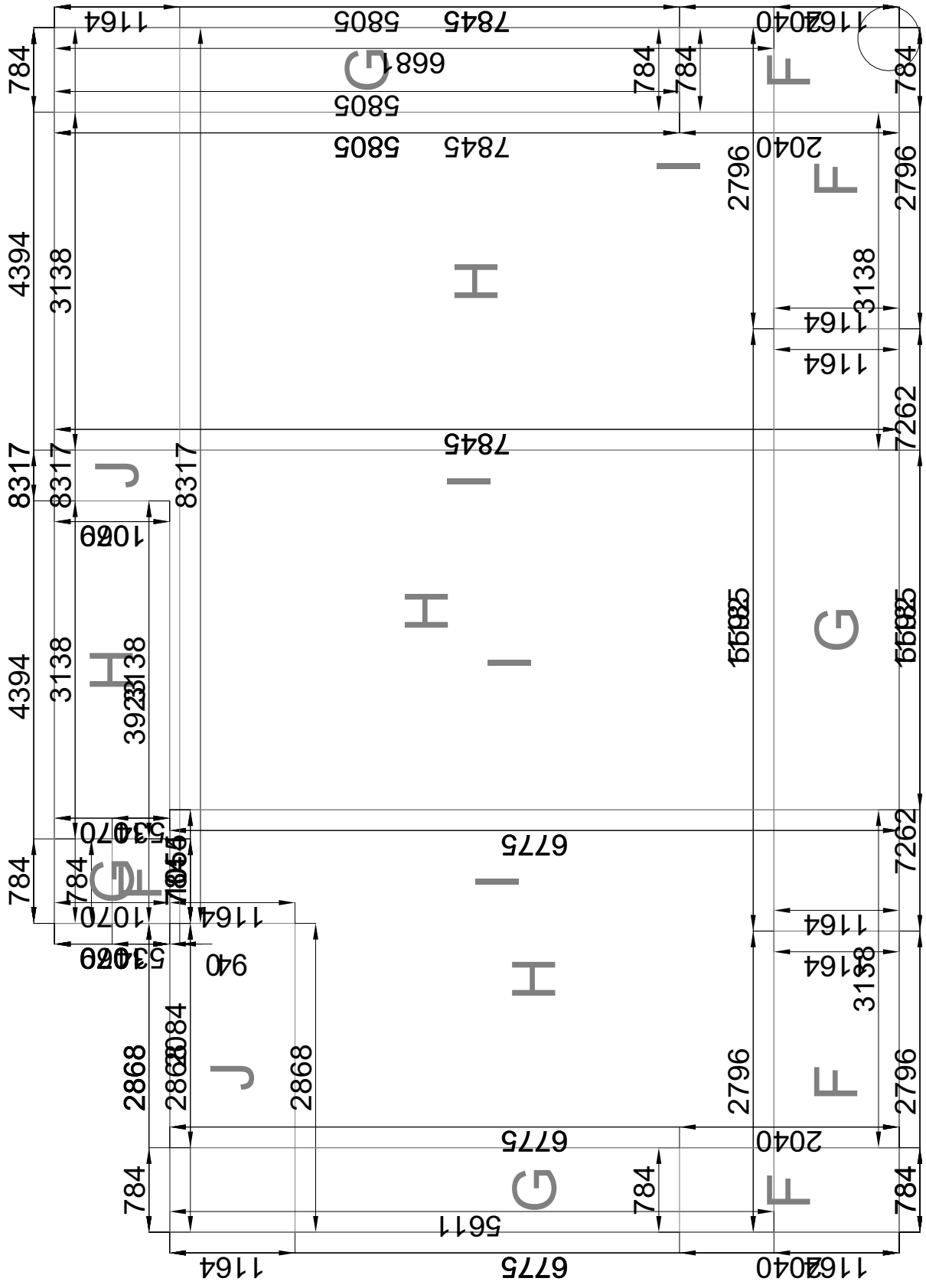
INSTALLATION-PLAN [ROOF_13]



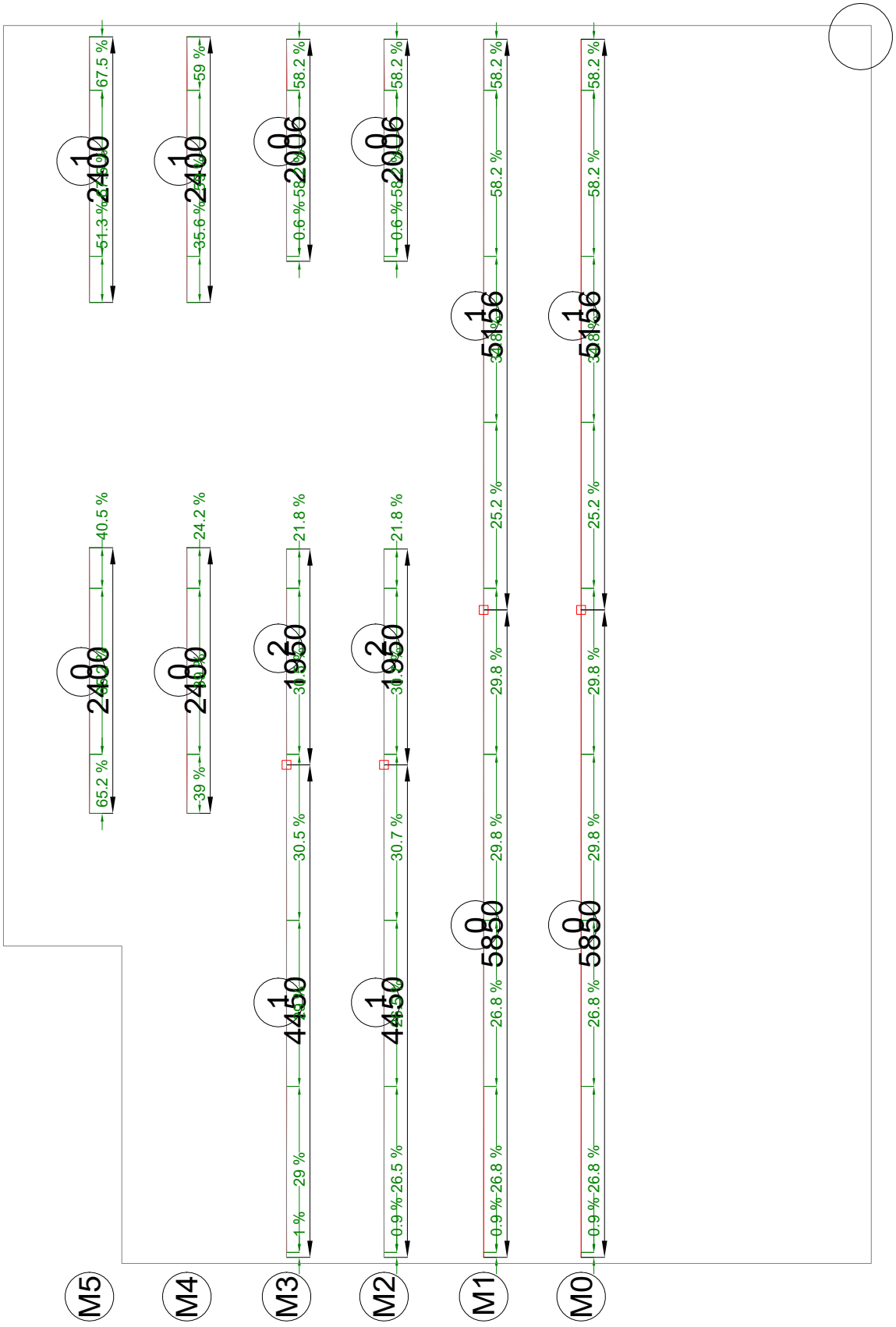
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_13]



STATIC INFORMATION: AREAS [ROOF_13]



RAIL CAPACITY [ROOF_13]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	16 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.12 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.11 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.032 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.22 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.062 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_13]

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.307**
Max. Suction	**0.46 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-0.46 kN/m²	0.029 kN/m²	0.46 kN/m²	183.64 °

AREA J 180

Tributary area	**10 m²**
Cpe Suction	**-0.98**
Max. Suction	**1.69 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.69 kN/m²	0.029 kN/m²	1.69 kN/m²	180.99 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.81 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-0.81 kN/m²	0.029 kN/m²	0.81 kN/m²	182.06 °

RESULTING SURFACE STRESSES [ROOF_13]

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.213**
Max. Suction	**2.12 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-2.12 kN/m²	0.029 kN/m²	2.12 kN/m²	180.79 °

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.613**
Max. Suction	**1.02 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

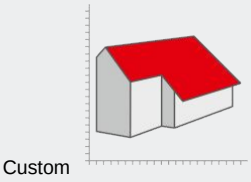
LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.02 kN/m²	0.029 kN/m²	1.02 kN/m²	181.64 °

MATERIAL LIST [ROOF_13]

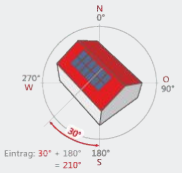
Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**19**	0.038
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**10**	**10**	52.750
	705225	XPCN60 rail connector X60	1	**4**	**4**	0.684
	705226	XCL60 side-lid left for rail X60	1	**10**	**10**	0.050
	705227	XCR60 side-lid right for rail X60	1	**10**	**10**	0.050
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**38**	**38**	19.418
	706457	CLP-R cable clip rail	1	**150**	**19**	0.076
	707003	CLE10 End clamp Click 30-46	1	**20**	**20**	1.500
	707011	CLM10 Middle clamp Click 30-46	1	**30**	**28**	1.792
						76.36

ROOF [ROOF_14]

Building height h [mm]	**10000**
Slope of roof [°]	**21**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**312.38**



System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

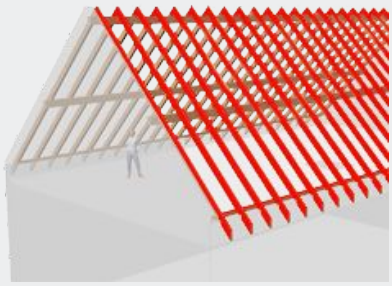
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**21**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

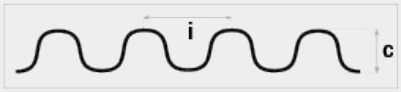
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

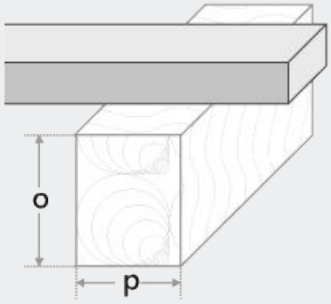
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_14]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**602**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





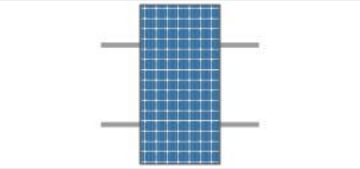


PV-MODULE [ROOF_14]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_14]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**20**
Max. Utilization of fixation points	**38 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_14]

Module rail	**Rail X60**
Max. utilization Module Profile	**46.8 %**

CLAMPS [ROOF_14]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**34.62 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**26.14 %**

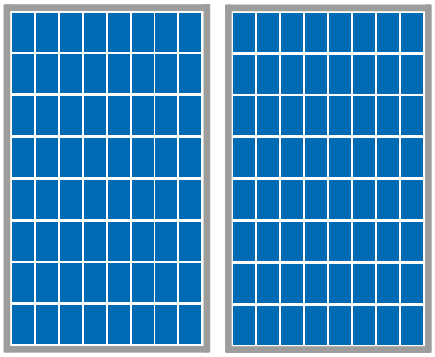
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_14]

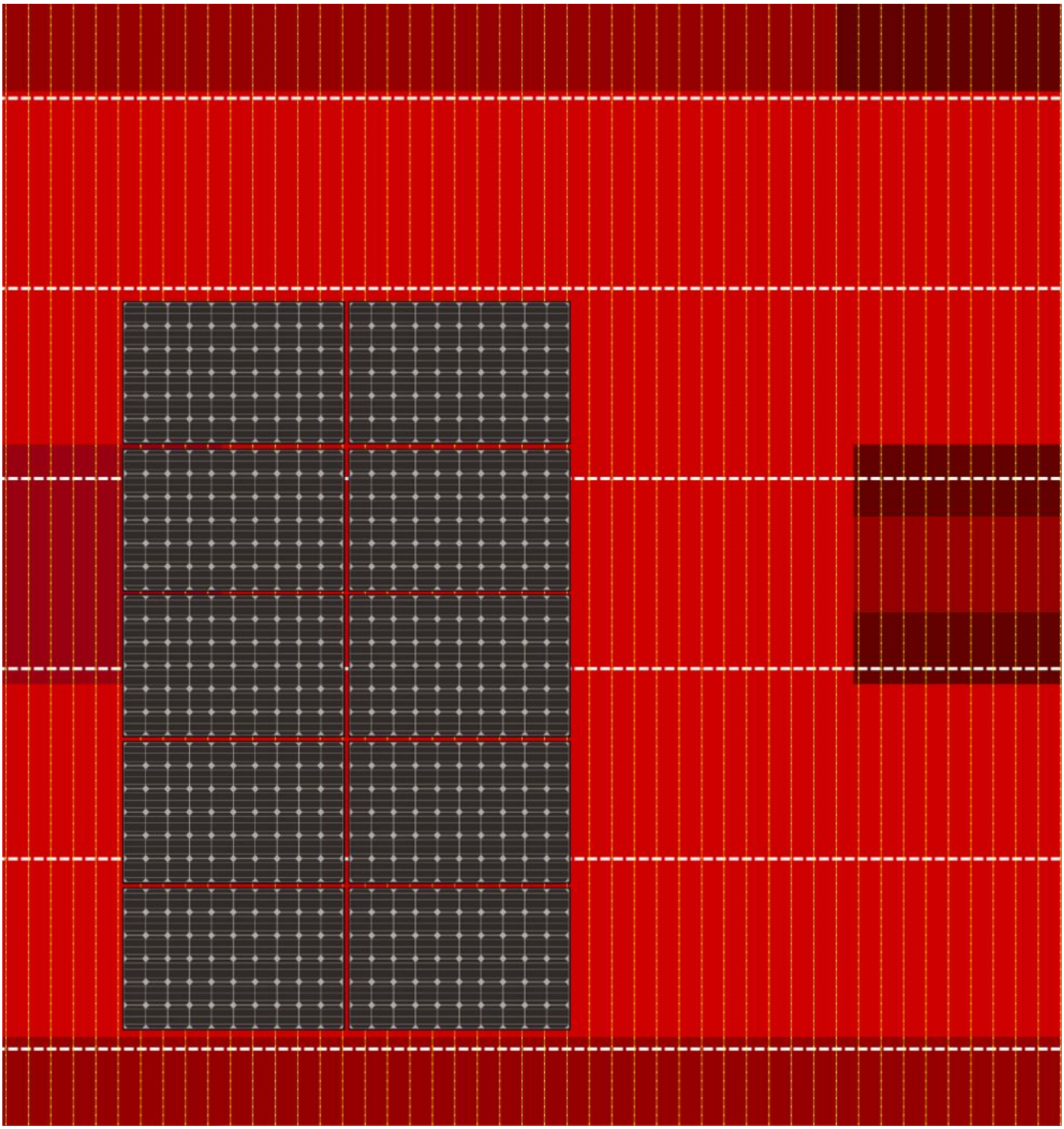
Allocated Roof Area	**19.98 m²**
Load on Allocated Area	**22.49 kN**
Max. Pressure (design):	**0.85 kN/m²**
Max. Tension (design):	**-1.28 kN/m²**
Total System weight	**254.28 kg**
Pressure on allocated Area	**0.12 kN/m²**

MODULE LAYOUT PLAN [ROOF_14]

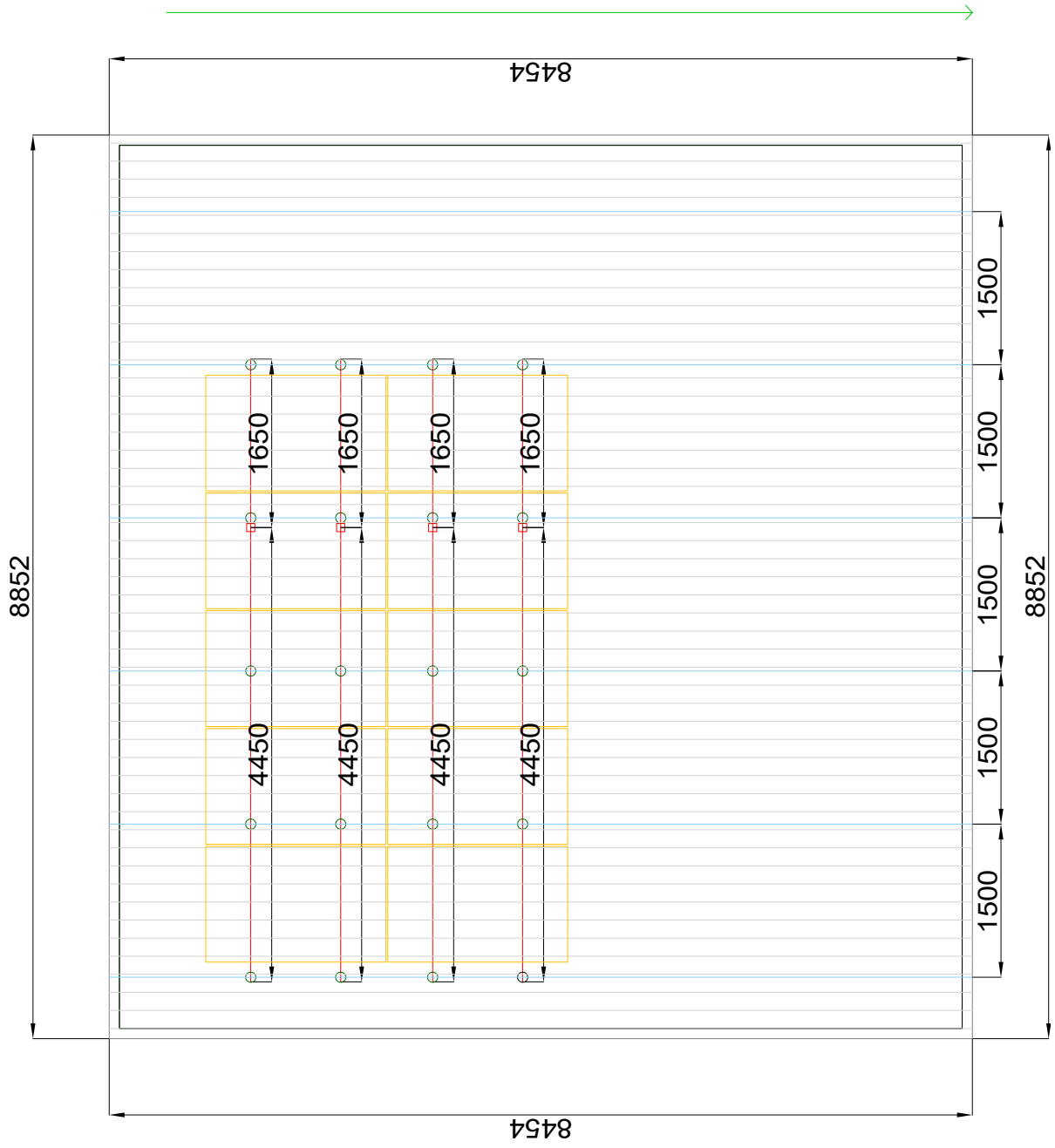
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



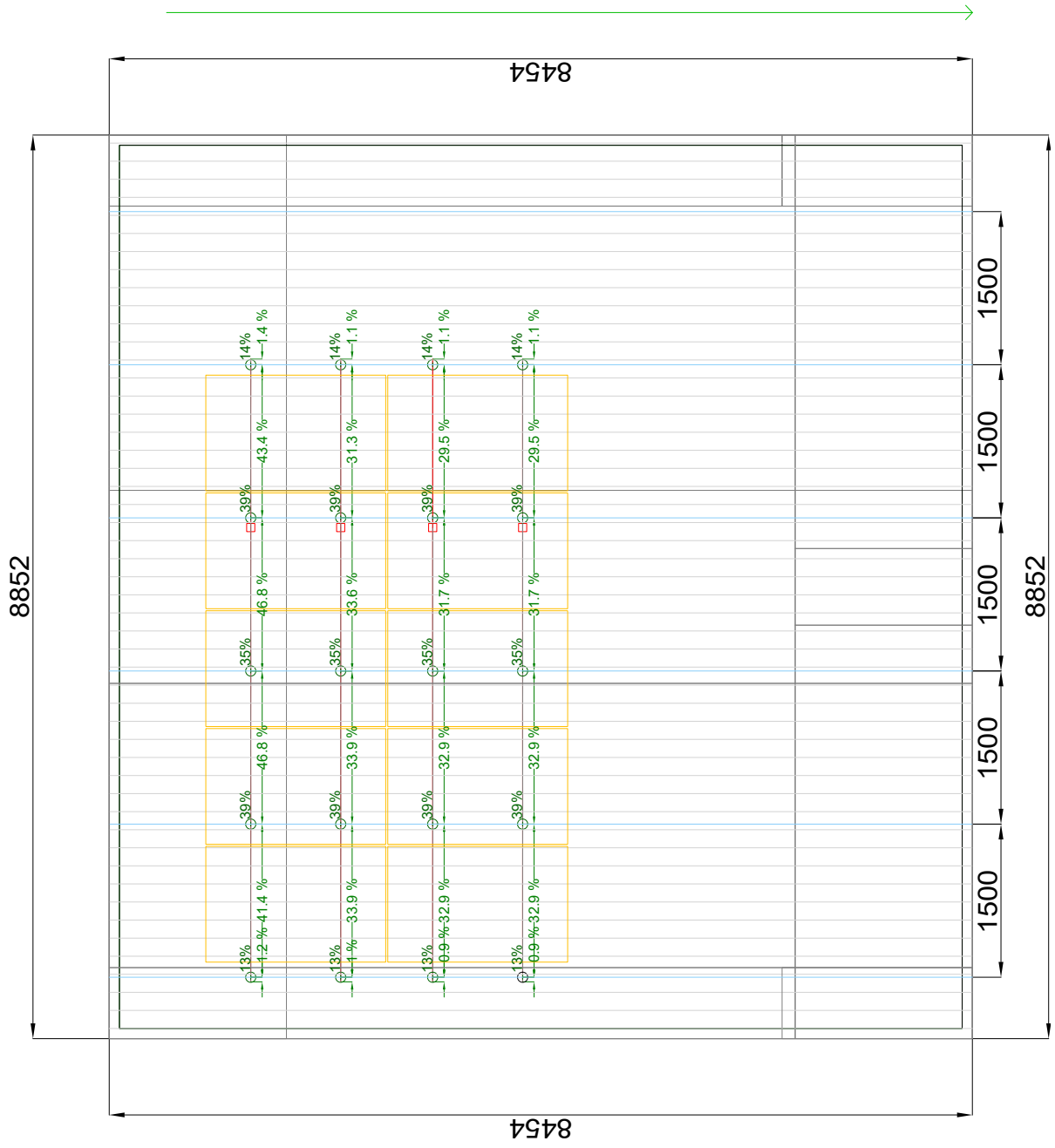
POSITION [ROOF_14]



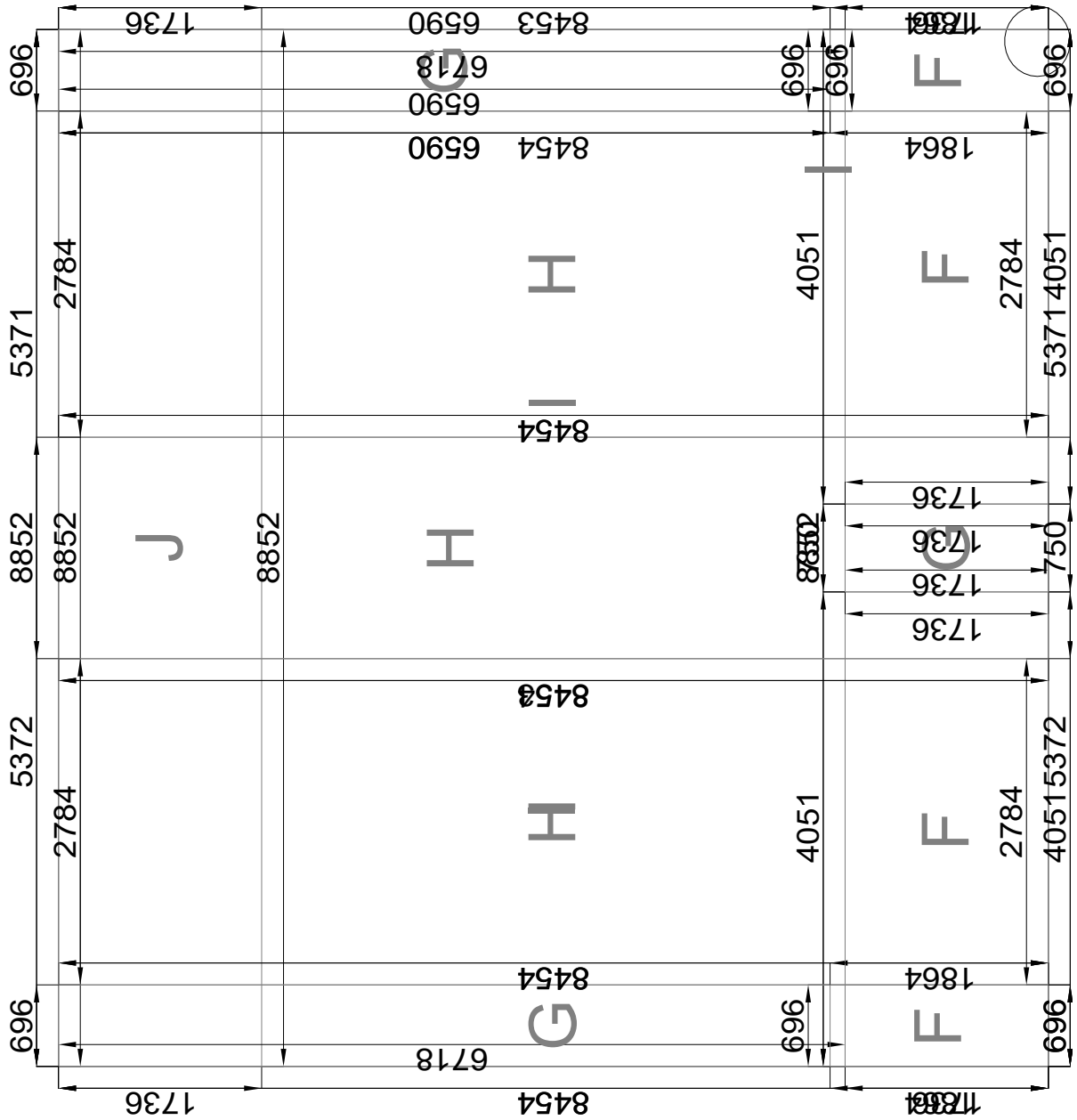
INSTALLATION-PLAN [ROOF_14]



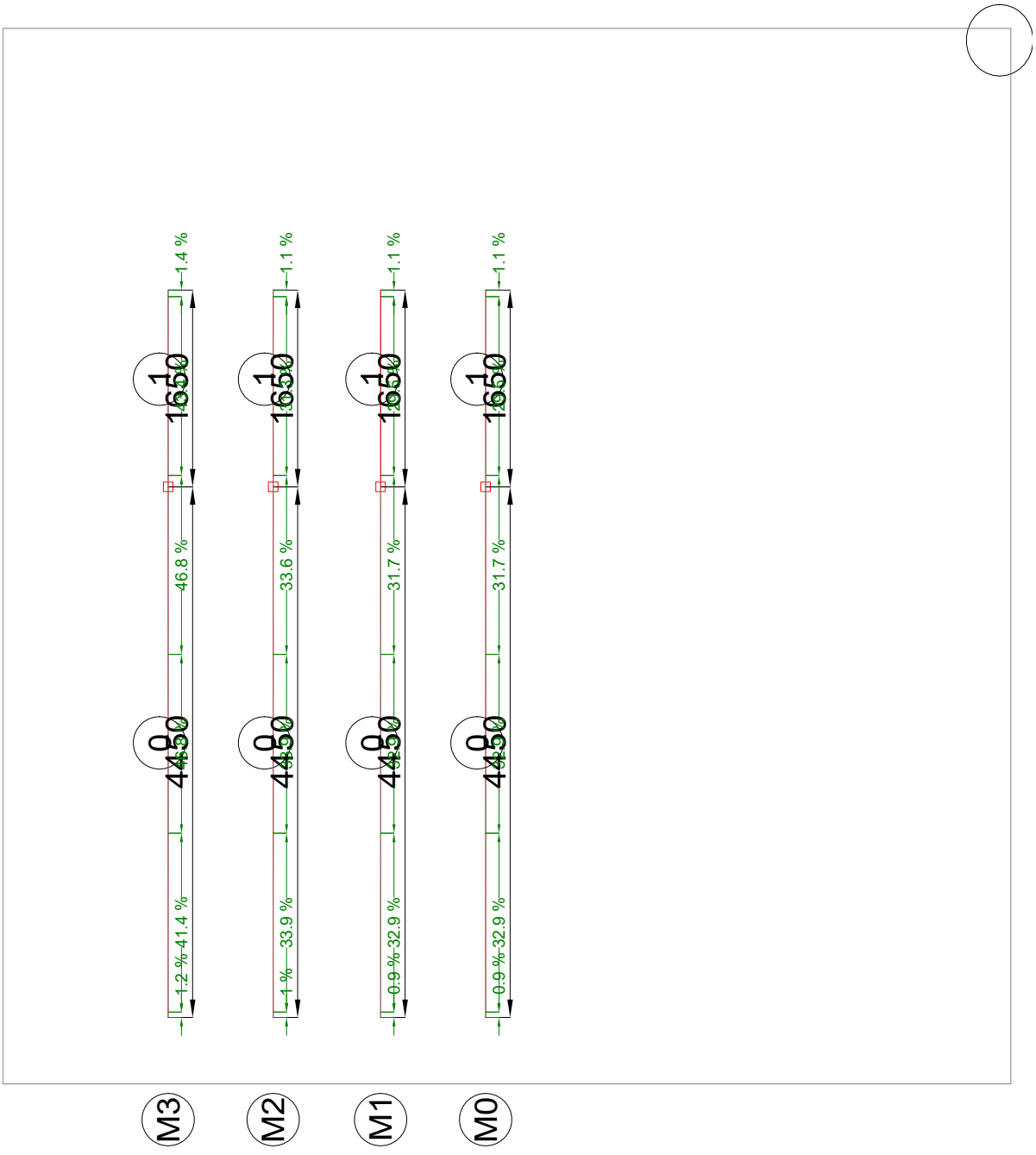
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_14]



STATIC INFORMATION: AREAS [ROOF_14]



RAIL CAPACITY [ROOF_14]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	21 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.15 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.14 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.054 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.2 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.078 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_14]

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.34**
Max. Suction	**0.5 kN/m²**
Cpe Pressure	**0.28**
Max. downward load	**0.86 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.8 kN/m²	0.19 kN/m²	0.82 kN/m²	13.32 °
LC 2	0.85 kN/m²	0.13 kN/m²	0.86 kN/m²	8.73 °
LC 3	-0.5 kN/m²	0.048 kN/m²	0.5 kN/m²	185.57 °

AREA J 180

Tributary area	**10 m²**
Cpe Suction	**-0.88**
Max. Suction	**1.49 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.53 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.49 kN/m²	0.19 kN/m²	0.53 kN/m²	21 °
LC 2	0.34 kN/m²	0.13 kN/m²	0.37 kN/m²	21 °
LC 3	-1.48 kN/m²	0.048 kN/m²	1.49 kN/m²	181.87 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.79 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.53 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.49 kN/m²	0.19 kN/m²	0.53 kN/m²	21 °
LC 2	0.34 kN/m²	0.13 kN/m²	0.37 kN/m²	21 °
LC 3	-0.79 kN/m²	0.048 kN/m²	0.79 kN/m²	183.51 °

RESULTING SURFACE STRESSES [ROOF_14]

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.68**
Max. Suction	**1.12 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.53 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

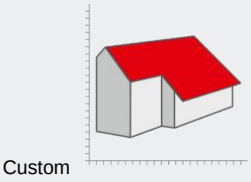
LC 1	0.49 kN/m²	0.19 kN/m²	0.53 kN/m²	21 °
LC 2	0.34 kN/m²	0.13 kN/m²	0.37 kN/m²	21 °
LC 3	-1.12 kN/m²	0.048 kN/m²	1.12 kN/m²	182.48 °

MATERIAL LIST [ROOF_14]

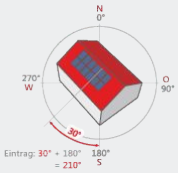
Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**10**	0.020
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**6**	**6**	31.650
	705225	XPCN60 rail connector X60	1	**4**	**4**	0.684
	705226	XCL60 side-lid left for rail X60	1	**4**	**4**	0.020
	705227	XCR60 side-lid right for rail X60	1	**4**	**4**	0.020
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**20**	**20**	10.220
	706457	CLP-R cable clip rail	1	**150**	**10**	0.040
	707003	CLE10 End clamp Click 30-46	1	**10**	**8**	0.600
	707011	CLM10 Middle clamp Click 30-46	1	**20**	**16**	1.024
						44.28

ROOF [ROOF_2]

Building height h [mm]	**10000**
Slope of roof [°]	**21**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**132.38**



System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

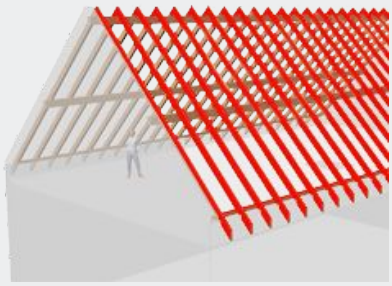
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**21**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

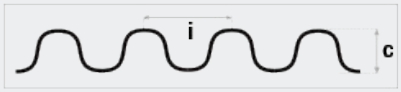
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

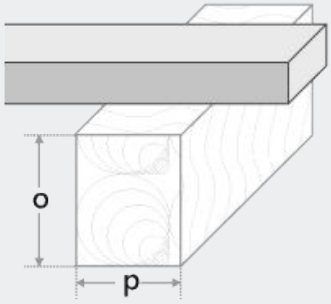
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_2]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**602**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





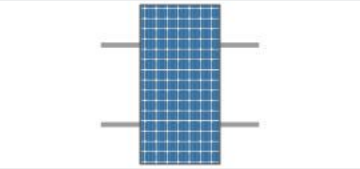


PV-MODULE [ROOF_2]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_2]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**26**
Max. Utilization of fixation points	**36 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_2]

Module rail	**Rail X60**
Max. utilization Module Profile	**75.05 %**

CLAMPS [ROOF_2]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**36.77 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**33.51 %**

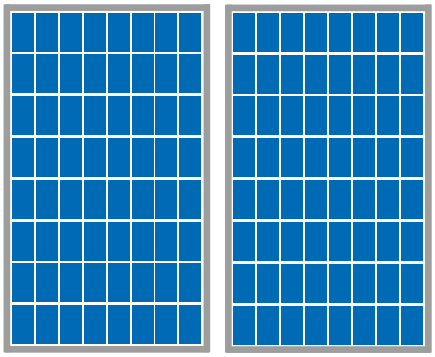
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_2]

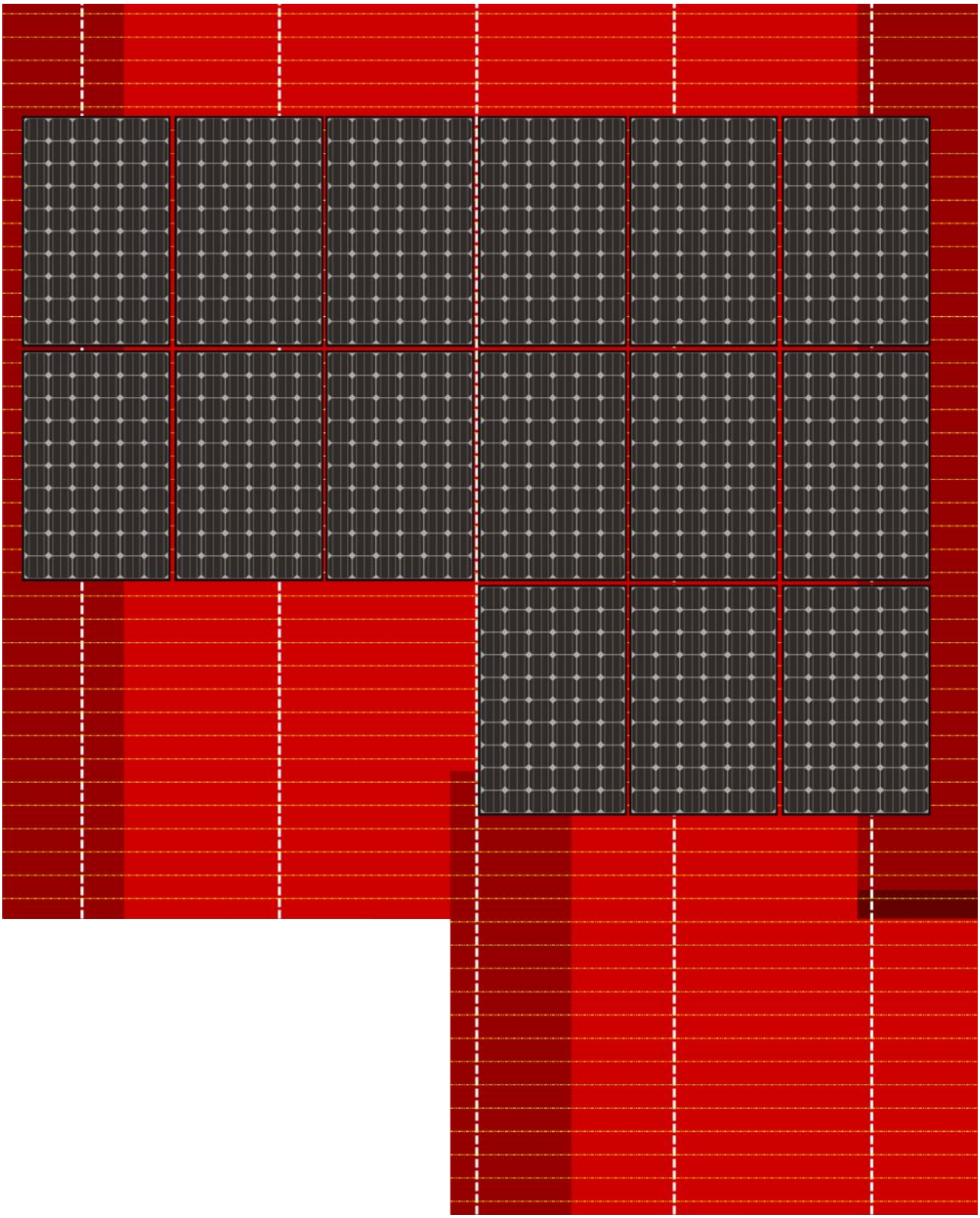
Allocated Roof Area	**29.97 m²**
Load on Allocated Area	**40.84 kN**
Max. Pressure (design):	**0.81 kN/m²**
Max. Tension (design):	**-1.9 kN/m²**
Total System weight	**368.48 kg**
Pressure on allocated Area	**0.12 kN/m²**

MODULE LAYOUT PLAN [ROOF_2]

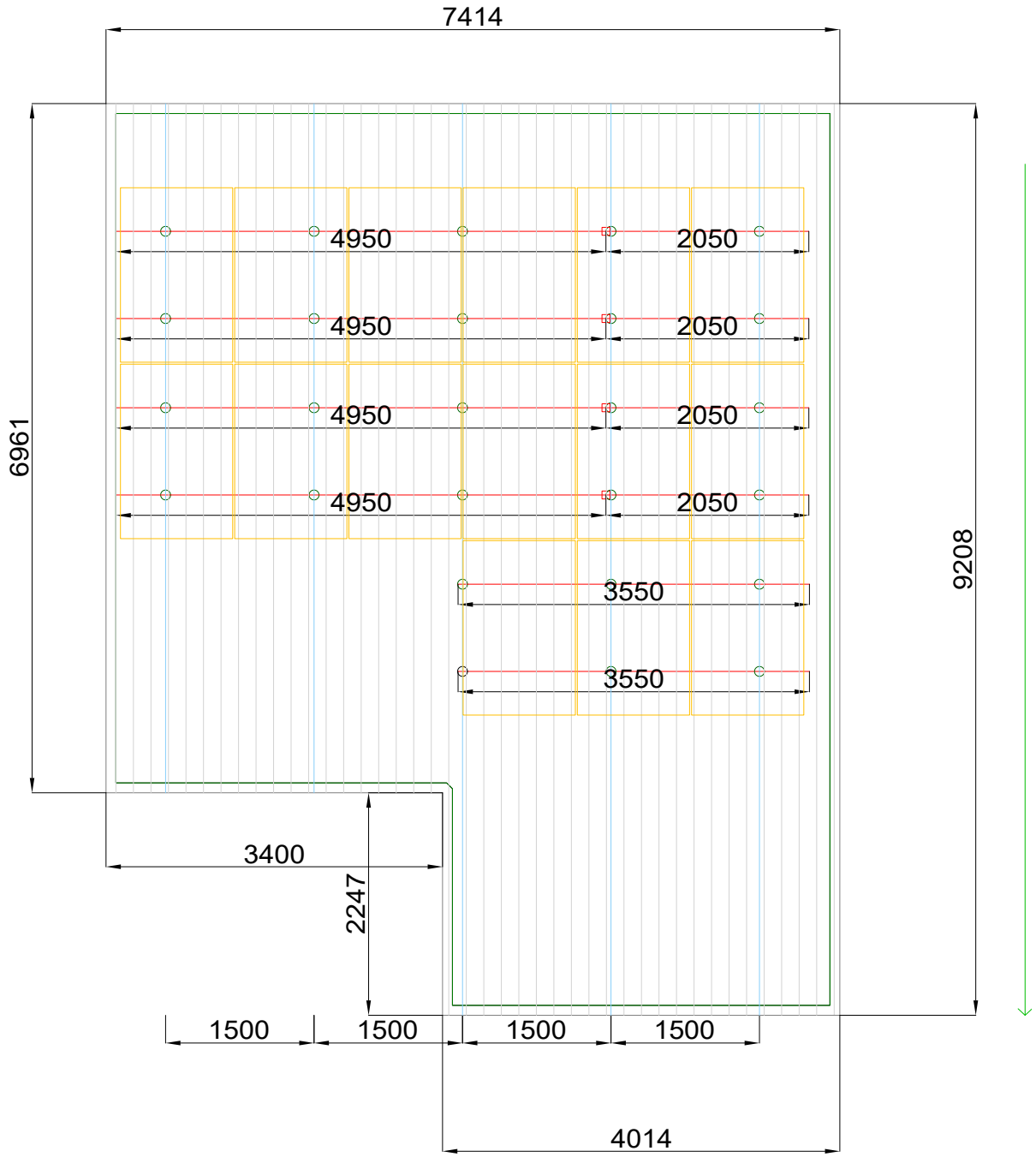
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



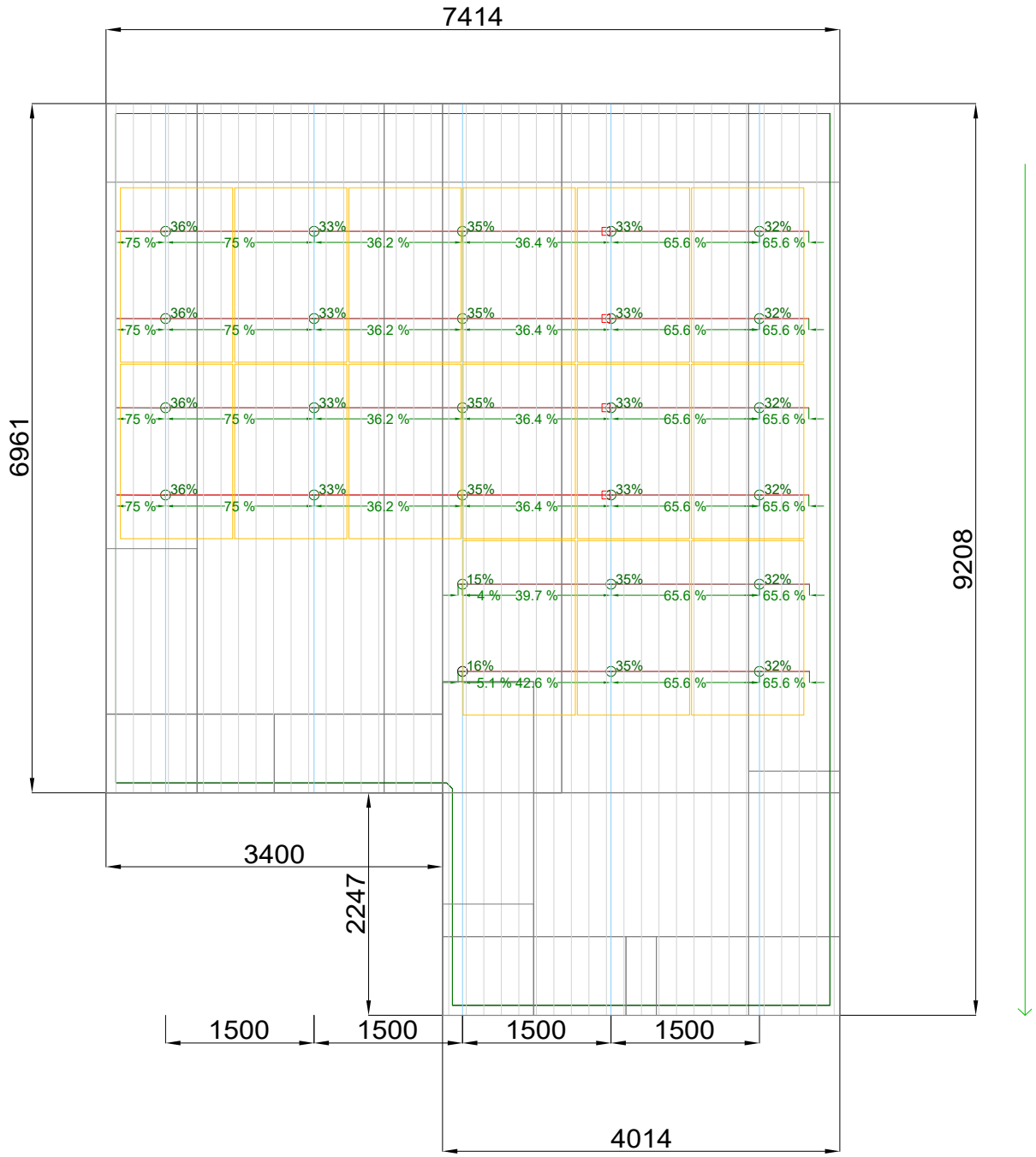
POSITION [ROOF_2]



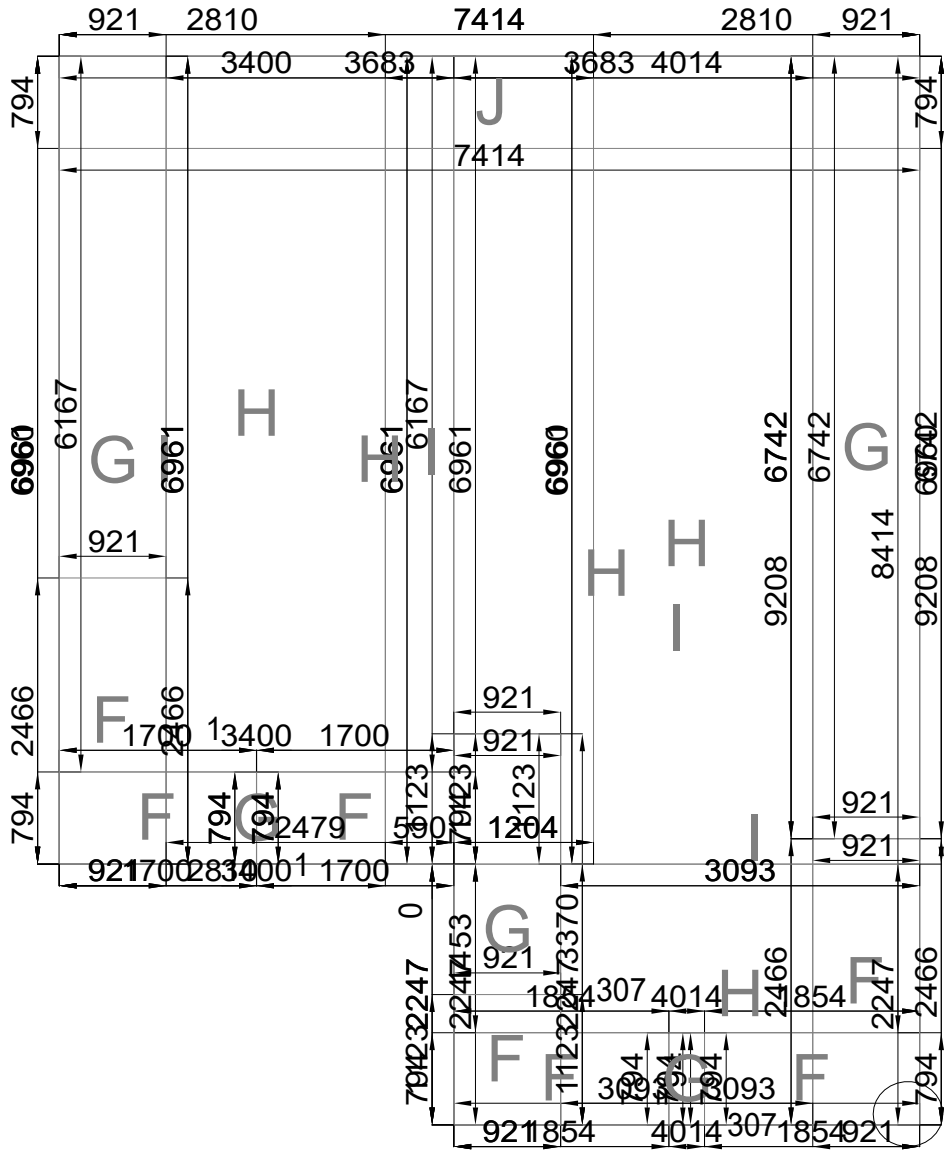
INSTALLATION-PLAN [ROOF_2]



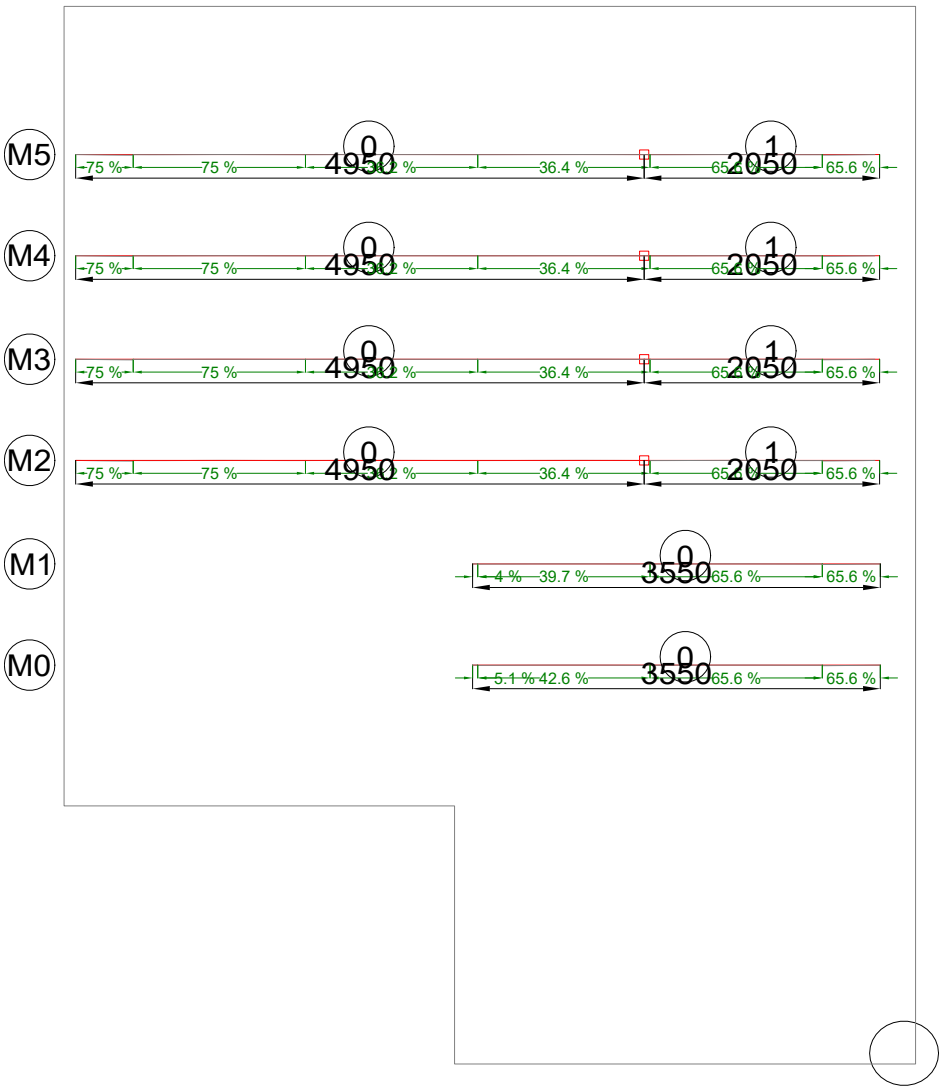
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_2]



STATIC INFORMATION: AREAS [ROOF_2]



RAIL CAPACITY [ROOF_2]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	21 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.12 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.11 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.042 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.2 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.078 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_2]

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.34**
Max. Suction	**0.52 kN/m²**
Cpe Pressure	**0.28**
Max. downward load	**0.82 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.76 kN/m²	0.17 kN/m²	0.78 kN/m²	12.89 °
LC 2	0.81 kN/m²	0.12 kN/m²	0.82 kN/m²	8.09 °
LC 3	-0.52 kN/m²	0.038 kN/m²	0.52 kN/m²	184.15 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.82 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.49 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.45 kN/m²	0.17 kN/m²	0.49 kN/m²	21 °
LC 2	0.3 kN/m²	0.12 kN/m²	0.32 kN/m²	21 °
LC 3	-0.82 kN/m²	0.038 kN/m²	0.82 kN/m²	182.67 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.28**
Max. Suction	**2.24 kN/m²**
Cpe Pressure	**0.28**
Max. downward load	**0.82 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.76 kN/m²	0.17 kN/m²	0.78 kN/m²	12.89 °
LC 2	0.81 kN/m²	0.12 kN/m²	0.82 kN/m²	8.09 °
LC 3	-2.24 kN/m²	0.038 kN/m²	2.24 kN/m²	180.97 °

RESULTING SURFACE STRESSES [ROOF_2]

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.68**
Max. Suction	**1.15 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.49 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

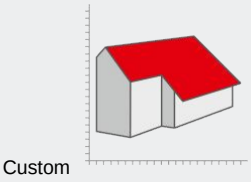
LC 1	0.45 kN/m²	0.17 kN/m²	0.49 kN/m²	21 °
LC 2	0.3 kN/m²	0.12 kN/m²	0.32 kN/m²	21 °
LC 3	-1.15 kN/m²	0.038 kN/m²	1.15 kN/m²	181.9 °

MATERIAL LIST [ROOF_2]

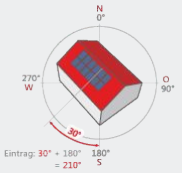
Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**15**	0.030
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**7**	**7**	36.925
	705225	XPCN60 rail connector X60	1	**4**	**4**	0.684
	705226	XCL60 side-lid left for rail X60	1	**6**	**6**	0.030
	705227	XCR60 side-lid right for rail X60	1	**6**	**6**	0.030
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**26**	**26**	13.286
	706457	CLP-R cable clip rail	1	**150**	**15**	0.060
	707003	CLE10 End clamp Click 30-46	1	**20**	**12**	0.900
	707011	CLM10 Middle clamp Click 30-46	1	**30**	**24**	1.536
						53.48

ROOF [ROOF_3]

Building height h [mm]	**10000**
Slope of roof [°]	**21**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**132.38**



System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

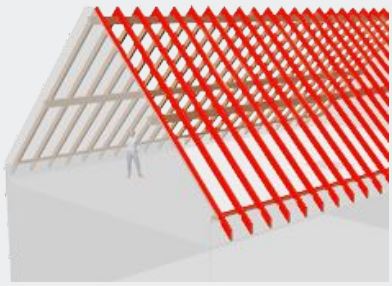
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**21**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

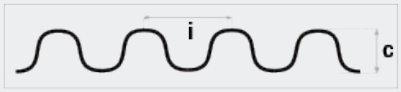
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

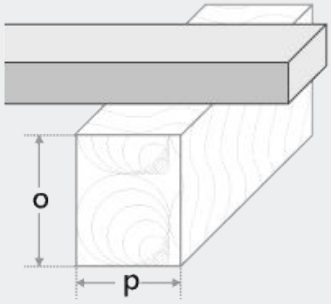
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_3]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**602**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





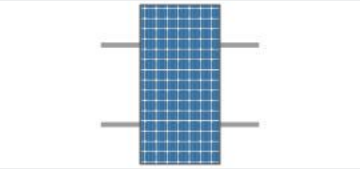


PV-MODULE [ROOF_3]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_3]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**24**
Max. Utilization of fixation points	**35 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_3]

Module rail	**Rail X60**
Max. utilization Module Profile	**55.84 %**

CLAMPS [ROOF_3]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**28.34 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**38.07 %**

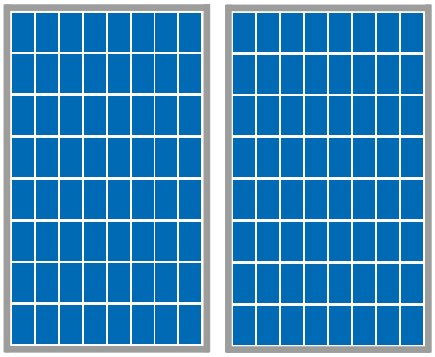
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_3]

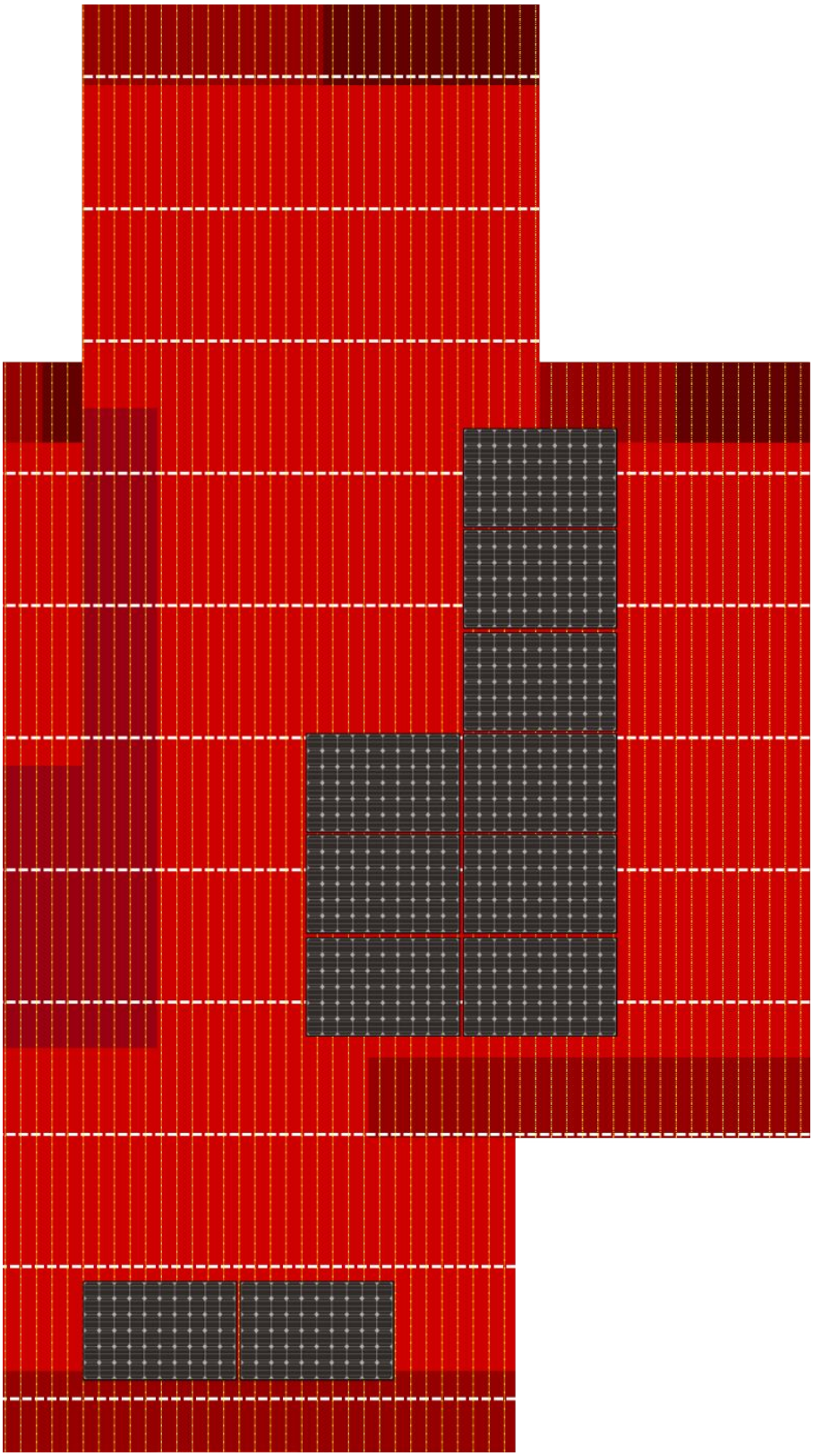
Allocated Roof Area	**21.98 m²**
Load on Allocated Area	**24.21 kN**
Max. Pressure (design):	**0.86 kN/m²**
Max. Tension (design):	**-1.79 kN/m²**
Total System weight	**277.5 kg**
Pressure on allocated Area	**0.12 kN/m²**

MODULE LAYOUT PLAN [ROOF_3]

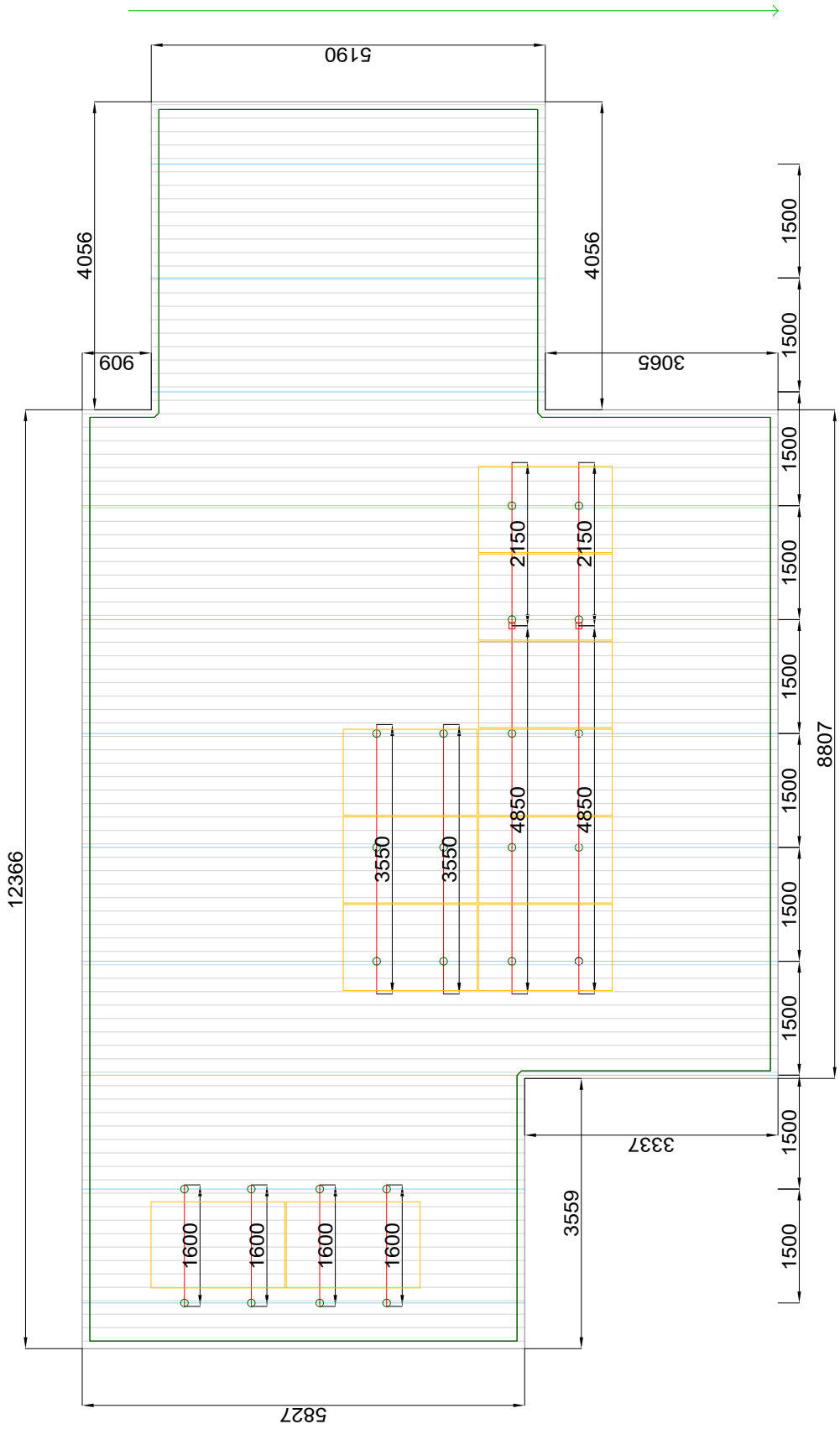
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



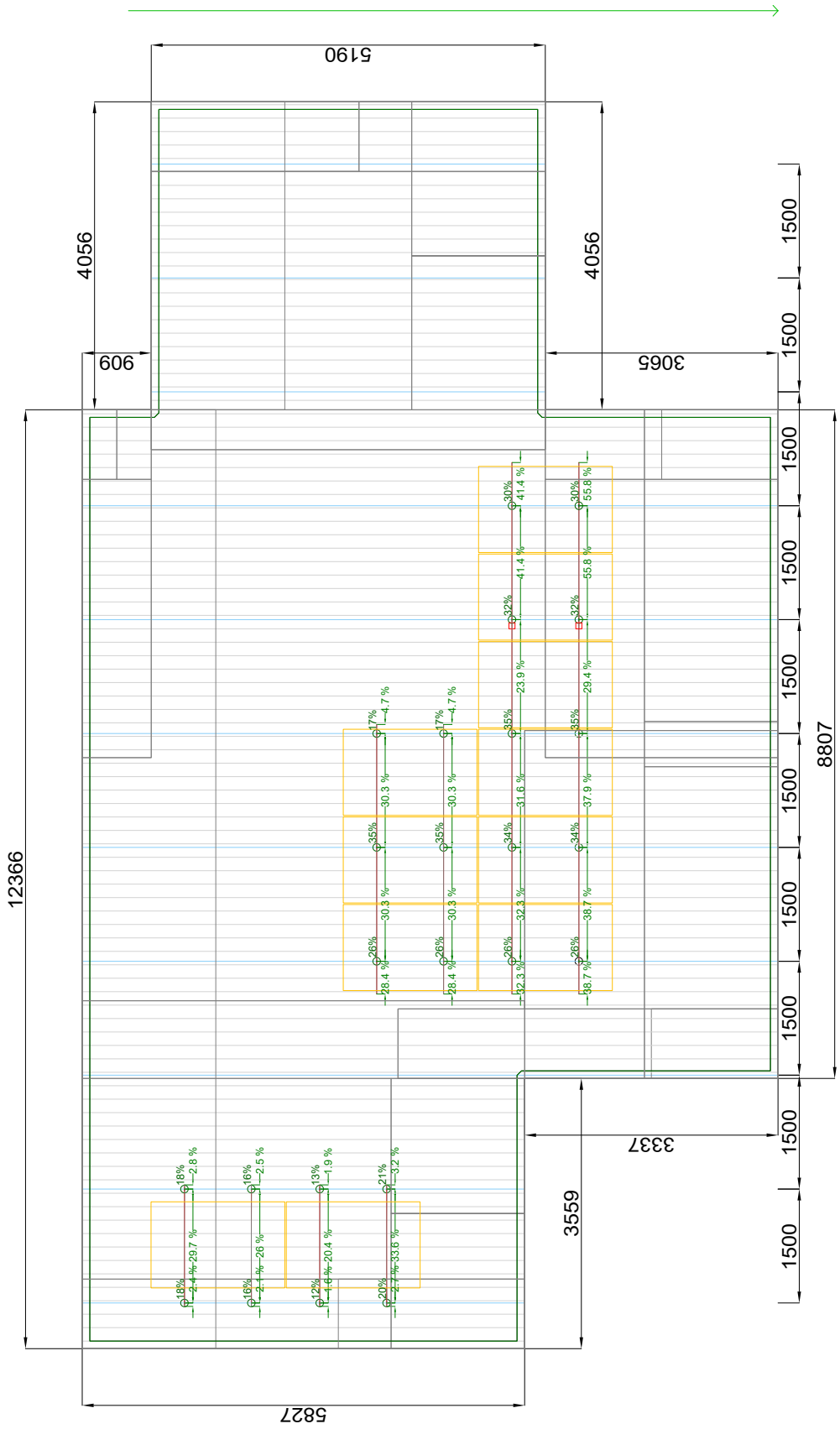
POSITION [ROOF_3]



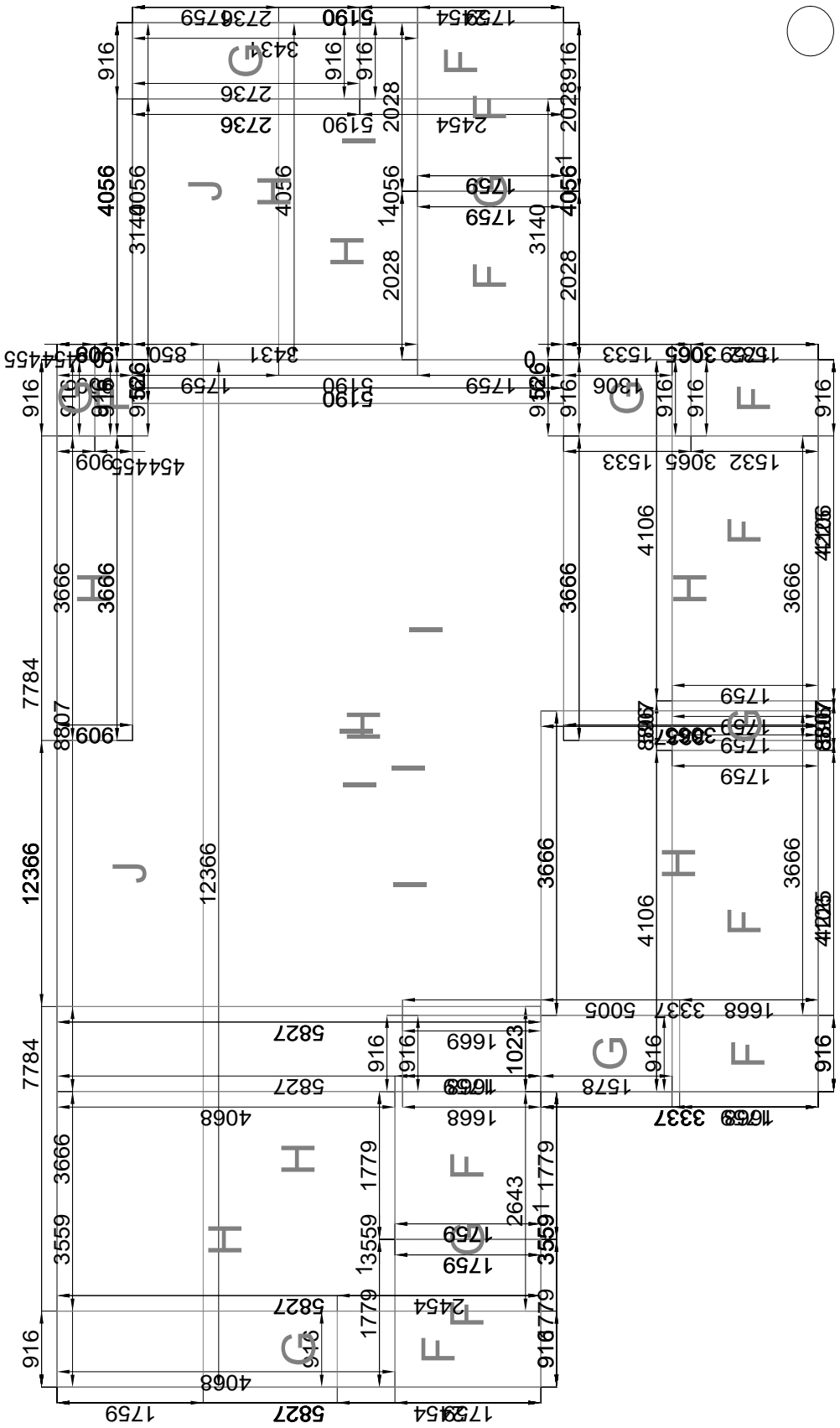
INSTALLATION-PLAN [ROOF_3]



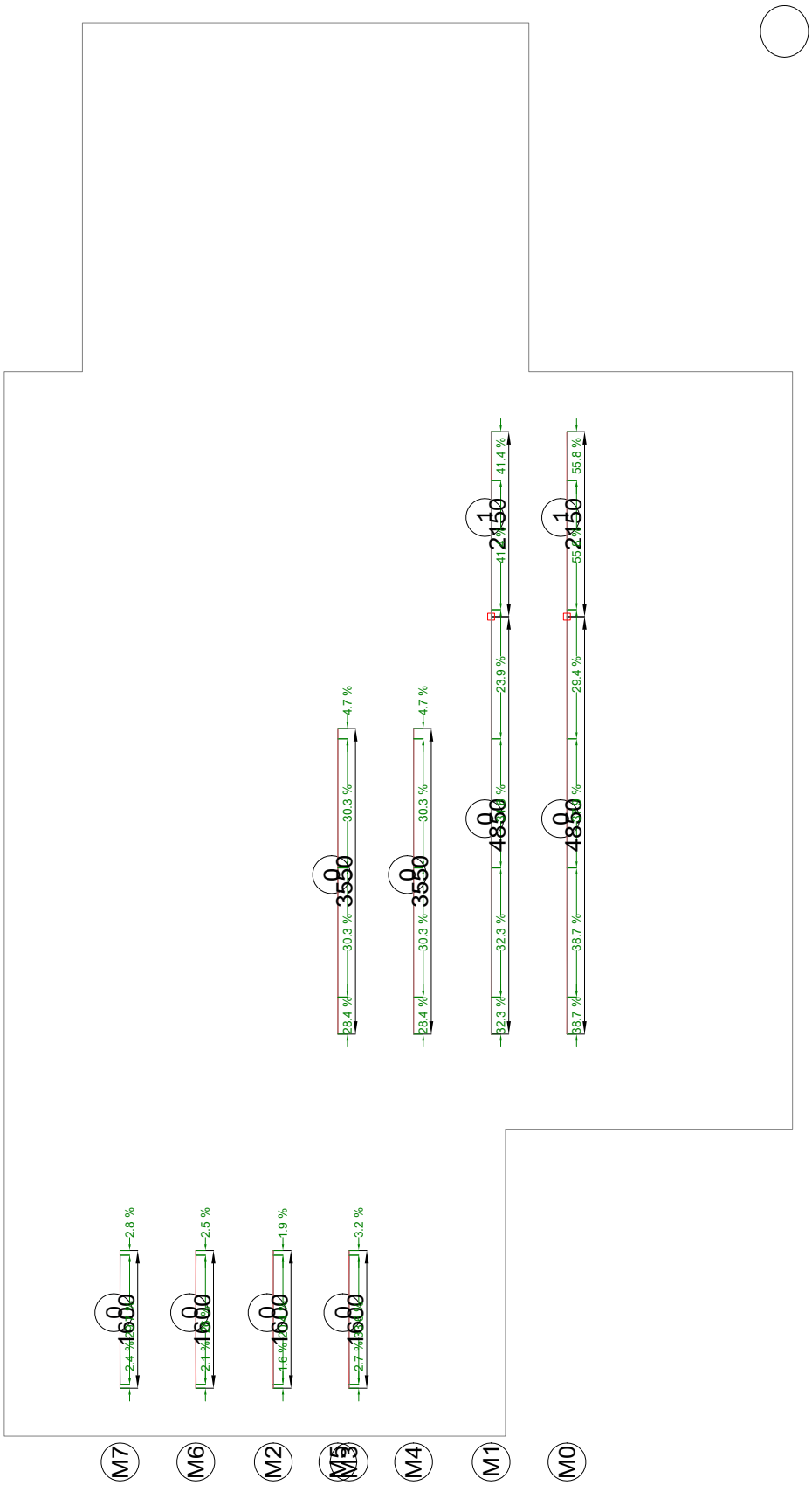
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_3]



STATIC INFORMATION: AREAS [ROOF_3]



RAIL CAPACITY [ROOF_3]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	21 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.12 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.11 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.042 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.2 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.078 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_3]

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.34**
Max. Suction	**0.52 kN/m²**
Cpe Pressure	**0.28**
Max. downward load	**0.82 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.76 kN/m²	0.17 kN/m²	0.78 kN/m²	12.89 °
LC 2	0.81 kN/m²	0.12 kN/m²	0.82 kN/m²	8.09 °
LC 3	-0.52 kN/m²	0.038 kN/m²	0.52 kN/m²	184.15 °

AREA F 0

Tributary area	**10 m²**
Cpe Suction	**-0.74**
Max. Suction	**1.26 kN/m²**
Cpe Pressure	**0.4**
Max. downward load	**1.04 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.89 kN/m²	0.17 kN/m²	0.91 kN/m²	11.04 °
LC 2	1.03 kN/m²	0.12 kN/m²	1.04 kN/m²	6.39 °
LC 3	-1.26 kN/m²	0.038 kN/m²	1.26 kN/m²	181.73 °

AREA F 0

Tributary area	**10 m²**
Cpe Suction	**-0.74**
Max. Suction	**1.26 kN/m²**
Cpe Pressure	**0.4**
Max. downward load	**1.04 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.89 kN/m²	0.17 kN/m²	0.91 kN/m²	11.04 °
LC 2	1.03 kN/m²	0.12 kN/m²	1.04 kN/m²	6.39 °
LC 3	-1.26 kN/m²	0.038 kN/m²	1.26 kN/m²	181.73 °

RESULTING SURFACE STRESSES [ROOF_3]

AREA G 0

Tributary area	**10 m²**
Cpe Suction	**-0.68**
Max. Suction	**1.15 kN/m²**
Cpe Pressure	**0.4**
Max. downward load	**1.04 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.89 kN/m²	0.17 kN/m²	0.91 kN/m²	11.04 °
LC 2	1.03 kN/m²	0.12 kN/m²	1.04 kN/m²	6.39 °
LC 3	-1.15 kN/m²	0.038 kN/m²	1.15 kN/m²	181.9 °

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.34**
Max. Suction	**0.52 kN/m²**
Cpe Pressure	**0.28**
Max. downward load	**0.82 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.76 kN/m²	0.17 kN/m²	0.78 kN/m²	12.89 °
LC 2	0.81 kN/m²	0.12 kN/m²	0.82 kN/m²	8.09 °
LC 3	-0.52 kN/m²	0.038 kN/m²	0.52 kN/m²	184.15 °

AREA J 180

Tributary area	**10 m²**
Cpe Suction	**-0.88**
Max. Suction	**1.51 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.49 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.45 kN/m²	0.17 kN/m²	0.49 kN/m²	21 °
LC 2	0.3 kN/m²	0.12 kN/m²	0.32 kN/m²	21 °
LC 3	-1.51 kN/m²	0.038 kN/m²	1.51 kN/m²	181.44 °

RESULTING SURFACE STRESSES [ROOF_3]

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.82 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.49 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.45 kN/m²	0.17 kN/m²	0.49 kN/m²	21 °
LC 2	0.3 kN/m²	0.12 kN/m²	0.32 kN/m²	21 °
LC 3	-0.82 kN/m²	0.038 kN/m²	0.82 kN/m²	182.67 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.82 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.49 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.45 kN/m²	0.17 kN/m²	0.49 kN/m²	21 °
LC 2	0.3 kN/m²	0.12 kN/m²	0.32 kN/m²	21 °
LC 3	-0.82 kN/m²	0.038 kN/m²	0.82 kN/m²	182.67 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.28**
Max. Suction	**2.24 kN/m²**
Cpe Pressure	**0.28**
Max. downward load	**0.82 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.76 kN/m²	0.17 kN/m²	0.78 kN/m²	12.89 °
LC 2	0.81 kN/m²	0.12 kN/m²	0.82 kN/m²	8.09 °
LC 3	-2.24 kN/m²	0.038 kN/m²	2.24 kN/m²	180.97 °

RESULTING SURFACE STRESSES [ROOF_3]

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.68**
Max. Suction	**1.15 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.49 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.45 kN/m²	0.17 kN/m²	0.49 kN/m²	21 °
LC 2	0.3 kN/m²	0.12 kN/m²	0.32 kN/m²	21 °
LC 3	-1.15 kN/m²	0.038 kN/m²	1.15 kN/m²	181.9 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.82 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.49 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.45 kN/m²	0.17 kN/m²	0.49 kN/m²	21 °
LC 2	0.3 kN/m²	0.12 kN/m²	0.32 kN/m²	21 °
LC 3	-0.82 kN/m²	0.038 kN/m²	0.82 kN/m²	182.67 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.82 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.49 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.45 kN/m²	0.17 kN/m²	0.49 kN/m²	21 °
LC 2	0.3 kN/m²	0.12 kN/m²	0.32 kN/m²	21 °
LC 3	-0.82 kN/m²	0.038 kN/m²	0.82 kN/m²	182.67 °

RESULTING SURFACE STRESSES [ROOF_3]

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.22**
Max. Suction	**2.13 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.49 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.45 kN/m²	0.17 kN/m²	0.49 kN/m²	21 °
LC 2	0.3 kN/m²	0.12 kN/m²	0.32 kN/m²	21 °
LC 3	-2.13 kN/m²	0.038 kN/m²	2.13 kN/m²	181.02 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.28**
Max. Suction	**2.24 kN/m²**
Cpe Pressure	**0.28**
Max. downward load	**0.82 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.76 kN/m²	0.17 kN/m²	0.78 kN/m²	12.89 °
LC 2	0.81 kN/m²	0.12 kN/m²	0.82 kN/m²	8.09 °
LC 3	-2.24 kN/m²	0.038 kN/m²	2.24 kN/m²	180.97 °

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.68**
Max. Suction	**1.15 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.49 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.45 kN/m²	0.17 kN/m²	0.49 kN/m²	21 °
LC 2	0.3 kN/m²	0.12 kN/m²	0.32 kN/m²	21 °
LC 3	-1.15 kN/m²	0.038 kN/m²	1.15 kN/m²	181.9 °

RESULTING SURFACE STRESSES [ROOF_3]

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.82 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.49 kN/m²**

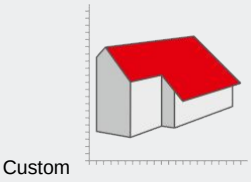
LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.45 kN/m²	0.17 kN/m²	0.49 kN/m²	21 °
LC 2	0.3 kN/m²	0.12 kN/m²	0.32 kN/m²	21 °
LC 3	-0.82 kN/m²	0.038 kN/m²	0.82 kN/m²	182.67 °

MATERIAL LIST [ROOF_3]

Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**11**	0.022
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**6**	**6**	31.650
	705225	XPCN60 rail connector X60	1	**2**	**2**	0.342
	705226	XCL60 side-lid left for rail X60	1	**8**	**8**	0.040
	705227	XCR60 side-lid right for rail X60	1	**8**	**8**	0.040
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**24**	**24**	12.264
	706457	CLP-R cable clip rail	1	**150**	**11**	0.044
	707003	CLE10 End clamp Click 30-46	1	**20**	**16**	1.200
	707011	CLM10 Middle clamp Click 30-46	1	**20**	**14**	0.896
						46.50

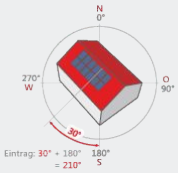
ROOF [ROOF_4]

Building height h [mm]	**10000**
Slope of roof [°]	**16**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**98.02**



Custom

System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

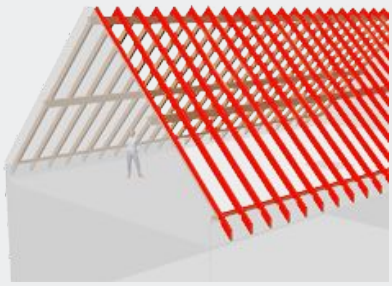
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**16**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

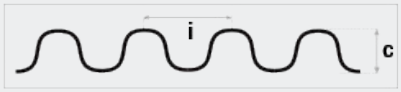
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

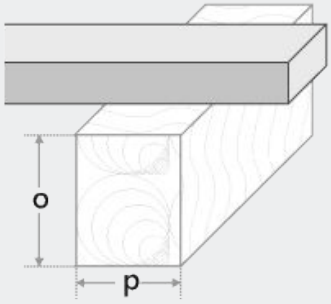
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_4]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**200**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





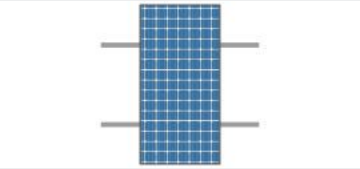


PV-MODULE [ROOF_4]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_4]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**56**
Max. Utilization of fixation points	**45 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_4]

Module rail	**Rail X60**
Max. utilization Module Profile	**62.71 %**

CLAMPS [ROOF_4]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**43.05 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**34.69 %**

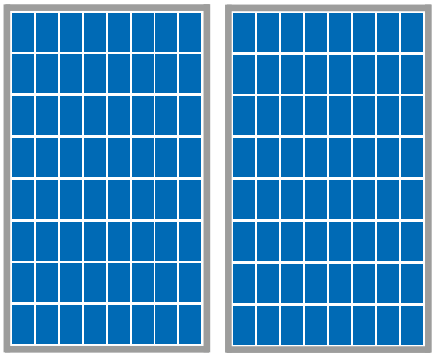
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_4]

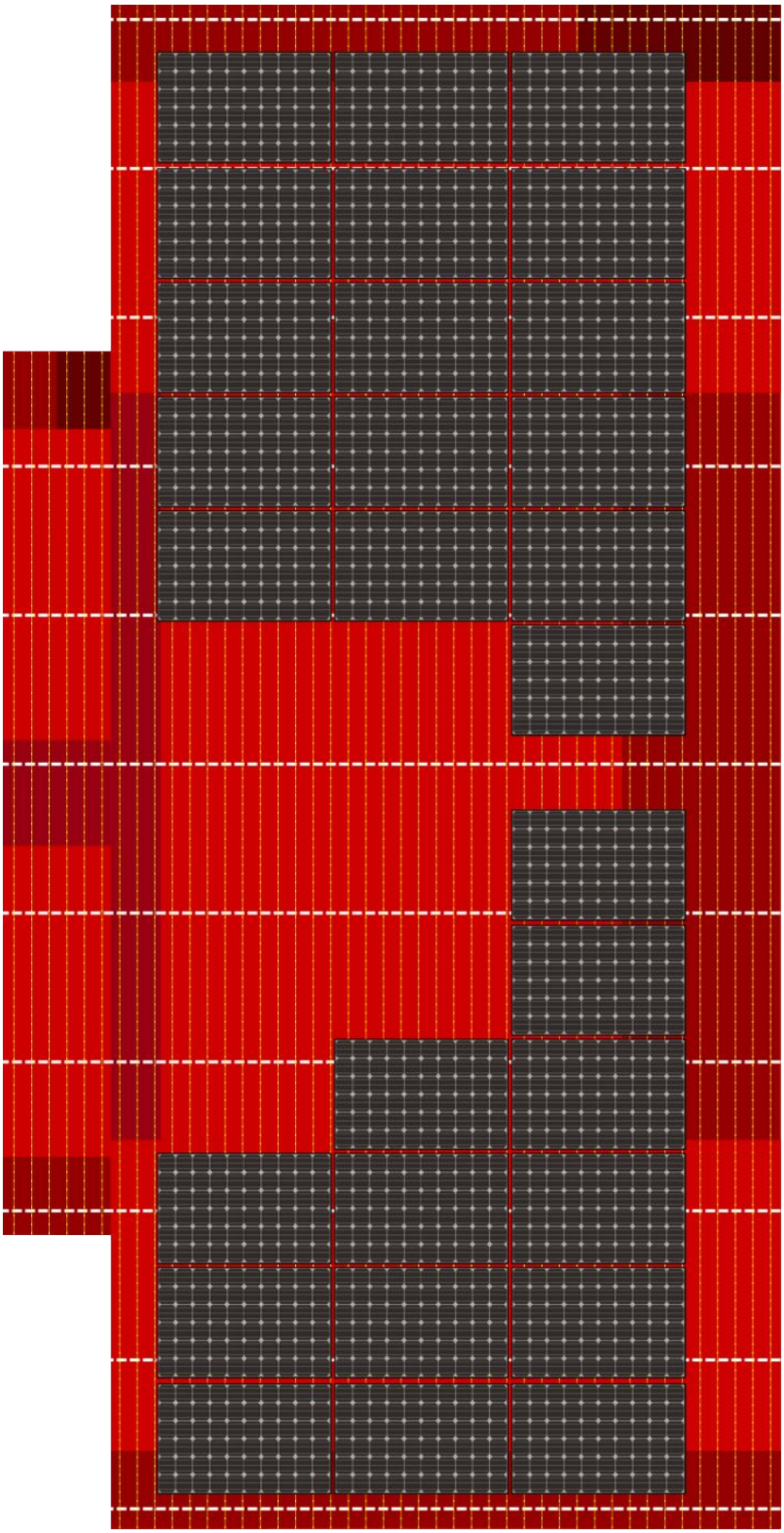
Allocated Roof Area	**57.95 m²**
Load on Allocated Area	**66.96 kN**
Max. Pressure (design):	**0.72 kN/m²**
Max. Tension (design):	**-1.71 kN/m²**
Total System weight	**717.85 kg**
Pressure on allocated Area	**0.12 kN/m²**

MODULE LAYOUT PLAN [ROOF_4]

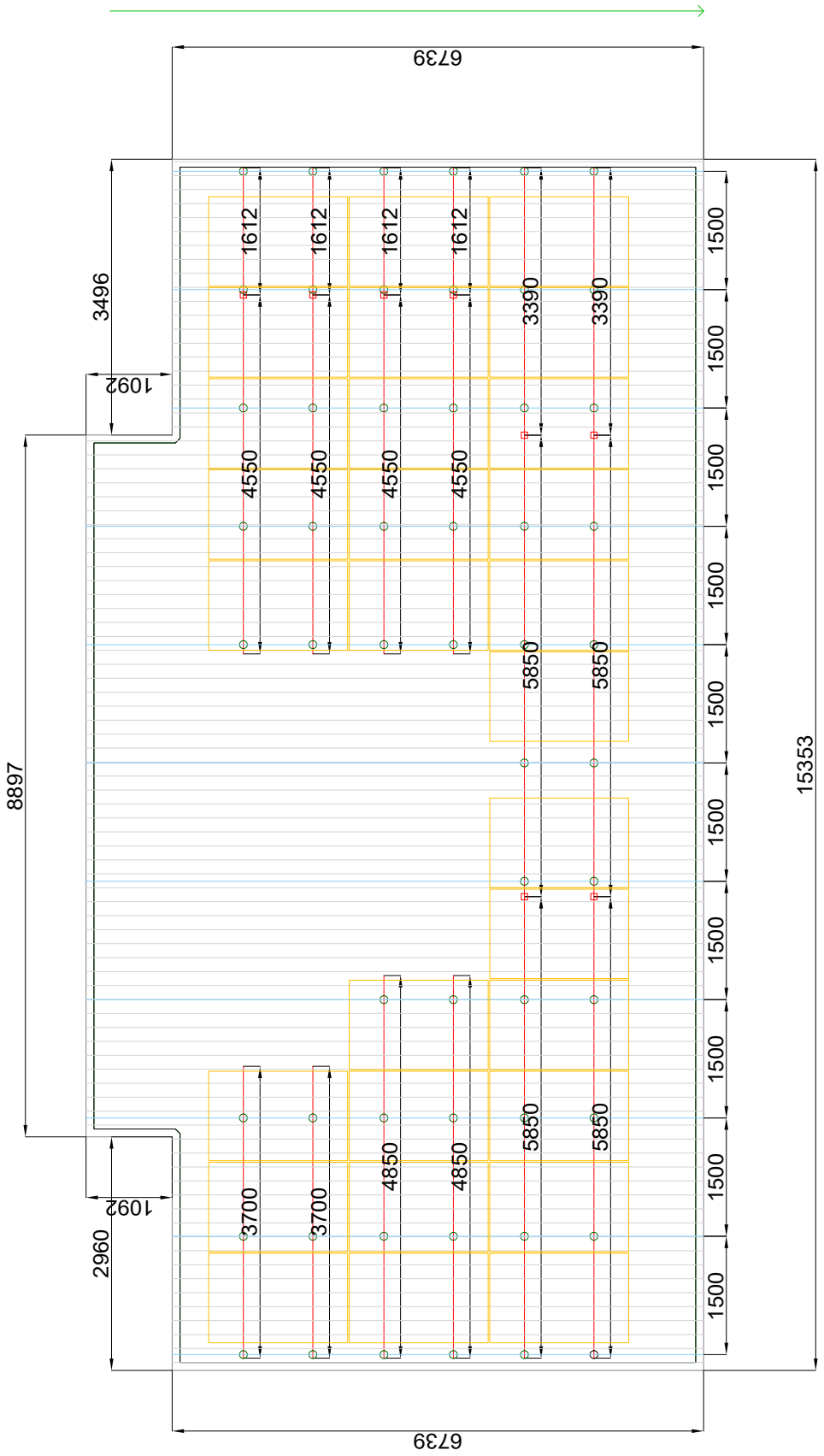
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



POSITION [ROOF_4]



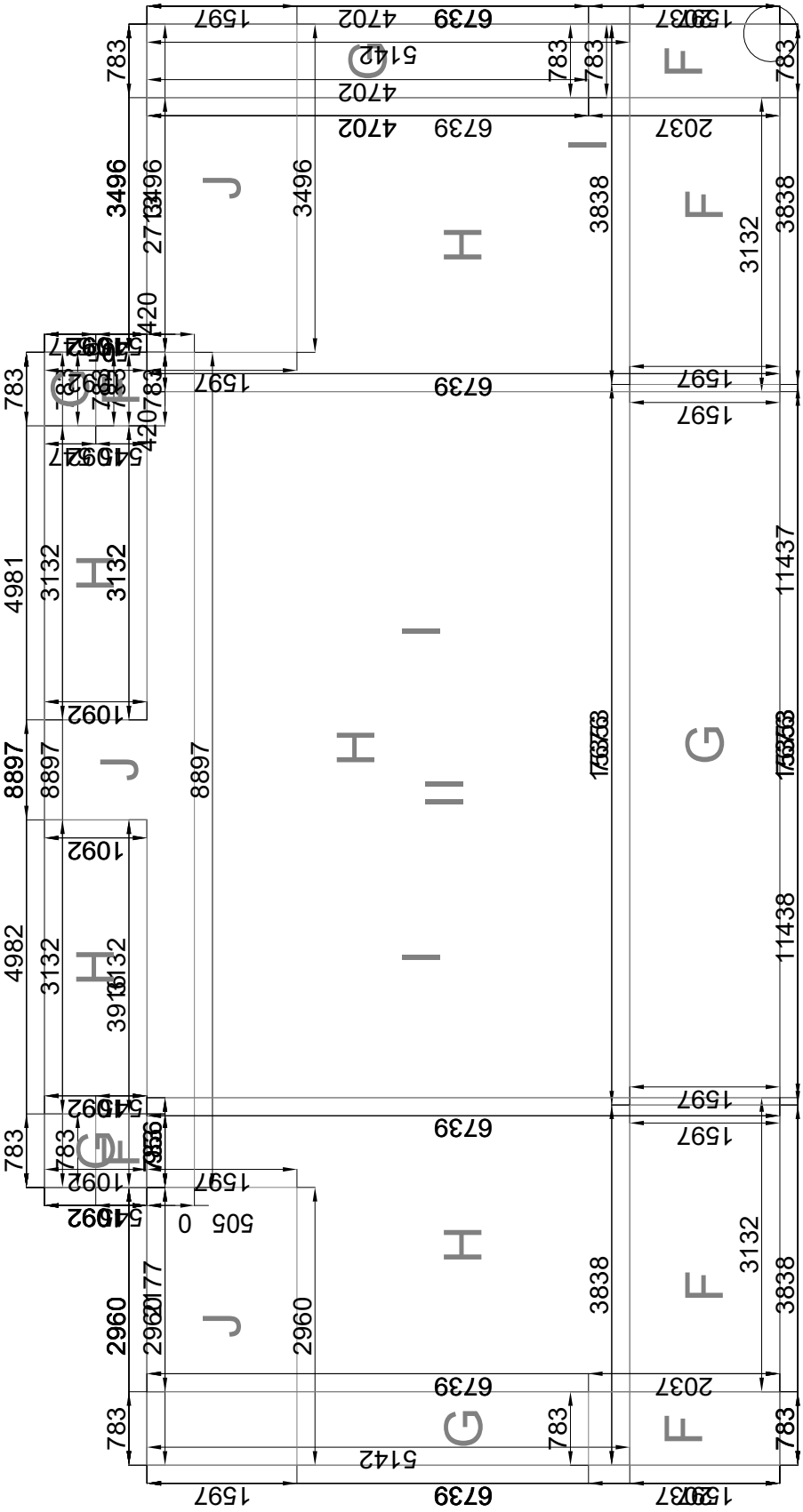
INSTALLATION-PLAN [ROOF_4]



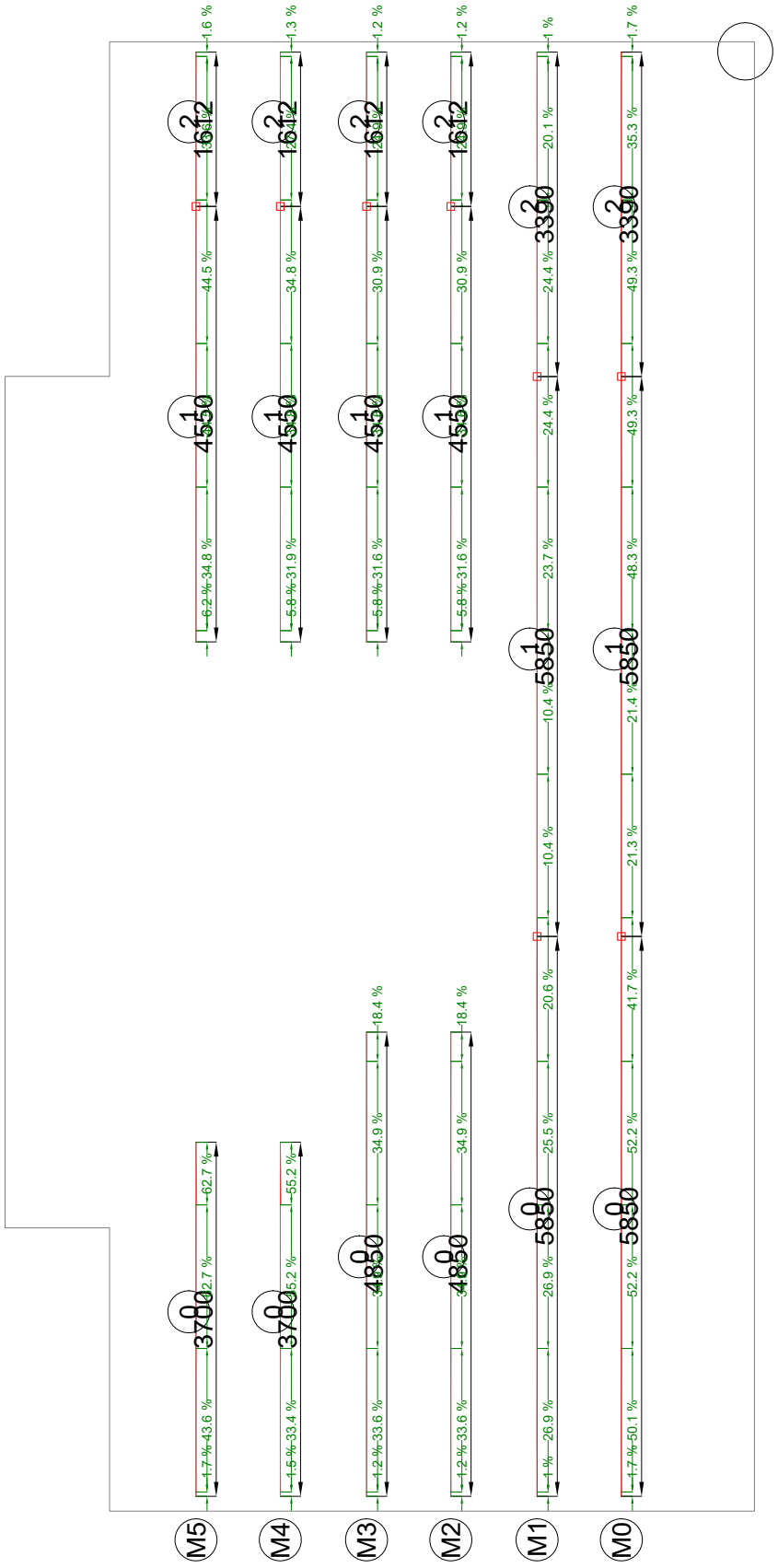
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_4]



STATIC INFORMATION: AREAS [ROOF_4]



RAIL CAPACITY [ROOF_4]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	16 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.12 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.11 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.032 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.22 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.062 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_4]

AREA F 0

Tributary area	**10 m²**
Cpe Suction	**-0.873**
Max. Suction	**1.5 kN/m²**
Cpe Pressure	**0.233**
Max. downward load	**0.75 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.73 kN/m²	0.14 kN/m²	0.75 kN/m²	10.57 °
LC 2	0.74 kN/m²	0.09 kN/m²	0.75 kN/m²	6.94 °
LC 3	-1.5 kN/m²	0.029 kN/m²	1.5 kN/m²	181.12 °

AREA G 0

Tributary area	**10 m²**
Cpe Suction	**-0.78**
Max. Suction	**1.33 kN/m²**
Cpe Pressure	**0.233**
Max. downward load	**0.75 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.73 kN/m²	0.14 kN/m²	0.75 kN/m²	10.57 °
LC 2	0.74 kN/m²	0.09 kN/m²	0.75 kN/m²	6.94 °
LC 3	-1.33 kN/m²	0.029 kN/m²	1.33 kN/m²	181.26 °

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.307**
Max. Suction	**0.46 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-0.46 kN/m²	0.029 kN/m²	0.46 kN/m²	183.64 °

RESULTING SURFACE STRESSES [ROOF_4]

AREA J 180

Tributary area	**10 m²**
Cpe Suction	**-0.98**
Max. Suction	**1.69 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.69 kN/m²	0.029 kN/m²	1.69 kN/m²	180.99 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.81 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-0.81 kN/m²	0.029 kN/m²	0.81 kN/m²	182.06 °

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.287**
Max. Suction	**2.25 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-2.25 kN/m²	0.029 kN/m²	2.25 kN/m²	180.74 °

RESULTING SURFACE STRESSES [ROOF_4]

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.213**
Max. Suction	**2.12 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-2.12 kN/m²	0.029 kN/m²	2.12 kN/m²	180.79 °

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.613**
Max. Suction	**1.02 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

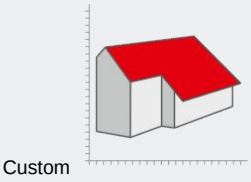
LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.02 kN/m²	0.029 kN/m²	1.02 kN/m²	181.64 °

MATERIAL LIST [ROOF_4]

Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**29**	0.058
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**14**	**14**	73.850
	705225	XPCN60 rail connector X60	1	**8**	**8**	1.368
	705226	XCL60 side-lid left for rail X60	1	**10**	**10**	0.050
	705227	XCR60 side-lid right for rail X60	1	**10**	**10**	0.050
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**56**	**56**	28.616
	706457	CLP-R cable clip rail	1	**150**	**29**	0.116
	707003	CLE10 End clamp Click 30-46	1	**30**	**24**	1.800
	707011	CLM10 Middle clamp Click 30-46	1	**50**	**46**	2.944
						108.85

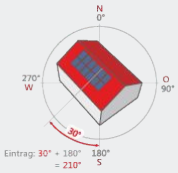
ROOF [ROOF_5]

Building height h [mm]	**10000**
Slope of roof [°]	**16**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**98.02**



Custom

System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

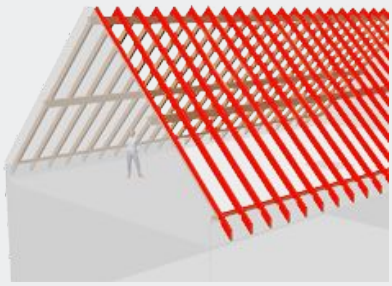
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**16**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

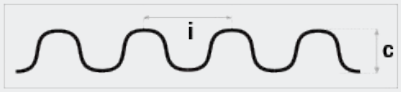
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

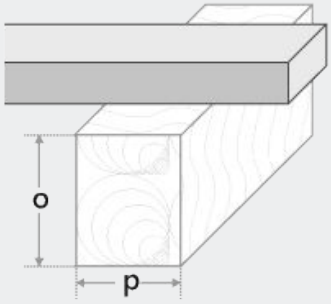
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_5]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**200**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





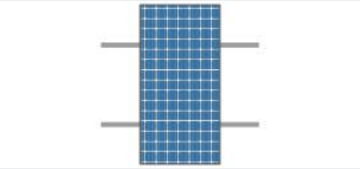


PV-MODULE [ROOF_5]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_5]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**20**
Max. Utilization of fixation points	**34 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_5]

Module rail	**Rail X60**
Max. utilization Module Profile	**44.55 %**

CLAMPS [ROOF_5]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**31.91 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**28.49 %**

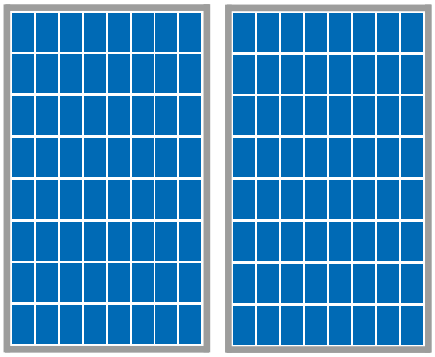
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_5]

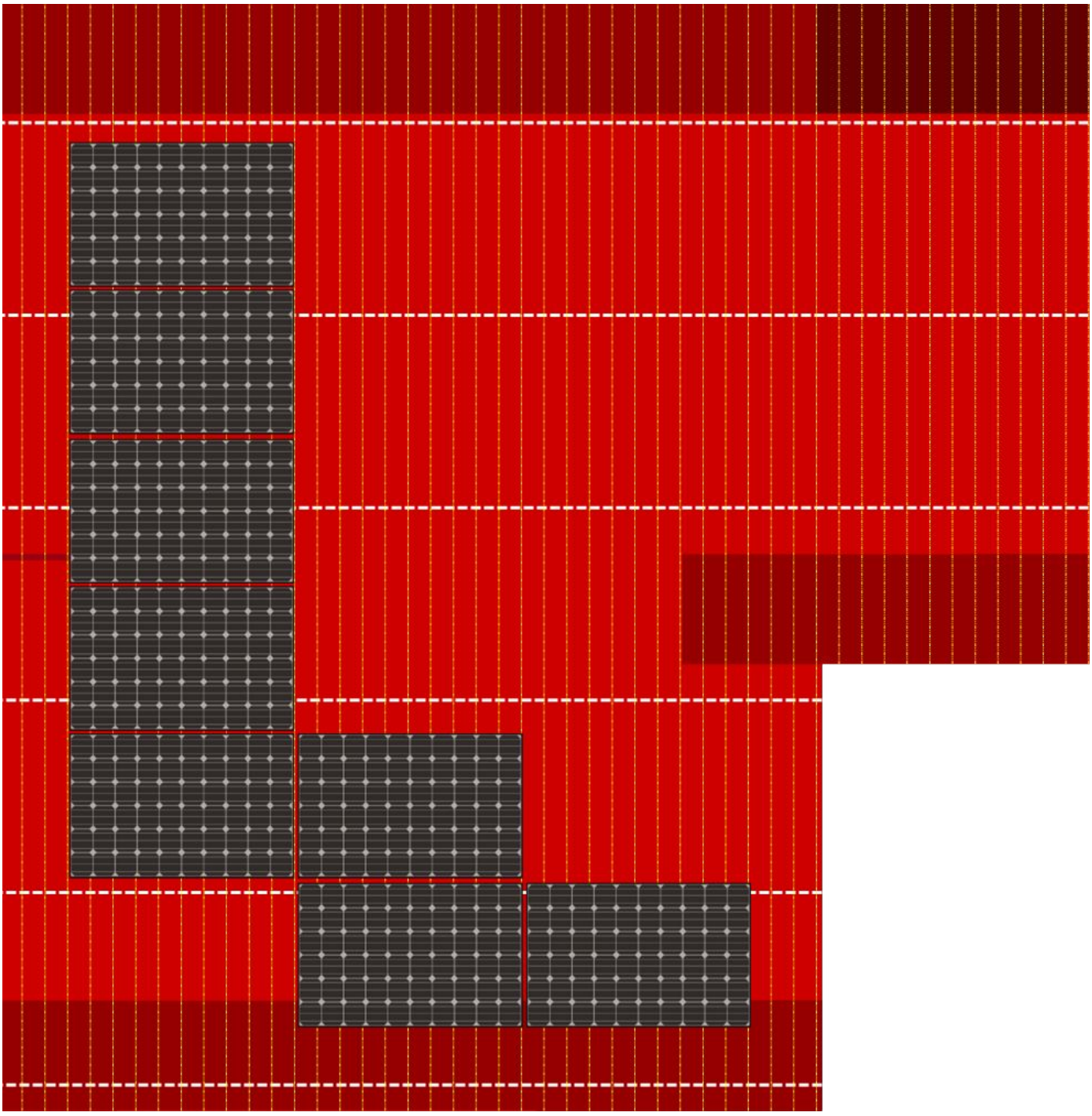
Allocated Roof Area	**15.98 m²**
Load on Allocated Area	**18.74 kN**
Max. Pressure (design):	**0.72 kN/m²**
Max. Tension (design):	**-1.32 kN/m²**
Total System weight	**206.58 kg**
Pressure on allocated Area	**0.13 kN/m²**

MODULE LAYOUT PLAN [ROOF_5]

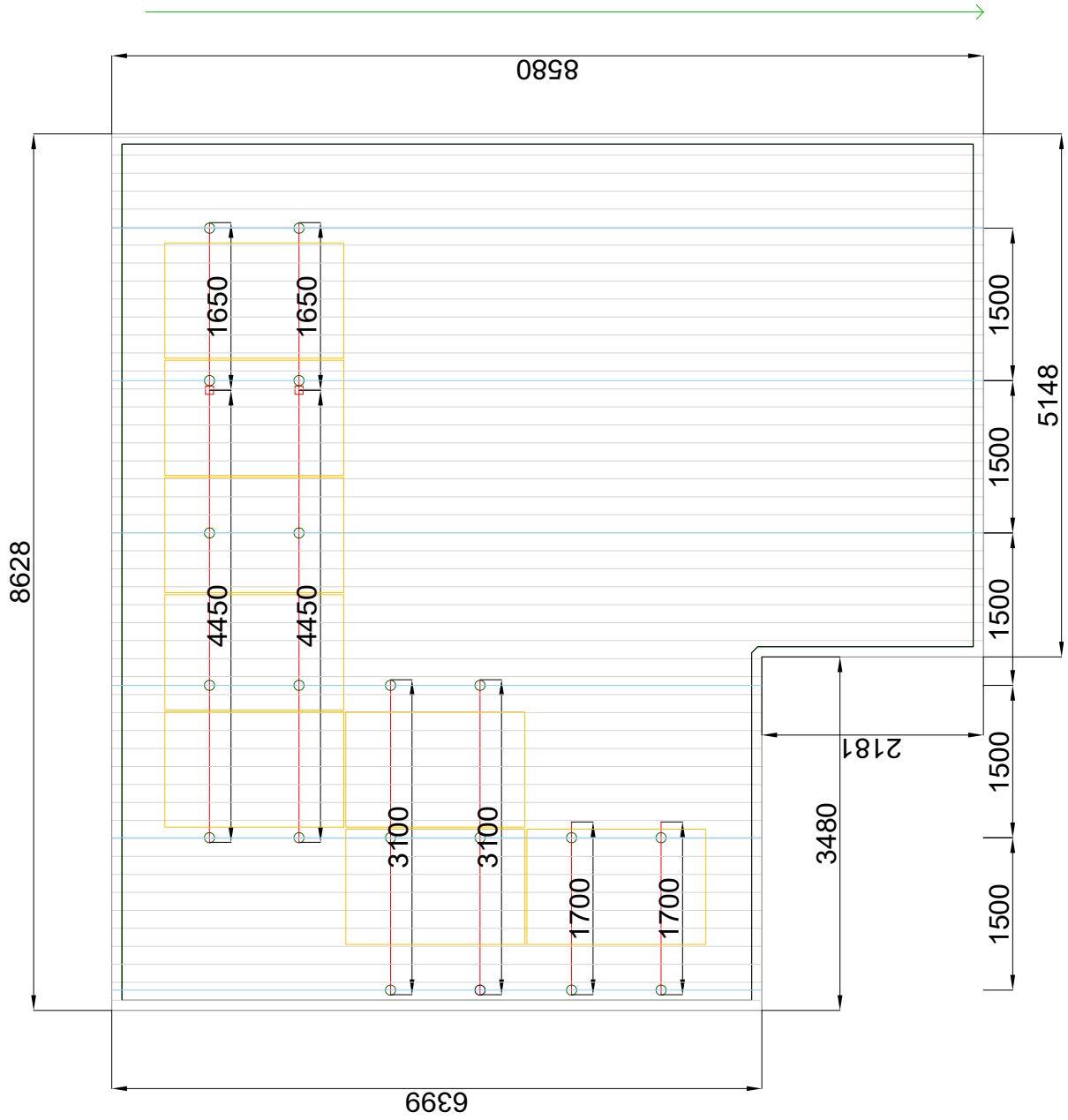
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



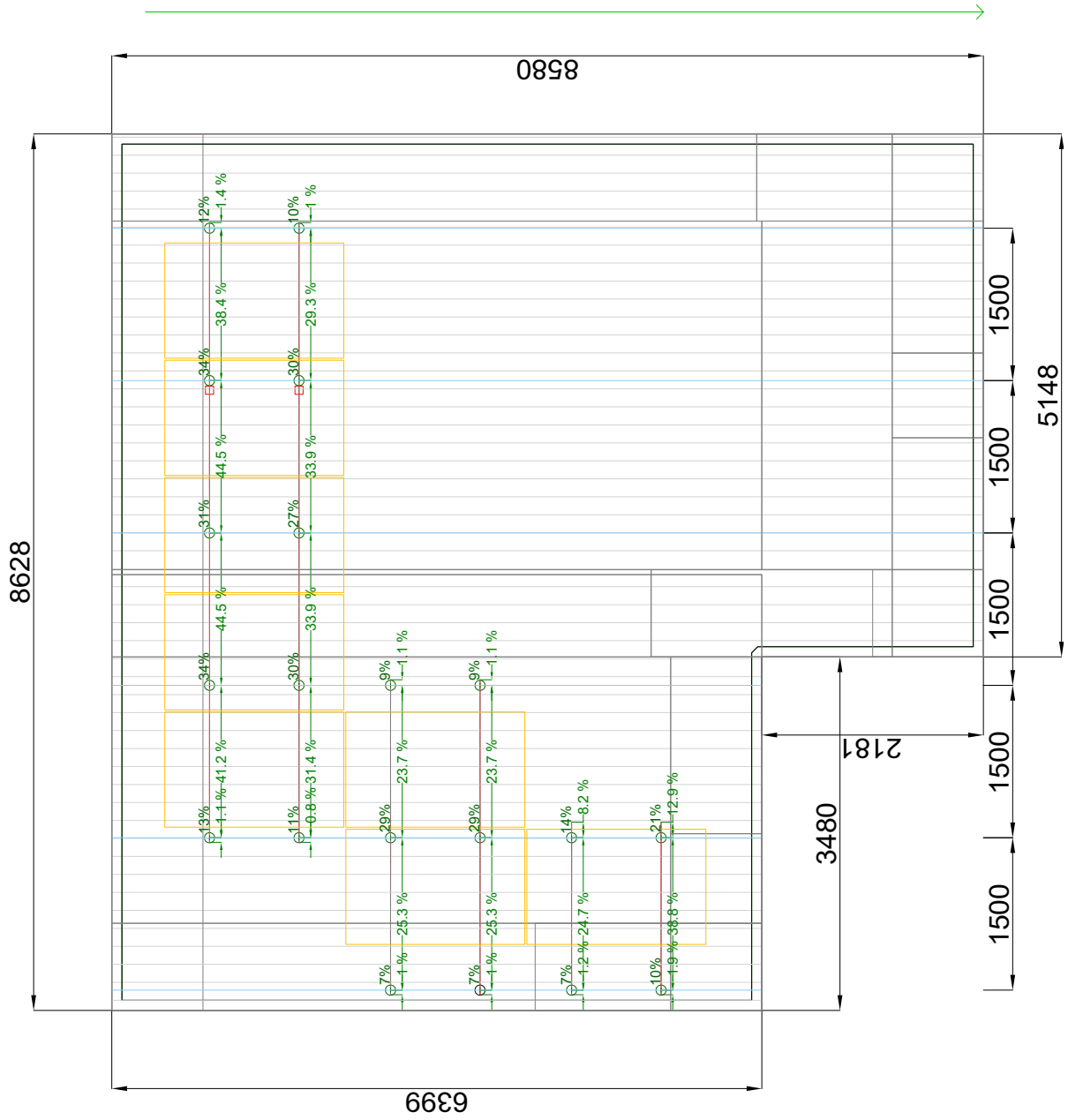
POSITION [ROOF_5]



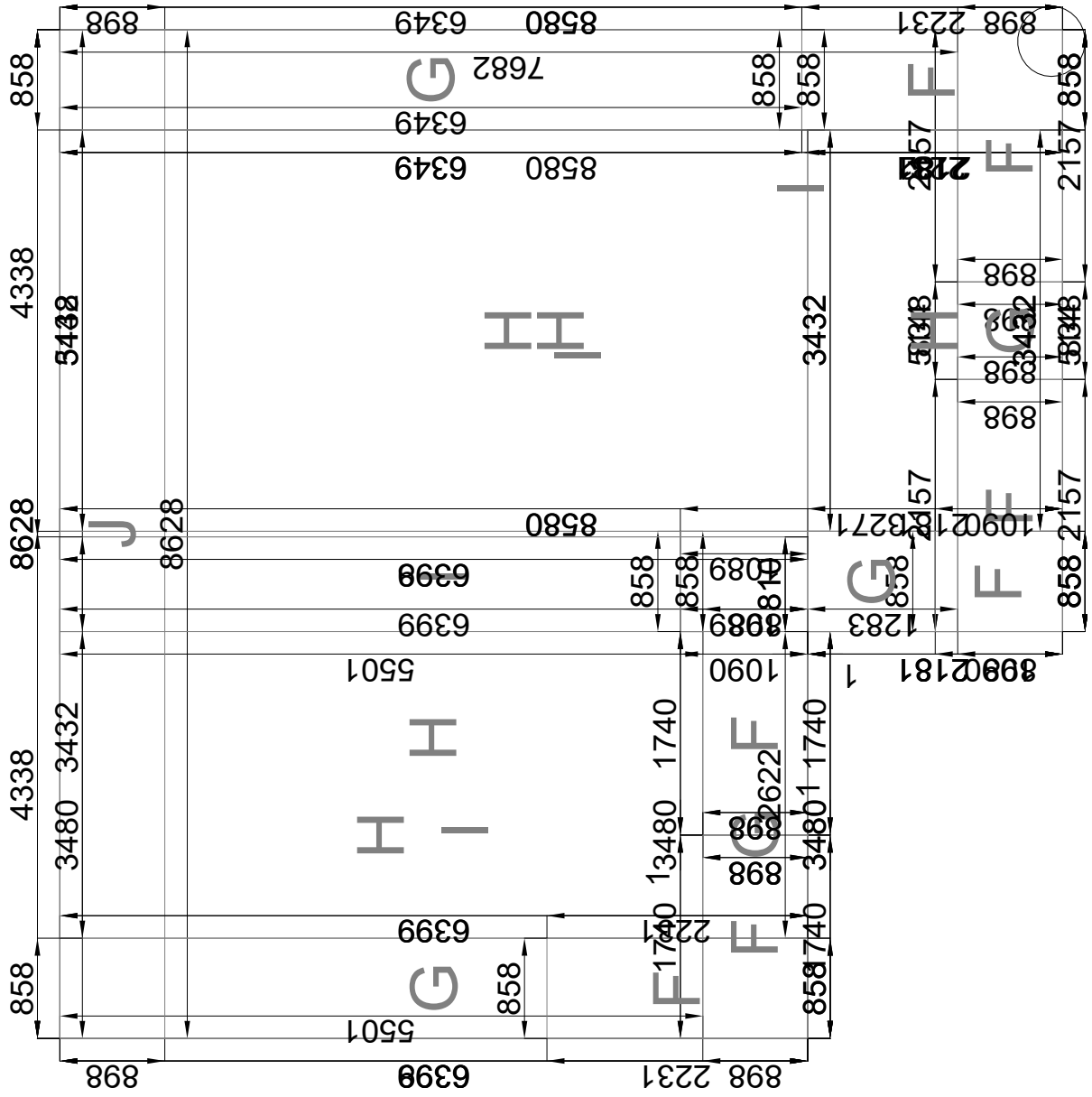
INSTALLATION-PLAN [ROOF_5]



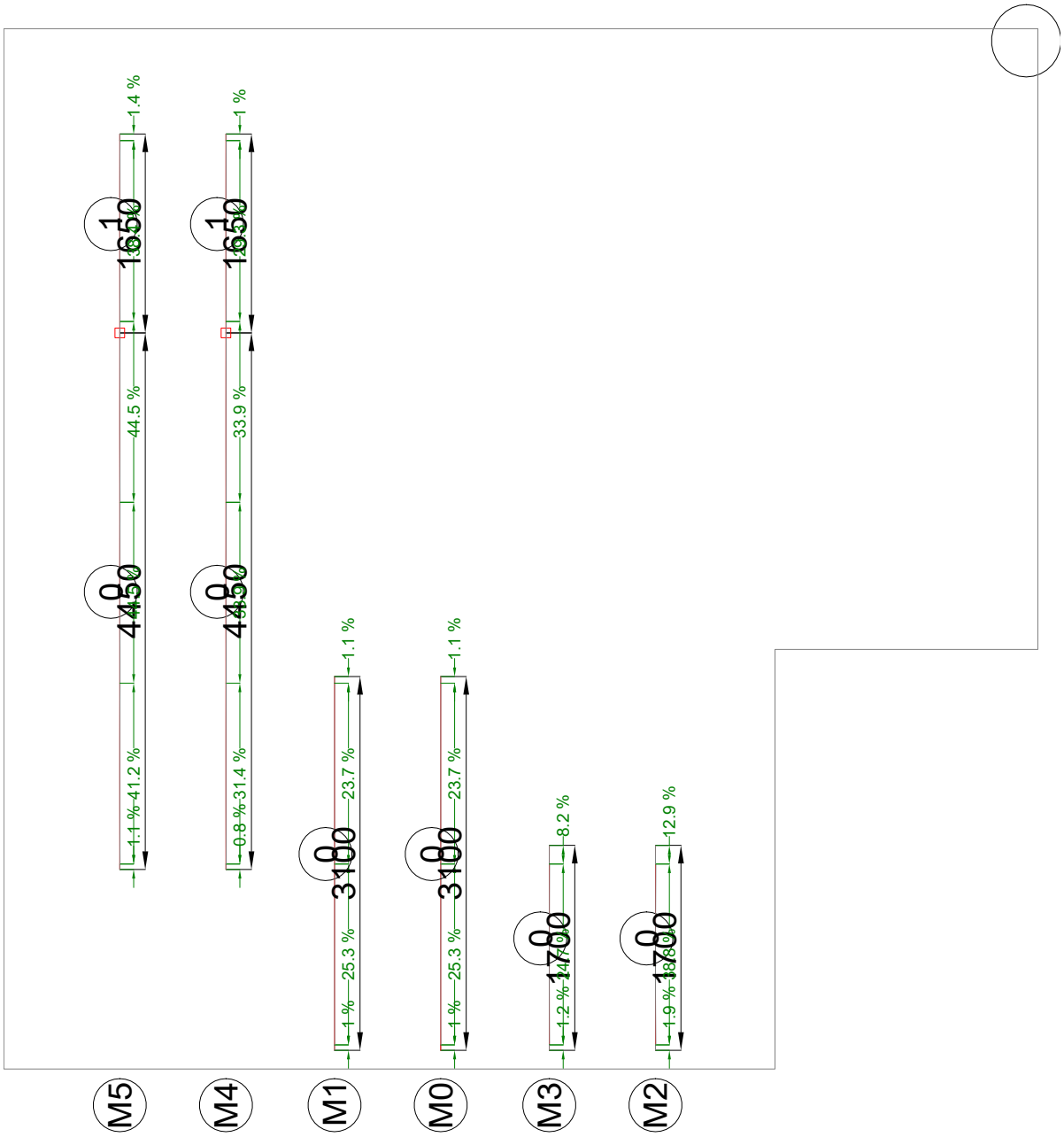
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_5]



STATIC INFORMATION: AREAS [ROOF_5]



RAIL CAPACITY [ROOF_5]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	16 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.12 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.11 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.032 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.22 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.062 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_5]

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.307**
Max. Suction	**0.46 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-0.46 kN/m²	0.029 kN/m²	0.46 kN/m²	183.64 °

AREA F 0

Tributary area	**10 m²**
Cpe Suction	**-0.873**
Max. Suction	**1.5 kN/m²**
Cpe Pressure	**0.233**
Max. downward load	**0.75 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.73 kN/m²	0.14 kN/m²	0.75 kN/m²	10.57 °
LC 2	0.74 kN/m²	0.09 kN/m²	0.75 kN/m²	6.94 °
LC 3	-1.5 kN/m²	0.029 kN/m²	1.5 kN/m²	181.12 °

AREA G 0

Tributary area	**10 m²**
Cpe Suction	**-0.78**
Max. Suction	**1.33 kN/m²**
Cpe Pressure	**0.233**
Max. downward load	**0.75 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.73 kN/m²	0.14 kN/m²	0.75 kN/m²	10.57 °
LC 2	0.74 kN/m²	0.09 kN/m²	0.75 kN/m²	6.94 °
LC 3	-1.33 kN/m²	0.029 kN/m²	1.33 kN/m²	181.26 °

RESULTING SURFACE STRESSES [ROOF_5]

AREA J 180

Tributary area	**10 m²**
Cpe Suction	**-0.98**
Max. Suction	**1.69 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.69 kN/m²	0.029 kN/m²	1.69 kN/m²	180.99 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.5**
Max. Suction	**0.81 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-0.81 kN/m²	0.029 kN/m²	0.81 kN/m²	182.06 °

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.613**
Max. Suction	**1.02 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.02 kN/m²	0.029 kN/m²	1.02 kN/m²	181.64 °

RESULTING SURFACE STRESSES [ROOF_5]

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.287**
Max. Suction	**2.25 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-2.25 kN/m²	0.029 kN/m²	2.25 kN/m²	180.74 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.213**
Max. Suction	**2.12 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-2.12 kN/m²	0.029 kN/m²	2.12 kN/m²	180.79 °

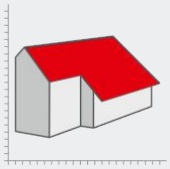
MATERIAL LIST [ROOF_5]

Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**8**	0.016
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**5**	**5**	26.375
	705225	XPCN60 rail connector X60	1	**2**	**2**	0.342
	705226	XCL60 side-lid left for rail X60	1	**6**	**6**	0.030
	705227	XCR60 side-lid right for rail X60	1	**6**	**6**	0.030
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**20**	**20**	10.220
	706457	CLP-R cable clip rail	1	**150**	**8**	0.032
	707003	CLE10 End clamp Click 30-46	1	**20**	**12**	0.900
	707011	CLM10 Middle clamp Click 30-46	1	**10**	**10**	0.640
						38.59

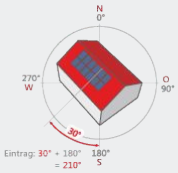
ROOF [ROOF_6]

Building height h [mm]	**10000**
Slope of roof [°]	**16**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**98.02**

Custom



System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

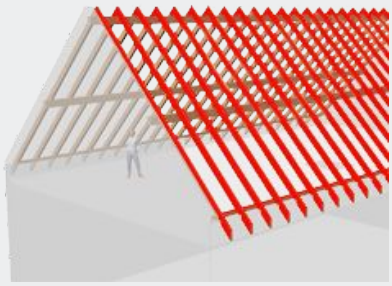
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**16**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

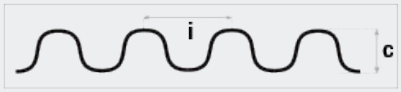
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

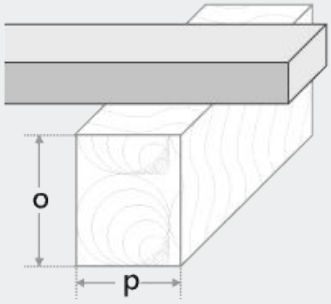
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_6]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**600**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





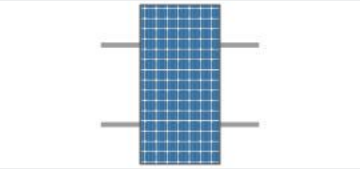


PV-MODULE [ROOF_6]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_6]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**12**
Max. Utilization of fixation points	**37 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_6]

Module rail	**Rail X60**
Max. utilization Module Profile	**59.87 %**

CLAMPS [ROOF_6]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**66.69 %**

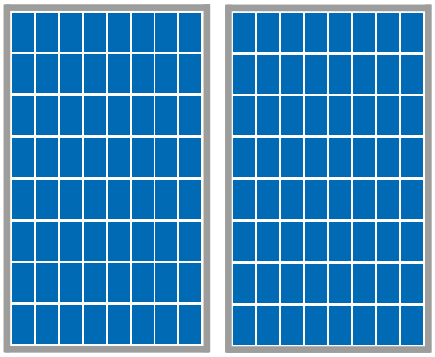
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_6]

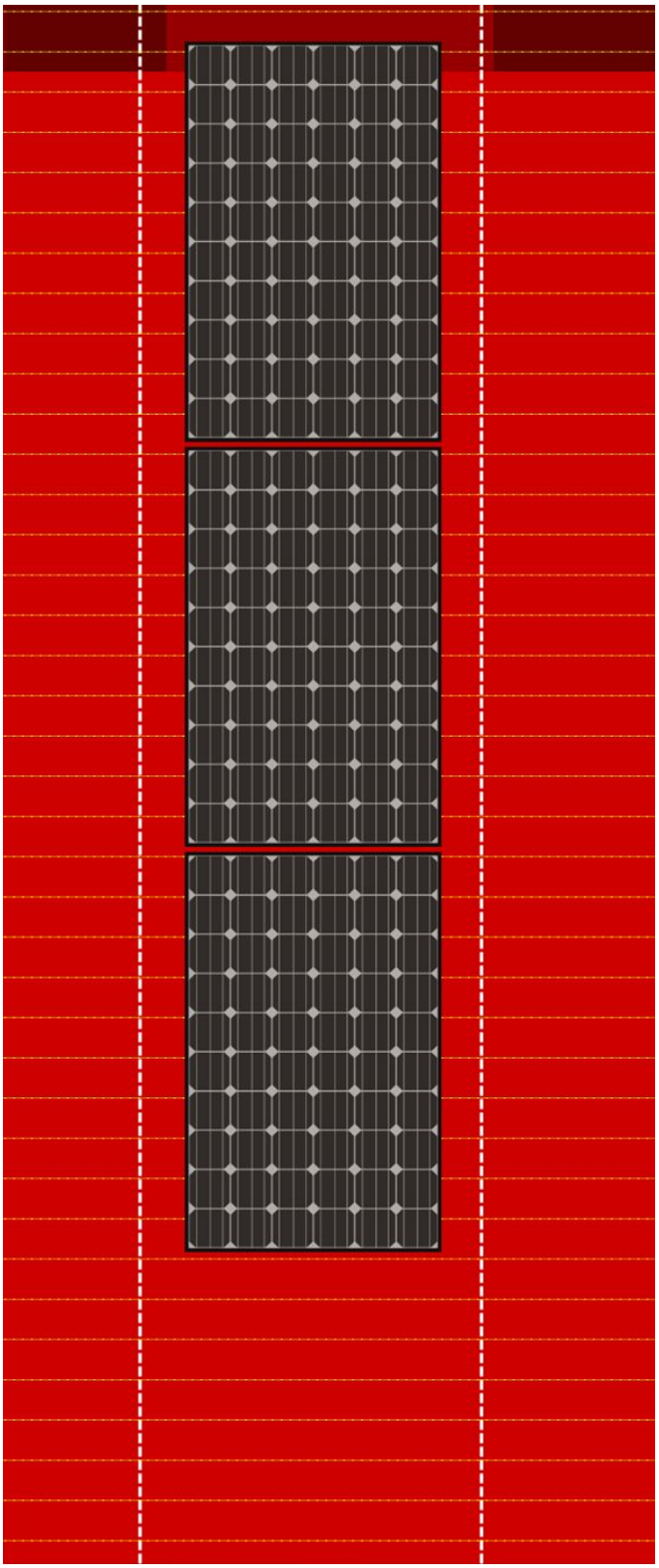
Allocated Roof Area	**5.99 m²**
Load on Allocated Area	**20.78 kN**
Max. Pressure (design):	**0.71 kN/m²**
Max. Tension (design):	**-3.89 kN/m²**
Total System weight	**80.66 kg**
Pressure on allocated Area	**0.13 kN/m²**

MODULE LAYOUT PLAN [ROOF_6]

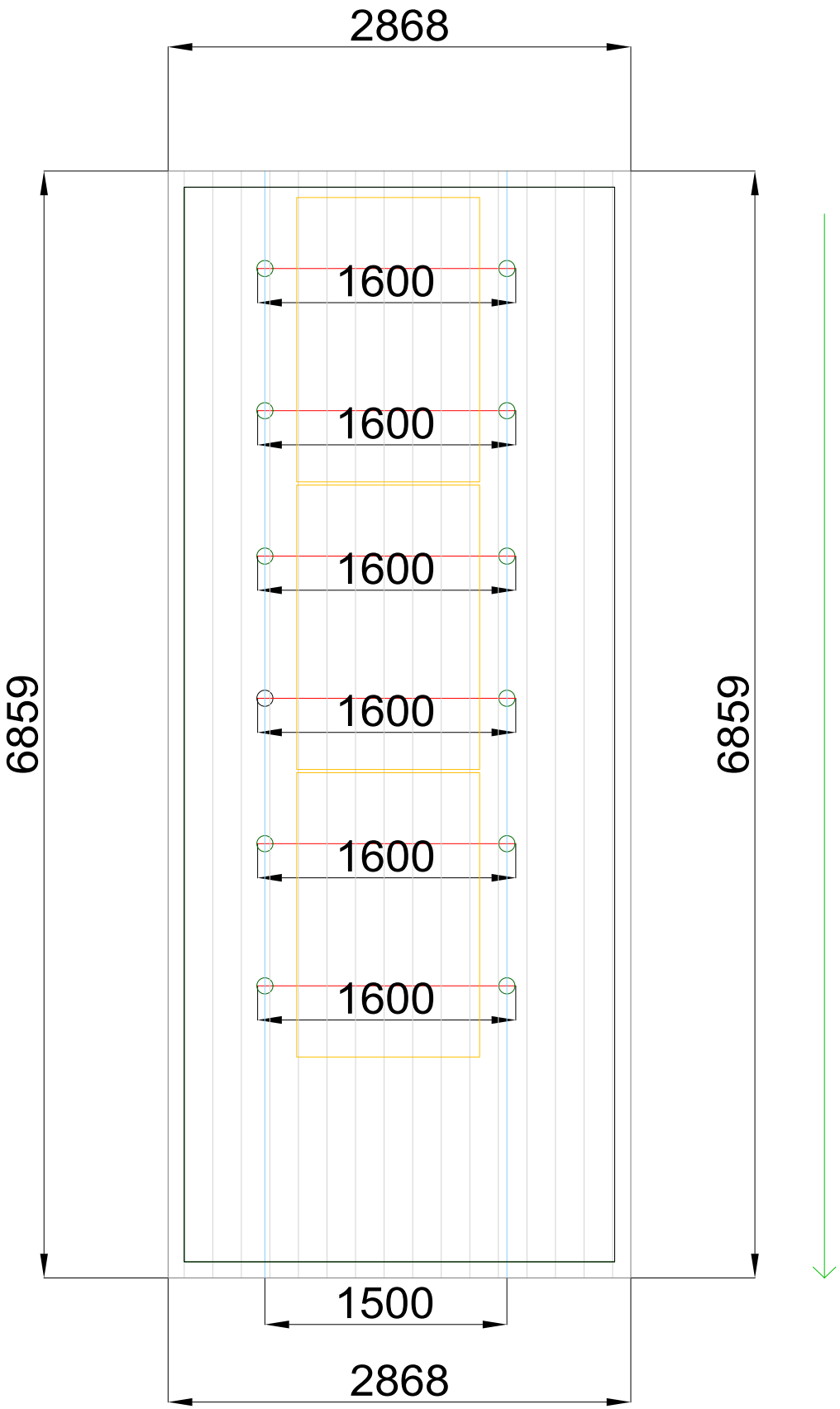
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



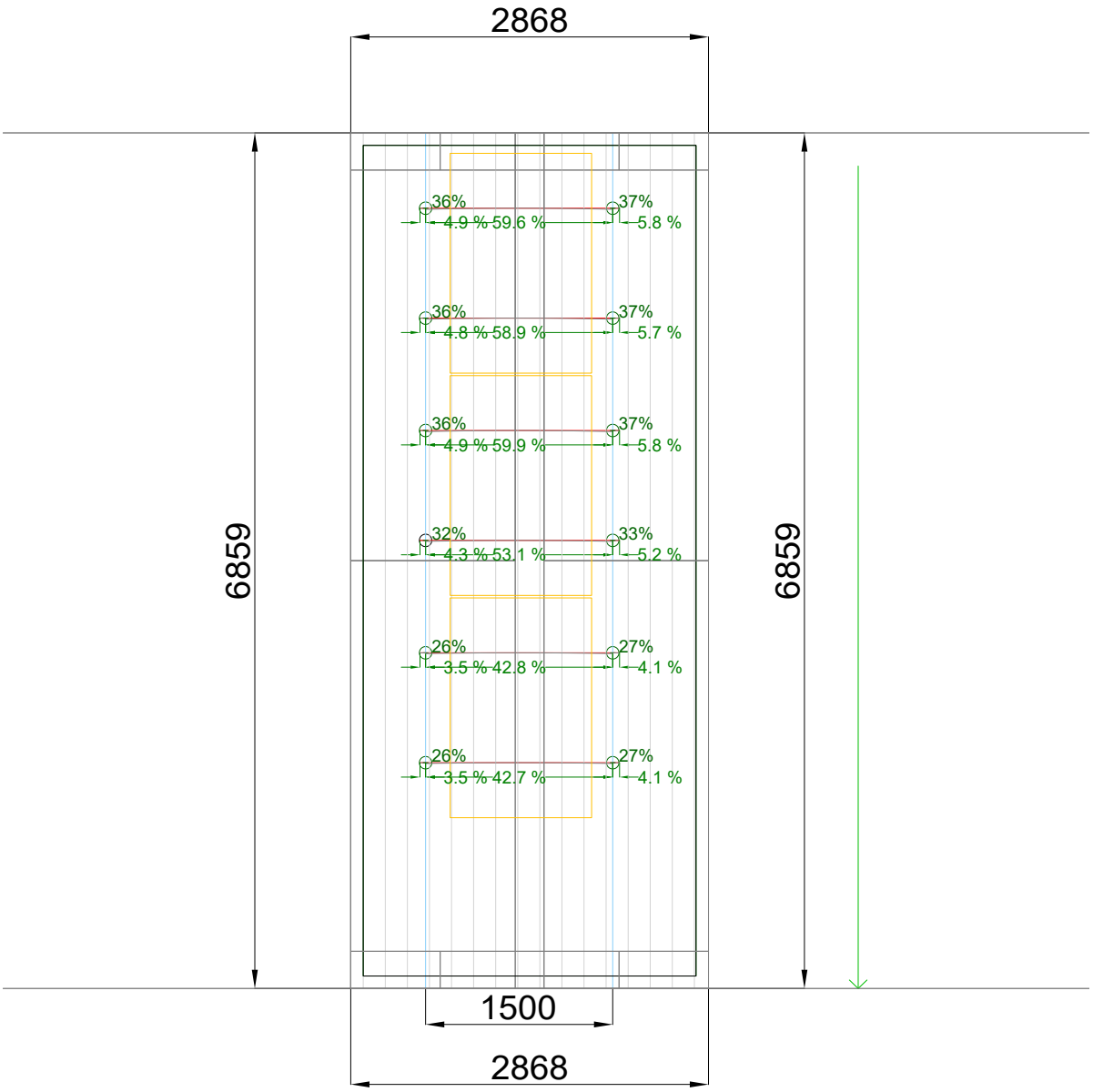
POSITION [ROOF_6]



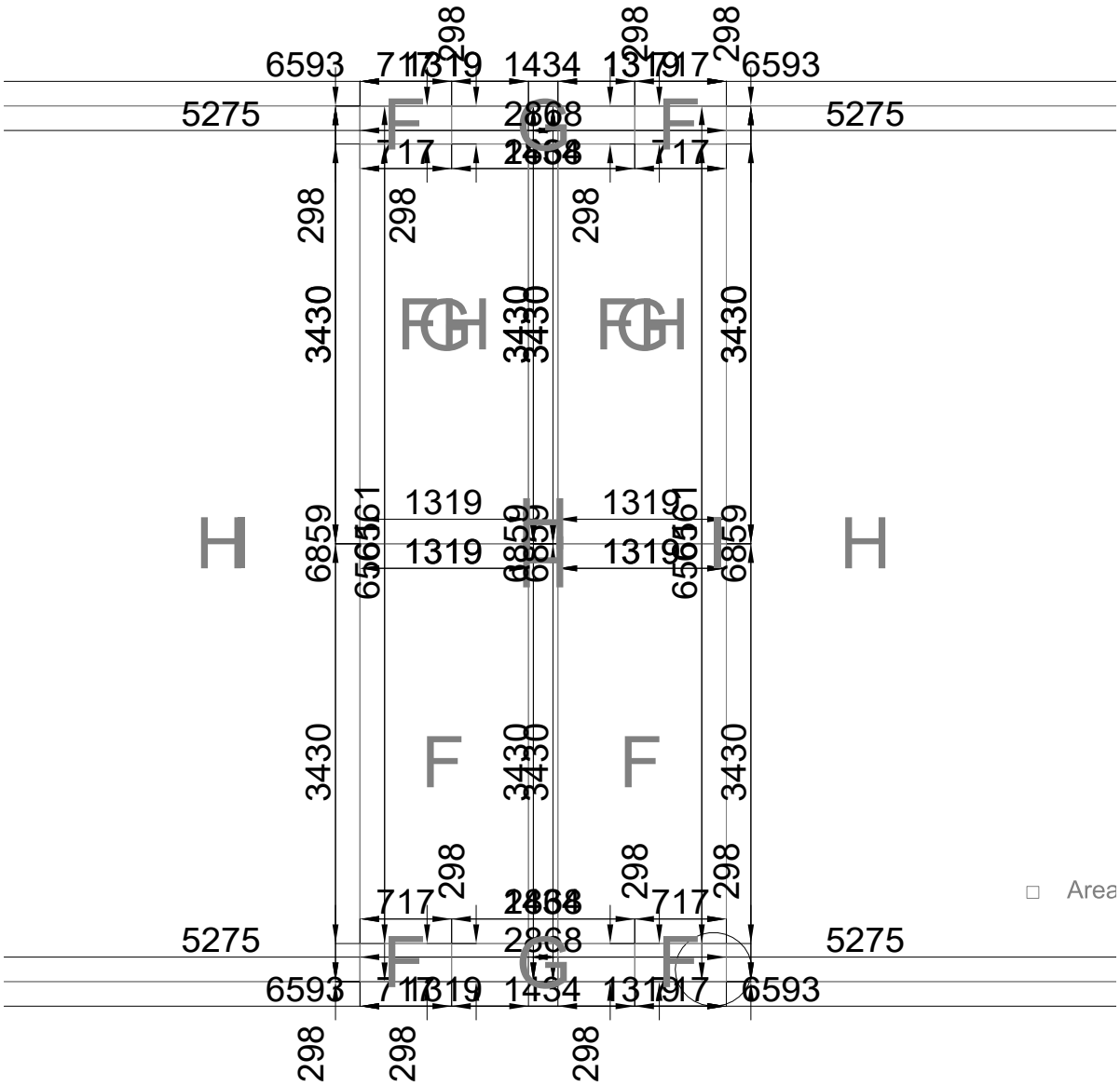
INSTALLATION-PLAN [ROOF_6]



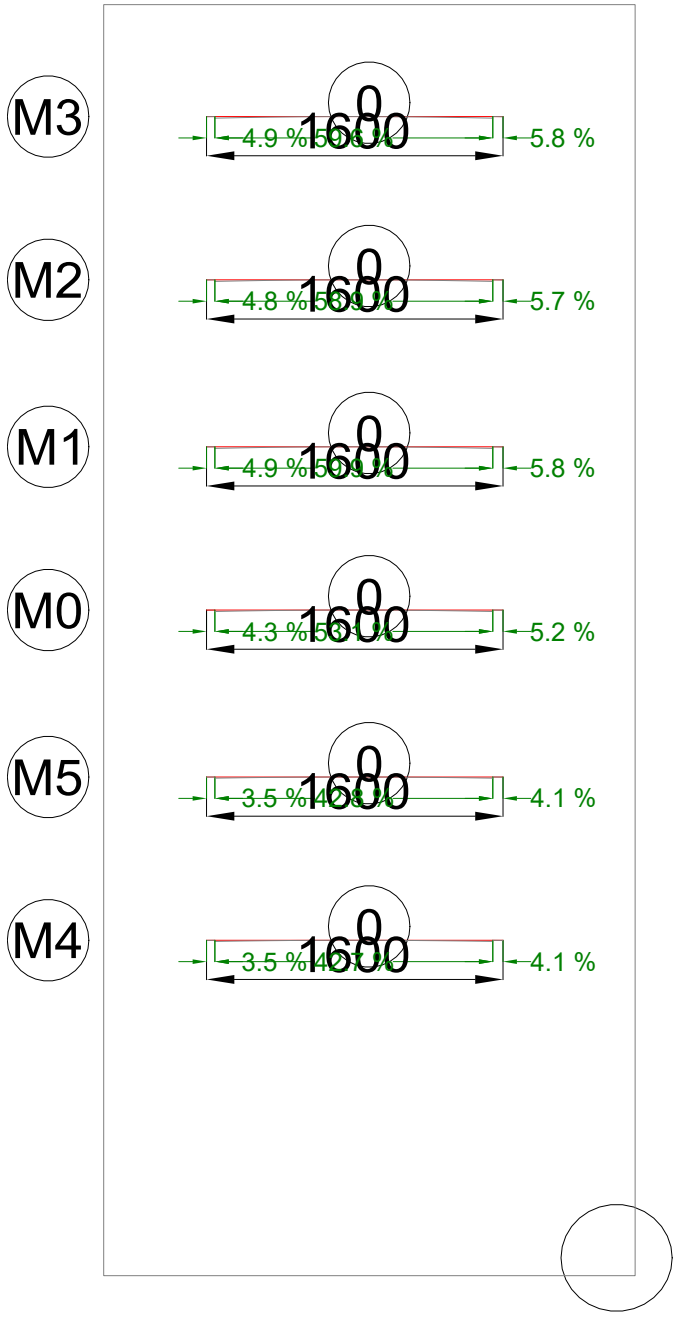
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_6]



STATIC INFORMATION: AREAS [ROOF_6]



RAIL CAPACITY [ROOF_6]



– Modi

RESULTING SURFACE STRESSES BASICS

Roof pitch	α	16 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.12 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.11 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.032 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.22 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.062 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_6]

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.58**
Max. Suction	**2.79 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-2.79 kN/m²	0.029 kN/m²	2.79 kN/m²	180.6 °

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.58**
Max. Suction	**2.79 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-2.79 kN/m²	0.029 kN/m²	2.79 kN/m²	180.6 °

AREA FH 90

Tributary area	**10 m²**
Cpe Suction	**-2.38**
Max. Suction	**4.25 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-4.25 kN/m²	0.029 kN/m²	4.25 kN/m²	180.39 °

RESULTING SURFACE STRESSES [ROOF_6]

AREA FH 90

Tributary area	**10 m²**
Cpe Suction	**-2.38**
Max. Suction	**4.25 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-4.25 kN/m²	0.029 kN/m²	4.25 kN/m²	180.39 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.873**
Max. Suction	**3.33 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-3.33 kN/m²	0.029 kN/m²	3.33 kN/m²	180.5 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.873**
Max. Suction	**3.33 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-3.33 kN/m²	0.029 kN/m²	3.33 kN/m²	180.5 °

RESULTING SURFACE STRESSES [ROOF_6]

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.813**
Max. Suction	**1.39 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.39 kN/m²	0.029 kN/m²	1.39 kN/m²	181.21 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.707**
Max. Suction	**1.19 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.19 kN/m²	0.029 kN/m²	1.19 kN/m²	181.41 °

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.813**
Max. Suction	**1.39 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.39 kN/m²	0.029 kN/m²	1.39 kN/m²	181.21 °

RESULTING SURFACE STRESSES [ROOF_6]

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.707**
Max. Suction	**1.19 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.19 kN/m²	0.029 kN/m²	1.19 kN/m²	181.41 °

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.293**
Max. Suction	**0.44 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-0.43 kN/m²	0.029 kN/m²	0.44 kN/m²	183.84 °

AREA G 180

Tributary area	**10 m²**
Cpe Suction	**-1.267**
Max. Suction	**2.22 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-2.22 kN/m²	0.029 kN/m²	2.22 kN/m²	180.76 °

RESULTING SURFACE STRESSES [ROOF_6]

AREA H 180

Tributary area	**10 m²**
Cpe Suction	**-0.893**
Max. Suction	**1.53 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

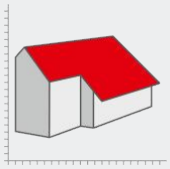
LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.53 kN/m²	0.029 kN/m²	1.53 kN/m²	181.09 °

MATERIAL LIST [ROOF_6]

Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**3**	0.006
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**2**	**2**	10.550
	705226	XCL60 side-lid left for rail X60	1	**6**	**6**	0.030
	705227	XCR60 side-lid right for rail X60	1	**6**	**6**	0.030
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**12**	**12**	6.132
	706457	CLP-R cable clip rail	1	**150**	**3**	0.012
	707003	CLE10 End clamp Click 30-46	1	**20**	**12**	0.900
						17.66

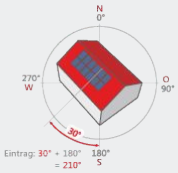
ROOF [ROOF_7]

Building height h [mm]	**10000**
Slope of roof [°]	**16**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**98.02**



Custom

System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

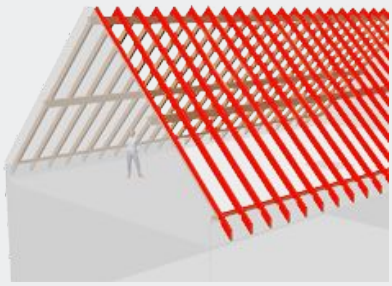
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**16**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

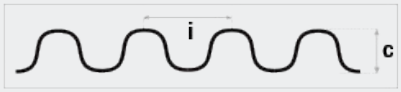
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

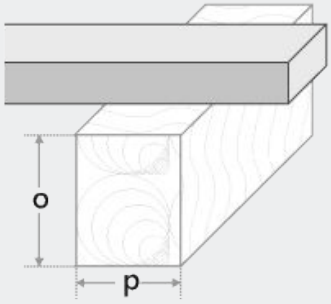
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_7]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**600**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





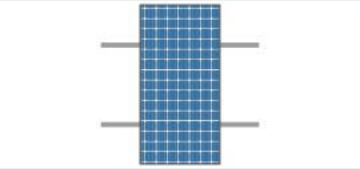


PV-MODULE [ROOF_7]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_7]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**32**
Max. Utilization of fixation points	**62 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_7]

Module rail	**Rail X60**
Max. utilization Module Profile	**105.01 %**

CLAMPS [ROOF_7]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**67.1 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**69.53 %**

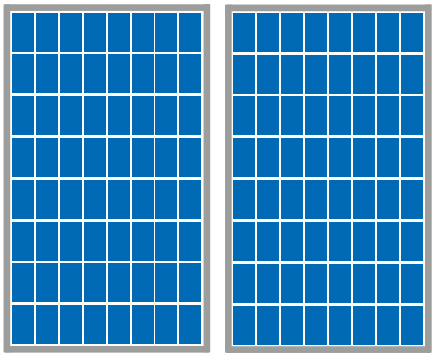
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_7]

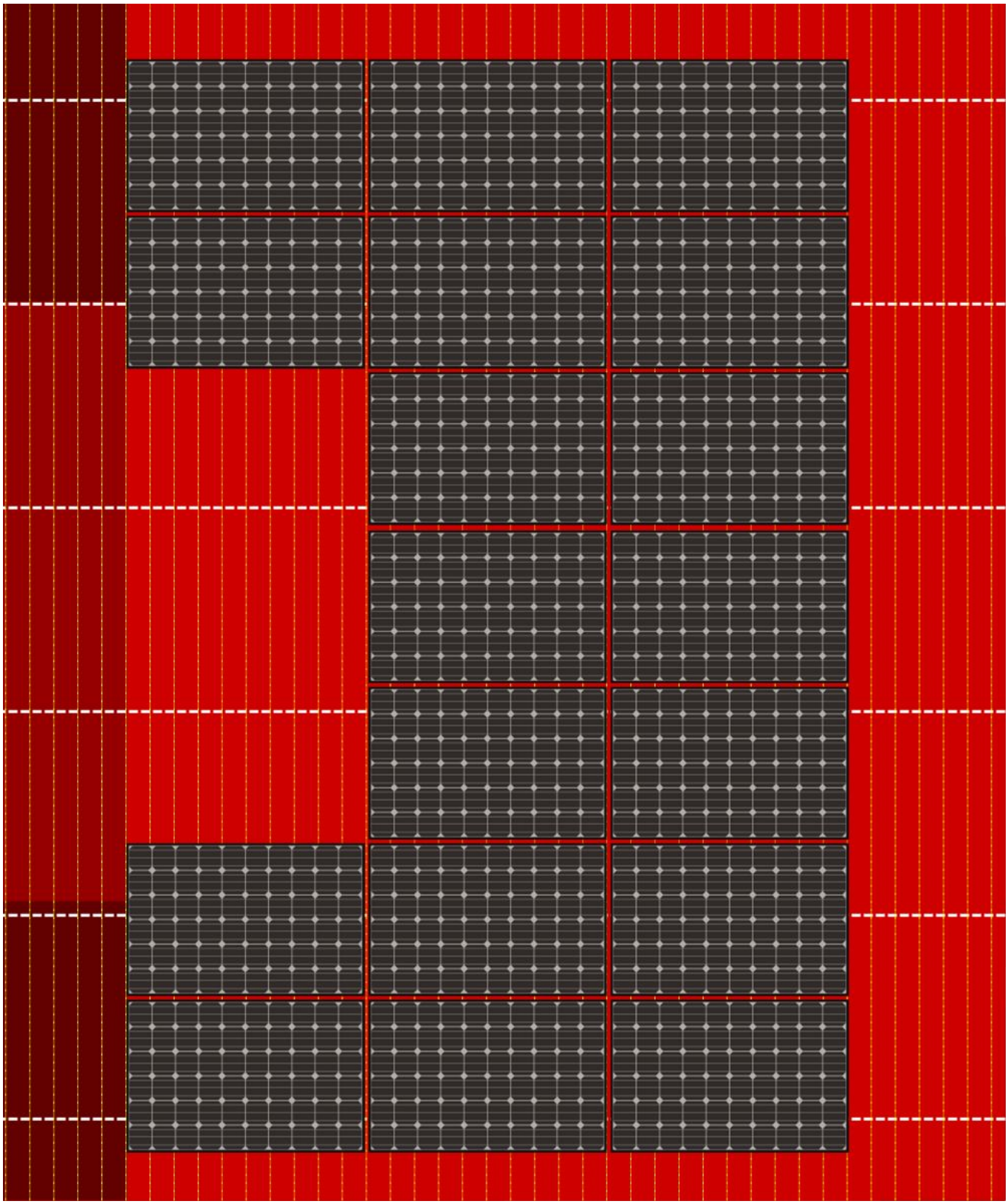
Allocated Roof Area	**35.97 m²**
Load on Allocated Area	**77.41 kN**
Max. Pressure (design):	**0.71 kN/m²**
Max. Tension (design):	**-4.1 kN/m²**
Total System weight	**440.42 kg**
Pressure on allocated Area	**0.12 kN/m²**

MODULE LAYOUT PLAN [ROOF_7]

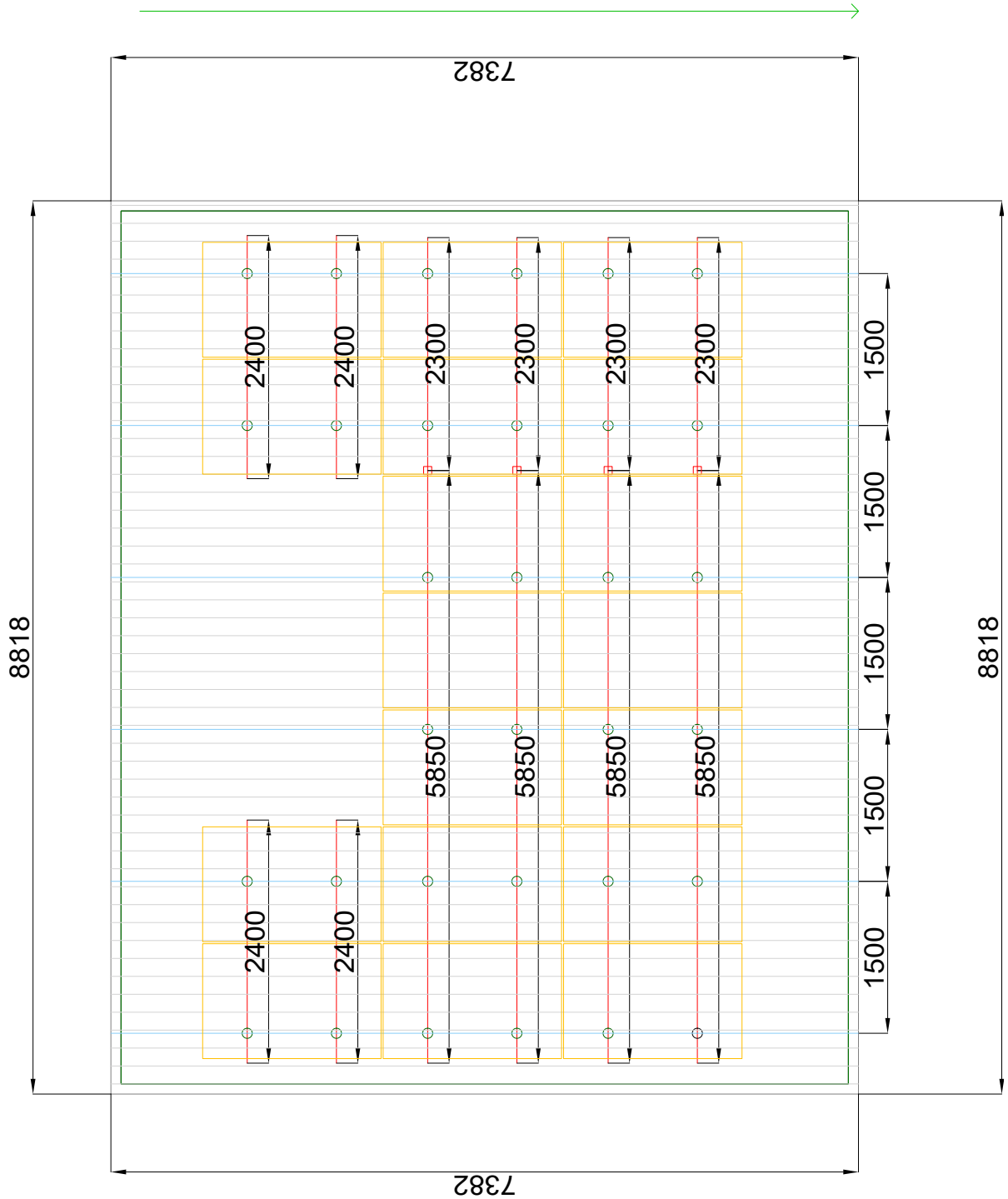
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



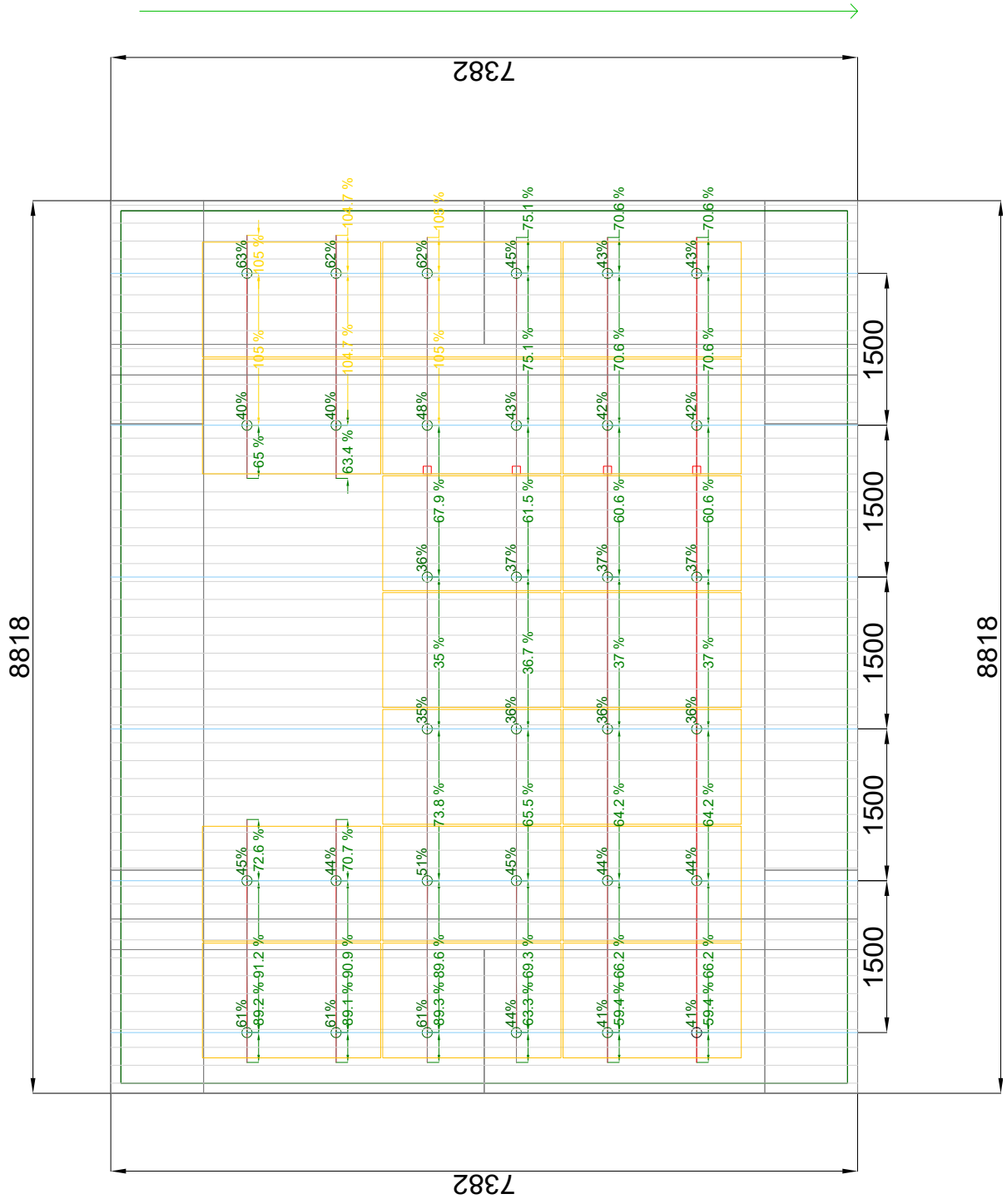
POSITION [ROOF_7]



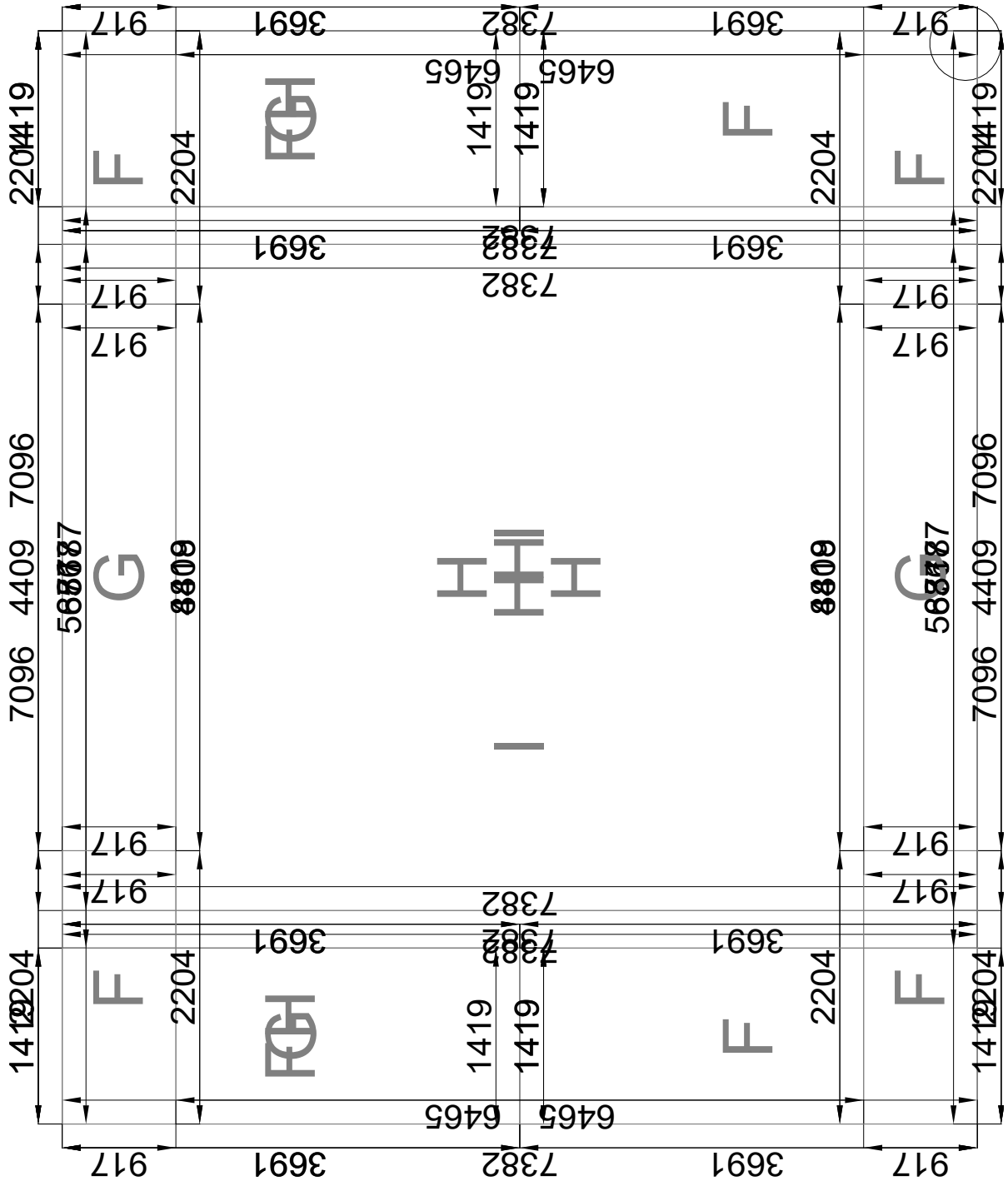
INSTALLATION-PLAN [ROOF_7]



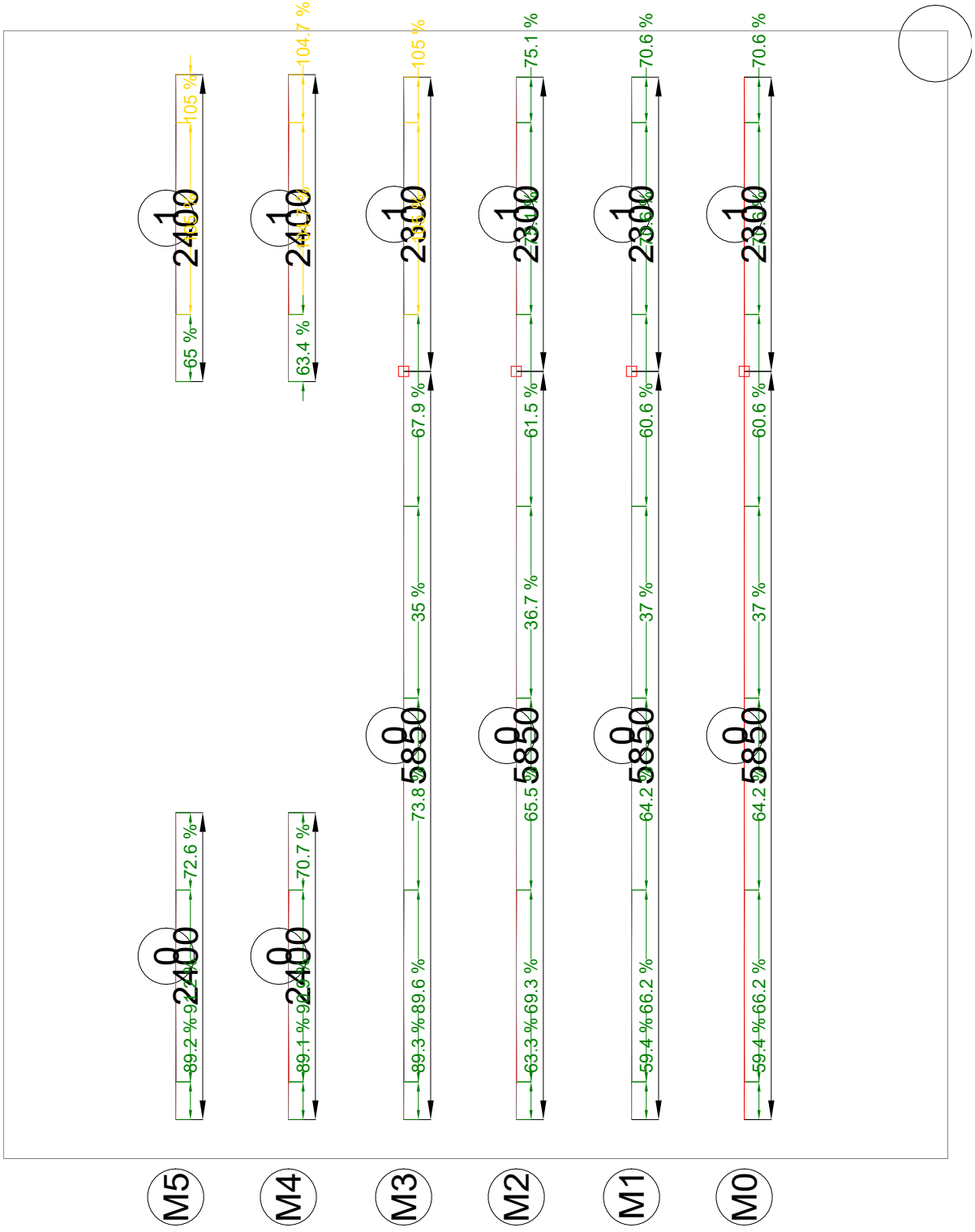
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_7]



STATIC INFORMATION: AREAS [ROOF_7]



RAIL CAPACITY [ROOF_7]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	16 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.12 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.11 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.032 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.22 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.062 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_7]

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.58**
Max. Suction	**2.79 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-2.79 kN/m²	0.029 kN/m²	2.79 kN/m²	180.6 °

AREA FH 90

Tributary area	**10 m²**
Cpe Suction	**-2.38**
Max. Suction	**4.25 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-4.25 kN/m²	0.029 kN/m²	4.25 kN/m²	180.39 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.873**
Max. Suction	**3.33 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-3.33 kN/m²	0.029 kN/m²	3.33 kN/m²	180.5 °

RESULTING SURFACE STRESSES [ROOF_7]

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.813**
Max. Suction	**1.39 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.39 kN/m²	0.029 kN/m²	1.39 kN/m²	181.21 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.707**
Max. Suction	**1.19 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.19 kN/m²	0.029 kN/m²	1.19 kN/m²	181.41 °

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.293**
Max. Suction	**0.44 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-0.43 kN/m²	0.029 kN/m²	0.44 kN/m²	183.84 °

RESULTING SURFACE STRESSES [ROOF_7]

AREA F 180

Tributary area	**10 m²**
Cpe Suction	**-2.407**
Max. Suction	**4.3 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-4.3 kN/m²	0.029 kN/m²	4.3 kN/m²	180.39 °

AREA G 180

Tributary area	**10 m²**
Cpe Suction	**-1.267**
Max. Suction	**2.22 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-2.22 kN/m²	0.029 kN/m²	2.22 kN/m²	180.76 °

AREA H 180

Tributary area	**10 m²**
Cpe Suction	**-0.893**
Max. Suction	**1.53 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

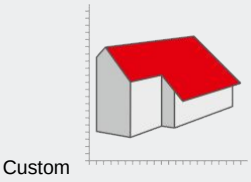
LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.53 kN/m²	0.029 kN/m²	1.53 kN/m²	181.09 °

MATERIAL LIST [ROOF_7]

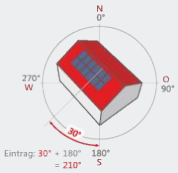
Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**18**	0.036
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**8**	**8**	42.200
	705225	XPCN60 rail connector X60	1	**4**	**4**	0.684
	705226	XCL60 side-lid left for rail X60	1	**8**	**8**	0.040
	705227	XCR60 side-lid right for rail X60	1	**8**	**8**	0.040
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**32**	**32**	16.352
	706457	CLP-R cable clip rail	1	**150**	**18**	0.072
	707003	CLE10 End clamp Click 30-46	1	**20**	**16**	1.200
	707011	CLM10 Middle clamp Click 30-46	1	**30**	**28**	1.792
						62.42

ROOF [ROOF_8]

Building height h [mm]	**10000**
Slope of roof [°]	**16**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**98.02**



System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

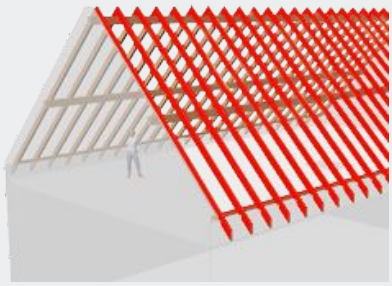
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**16**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

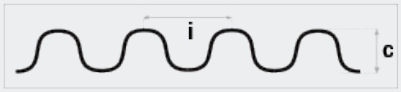
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

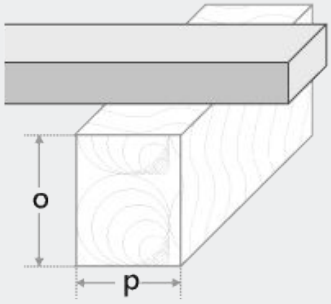
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_8]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**1000**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





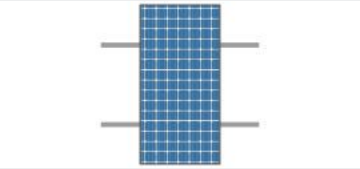


PV-MODULE [ROOF_8]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_8]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**8**
Max. Utilization of fixation points	**46 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_8]

Module rail	**Rail X60**
Max. utilization Module Profile	**84.98 %**

CLAMPS [ROOF_8]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**56.67 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**44.28 %**

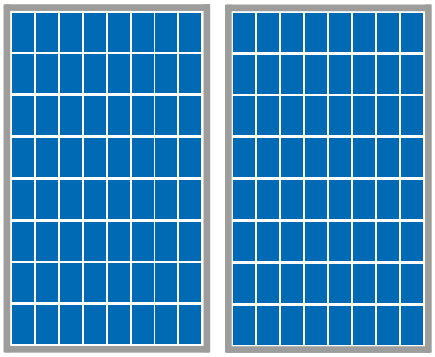
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_8]

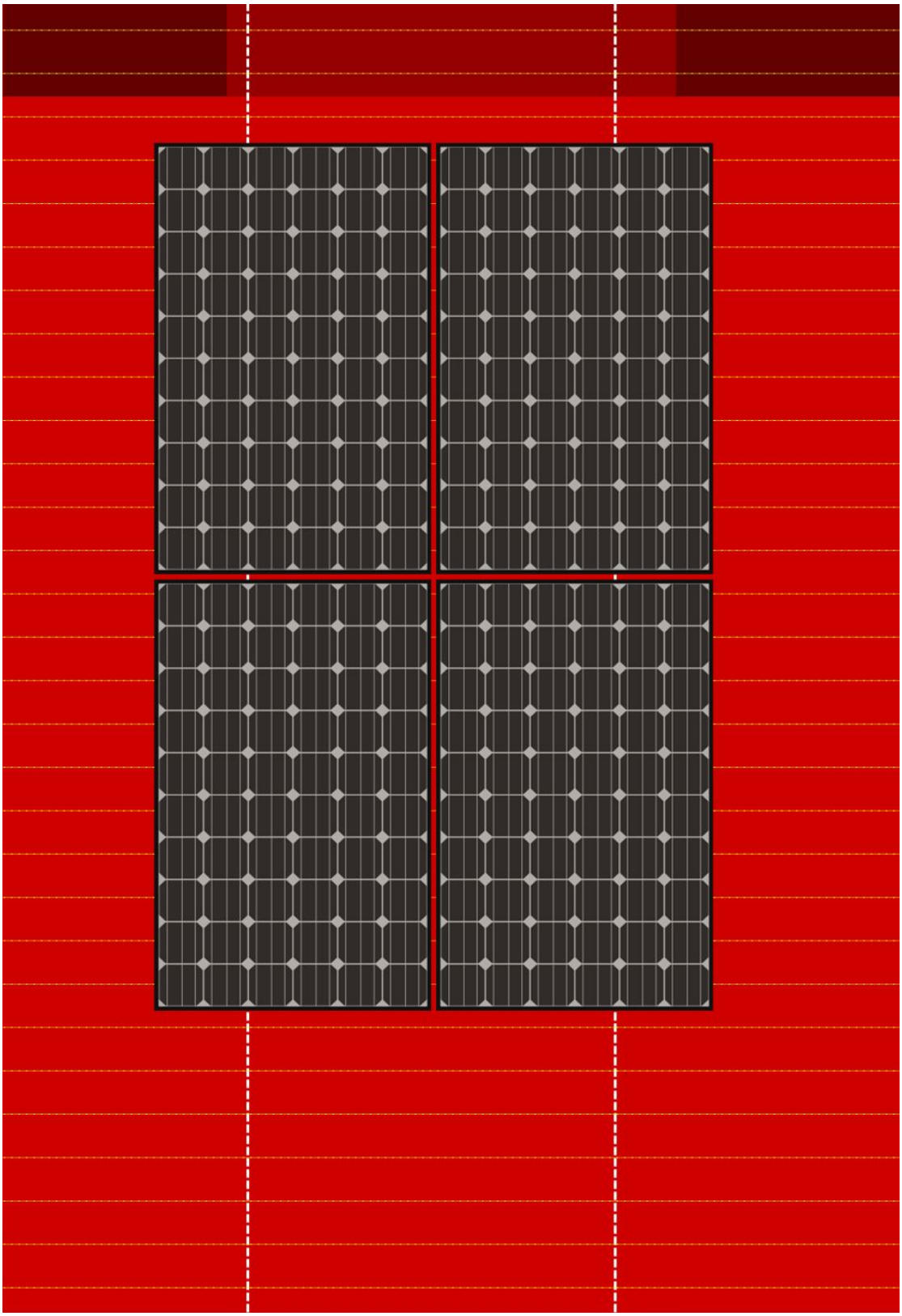
Allocated Roof Area	**7.99 m²**
Load on Allocated Area	**17.59 kN**
Max. Pressure (design):	**0.75 kN/m²**
Max. Tension (design):	**-2.55 kN/m²**
Total System weight	**99.56 kg**
Pressure on allocated Area	**0.12 kN/m²**

MODULE LAYOUT PLAN [ROOF_8]

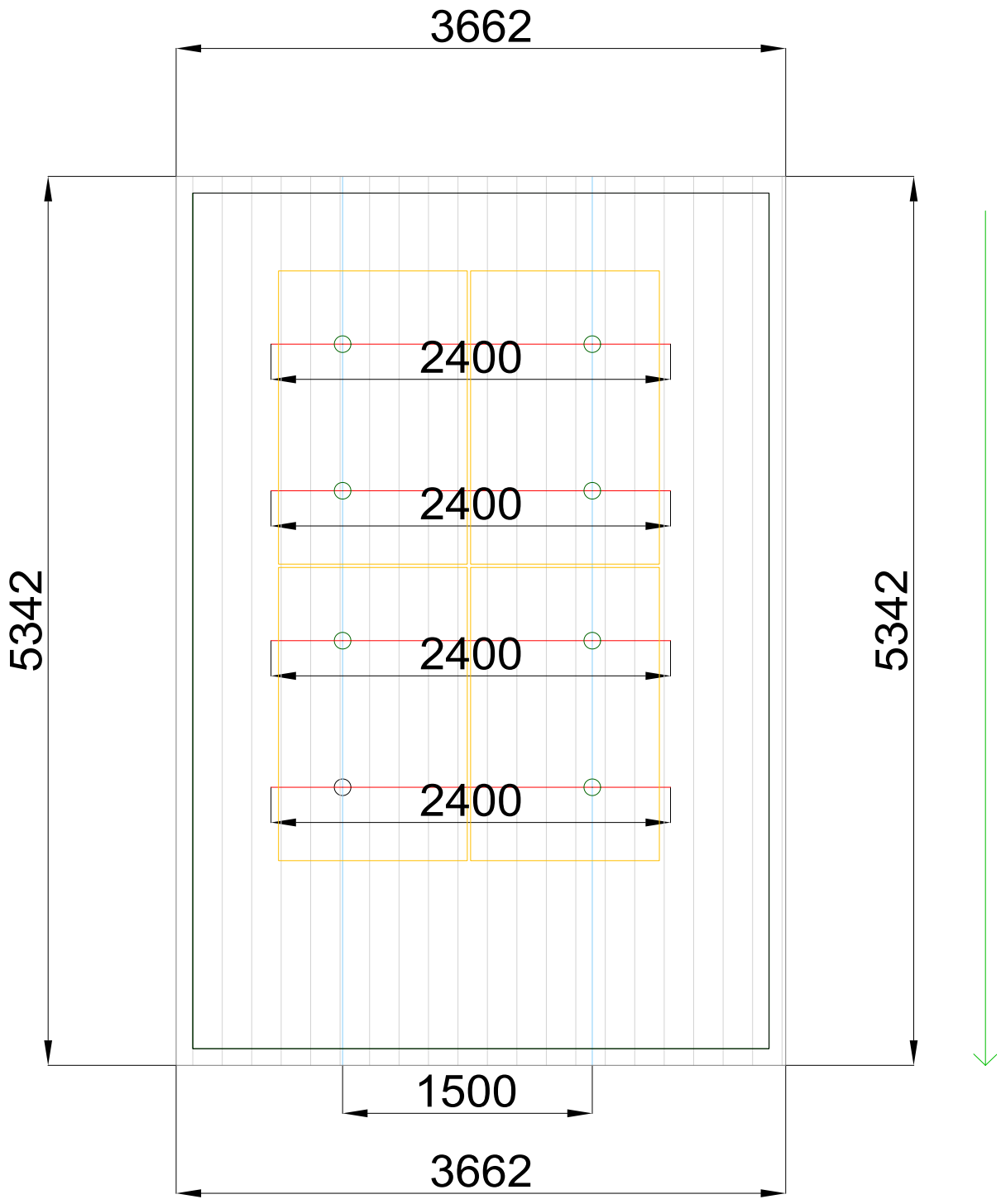
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



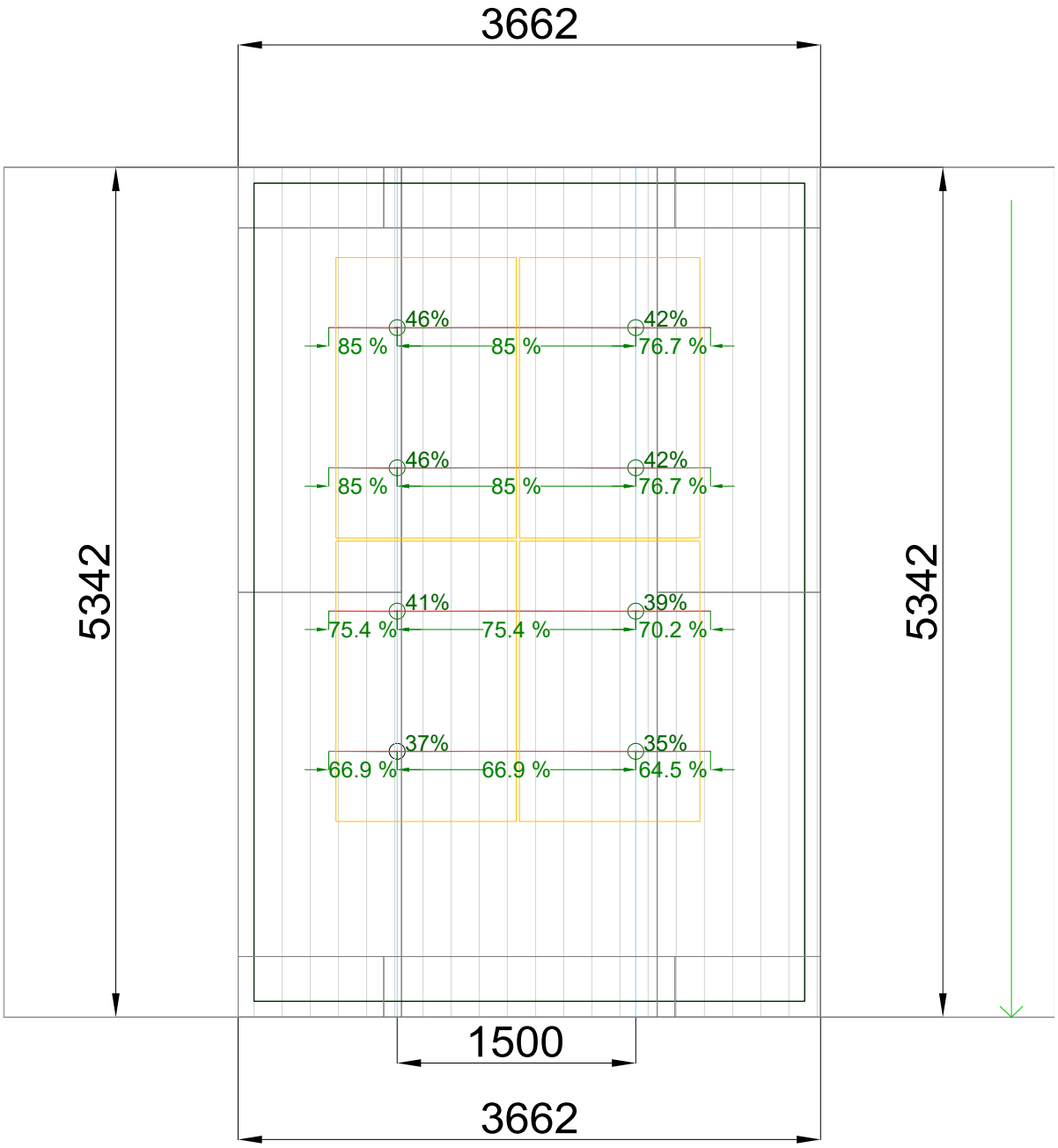
POSITION [ROOF_8]



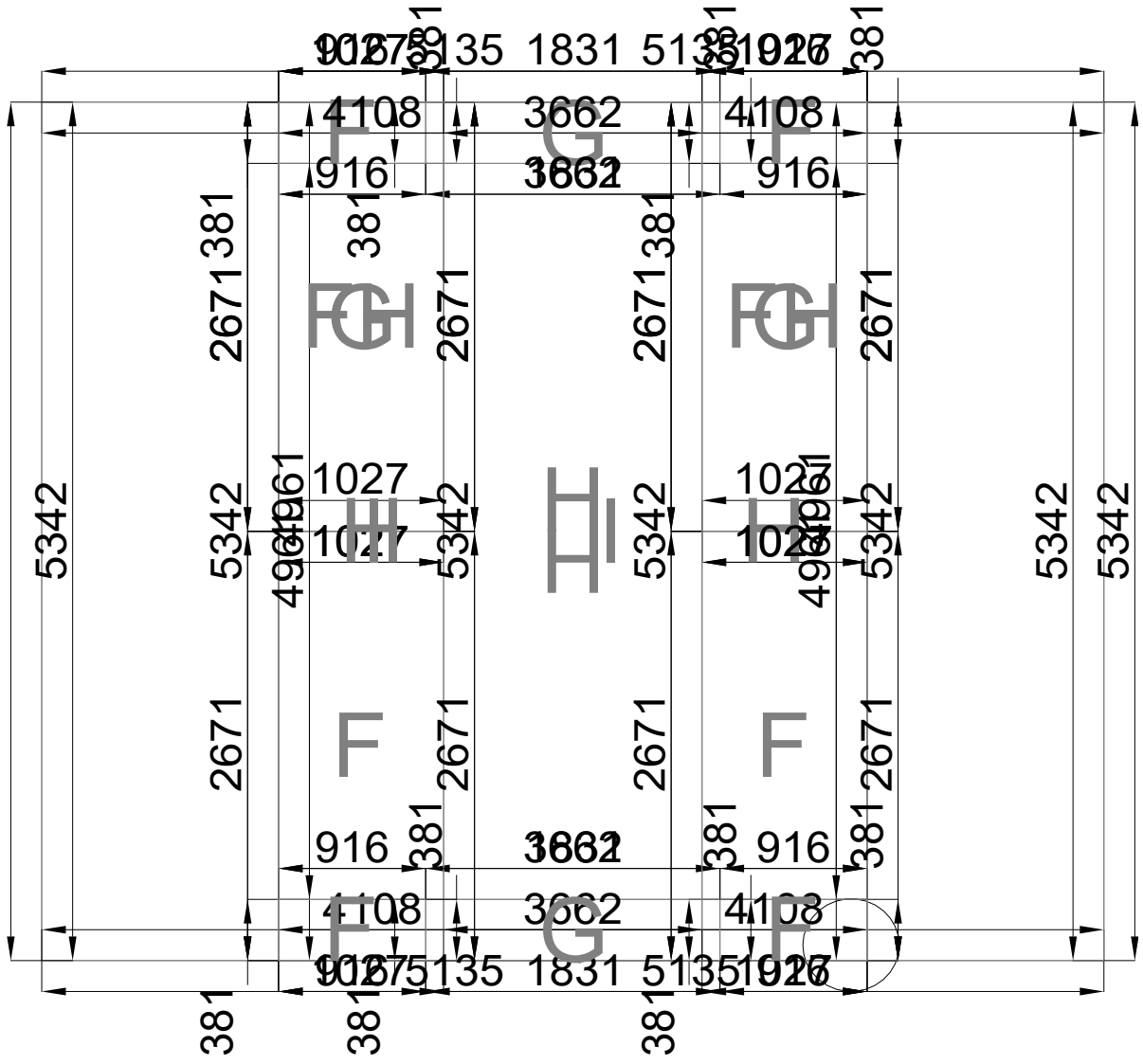
INSTALLATION-PLAN [ROOF_8]



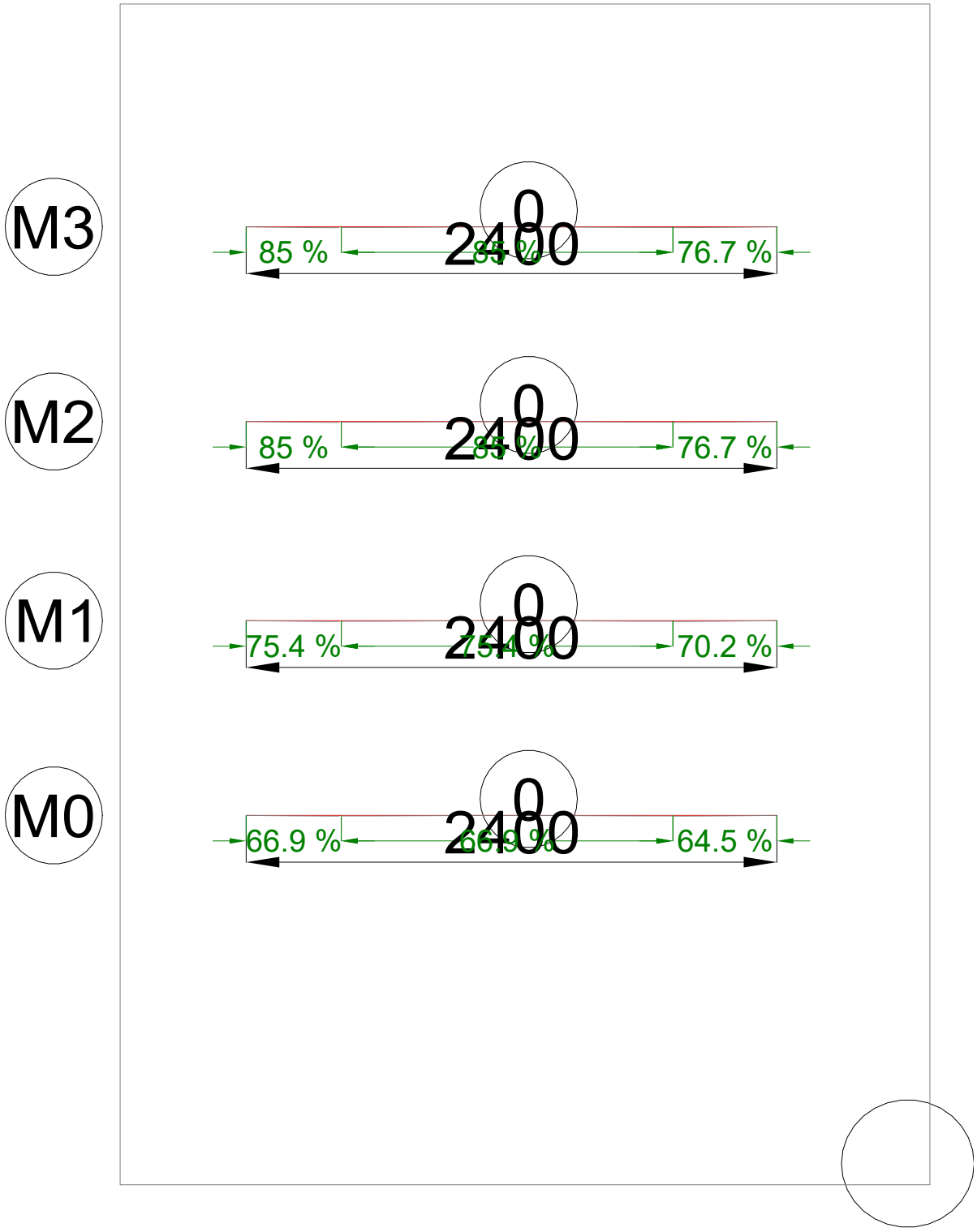
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_8]



STATIC INFORMATION: AREAS [ROOF_8]



RAIL CAPACITY [ROOF_8]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	16 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.15 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.14 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.041 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.22 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.062 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_8]

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.58**
Max. Suction	**2.76 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-2.76 kN/m²	0.037 kN/m²	2.76 kN/m²	180.77 °

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.58**
Max. Suction	**2.76 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-2.76 kN/m²	0.037 kN/m²	2.76 kN/m²	180.77 °

AREA FH 90

Tributary area	**10 m²**
Cpe Suction	**-2.38**
Max. Suction	**4.23 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-4.23 kN/m²	0.037 kN/m²	4.23 kN/m²	180.5 °

RESULTING SURFACE STRESSES [ROOF_8]

AREA FH 90

Tributary area	**10 m²**
Cpe Suction	**-2.38**
Max. Suction	**4.23 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-4.23 kN/m²	0.037 kN/m²	4.23 kN/m²	180.5 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.873**
Max. Suction	**3.3 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-3.3 kN/m²	0.037 kN/m²	3.3 kN/m²	180.65 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.873**
Max. Suction	**3.3 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-3.3 kN/m²	0.037 kN/m²	3.3 kN/m²	180.65 °

RESULTING SURFACE STRESSES [ROOF_8]

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.813**
Max. Suction	**1.36 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.36 kN/m²	0.037 kN/m²	1.36 kN/m²	181.57 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.707**
Max. Suction	**1.16 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.16 kN/m²	0.037 kN/m²	1.16 kN/m²	181.83 °

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.813**
Max. Suction	**1.36 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.36 kN/m²	0.037 kN/m²	1.36 kN/m²	181.57 °

RESULTING SURFACE STRESSES [ROOF_8]

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.707**
Max. Suction	**1.16 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.16 kN/m²	0.037 kN/m²	1.16 kN/m²	181.83 °

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.293**
Max. Suction	**0.41 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.77 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.75 kN/m²	0.15 kN/m²	0.77 kN/m²	11.18 °
LC 2	0.75 kN/m²	0.1 kN/m²	0.75 kN/m²	7.8 °
LC 3	-0.41 kN/m²	0.037 kN/m²	0.41 kN/m²	185.22 °

AREA H 180

Tributary area	**10 m²**
Cpe Suction	**-0.893**
Max. Suction	**1.51 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.54 kN/m²**

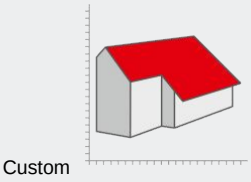
LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.52 kN/m²	0.15 kN/m²	0.54 kN/m²	16 °
LC 2	0.36 kN/m²	0.1 kN/m²	0.37 kN/m²	16 °
LC 3	-1.5 kN/m²	0.037 kN/m²	1.51 kN/m²	181.42 °

MATERIAL LIST [ROOF_8]

Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**4**	0.008
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**2**	**2**	10.550
	705226	XCL60 side-lid left for rail X60	1	**4**	**4**	0.020
	705227	XCR60 side-lid right for rail X60	1	**4**	**4**	0.020
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**8**	**8**	4.088
	706457	CLP-R cable clip rail	1	**150**	**4**	0.016
	707003	CLE10 End clamp Click 30-46	1	**10**	**8**	0.600
	707011	CLM10 Middle clamp Click 30-46	1	**10**	**4**	0.256
						15.56

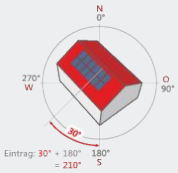
ROOF [ROOF_9]

Building height h [mm]	**10000**
Slope of roof [°]	**16**
Roofing	**Fiber Cement (Corrug. Roof)**
System alignment [°]	**278.02**



Custom

System alignment [°]*



CHAR. SNOW LOAD SIST EN 1991-1-3

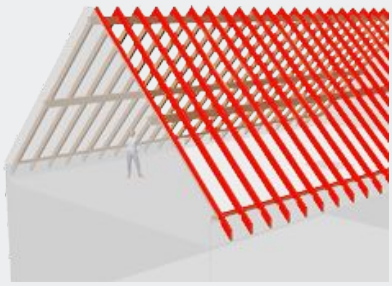
char. snow load [kN/m²]	**0.23**
Altitude above sea level [m]:	**49**
Slope of roof [°]:	**16**
Snow load zone	**M1**
Shape coefficient μ_i:	**0.8**

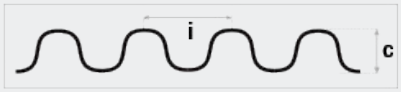
PEAK VELOCITY PRESSURE SIST EN 1991-1-4

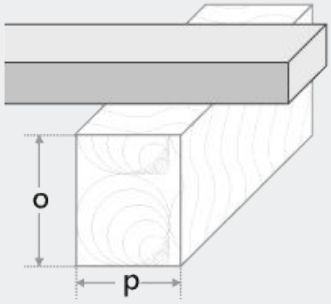
Peak velocity pressure [kN/m²]	**1.22**
Building height h [mm]	**10000**
Wind zone (see wind zone map)	**Area 3**
Terrain Category	**2**
Plant useful life	**25**
Reduction over useful life: (EN 1991-1-4, Attachment 4.2)	**0.922**
Reliability class: (EN 1990, Attachment D, Tab. B.1/2)	**RC2 (Standard supporting structure)**
Reduction / Increase over reliability class: (EN 1990, Attachment D, Tab. B.1,2,3)	**1**

CONSTRUCTION DESIGN (CD) -- RAFTER [ROOF_9]

Material	**Wood**
Rafter Width p [mm]	**80**
Rafter Height o [mm]	**160**
First rafter offset from verge left [mm]	**200**
Distance [mm]	**1500**
Waveheight c [mm]	**57**
First hight point after [mm]	**100**
Distance between the high points i [mm]	**177**





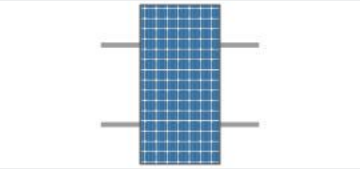


PV-MODULE [ROOF_9]

Manufacturer:	**Trina Solar Energy Co., Ltd**
Name	**Trina Vertex S+ TSM-450NEG9R.28 Doppelglas - (BF, R30, EVO2)**
Width [mm]:	**1134**
Height [mm]:	**1762**
Thickness [mm]:	**30**
Framing:	**Aluminium**
Weight (kg)	**21**
Nominal Power [Watt]:	**450**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Temperature coefficient [%/°C]:	**-0.29**
Efficiency STC:	**0.225**
Output current MPP - STC [A]:	**10.09**
Output voltage MPP - STC [V]:	**44.6**
Short circuit current [A]:	**10.74**
Open circuit voltage [V]:	**52.9**
Temperature coefficient Current [%/K]:	**0.04**
Temperature coefficient Voltage [%/K]:	**-0.24**
Max. System voltage EU:	**1500**
Max module backcurrent [A]	**25**
Galvanic seperation required:	**No**

ANCHOR TYPE & MODEL [ROOF_9]

Mounting system type	**XWS12250 CL hanger bolt M12x250 Click**
Metal roof plate for the correct installation of hanger bolts in combination with slate roofing must be obtained on site	
Number of Fixations	**18**
Max. Utilization of fixation points	**75 %**
Rail installation system	**single layer (horizontal)**
Module rail	**Rail X60**



MODULE RAIL [ROOF_9]

Module rail	**Rail X60**
Max. utilization Module Profile	**86.23 %**

CLAMPS [ROOF_9]

Mid Clamp:	**CLM10 Middleclamp Click 30-46**
Max. utilization	**76.38 %**
End Clamp:	**CLE10 End-Clamp Click 30-46mm**
Max. utilization	**63.01 %**

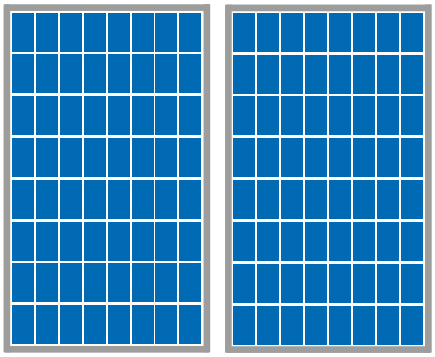
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

STATIC DETAILS [ROOF_9]

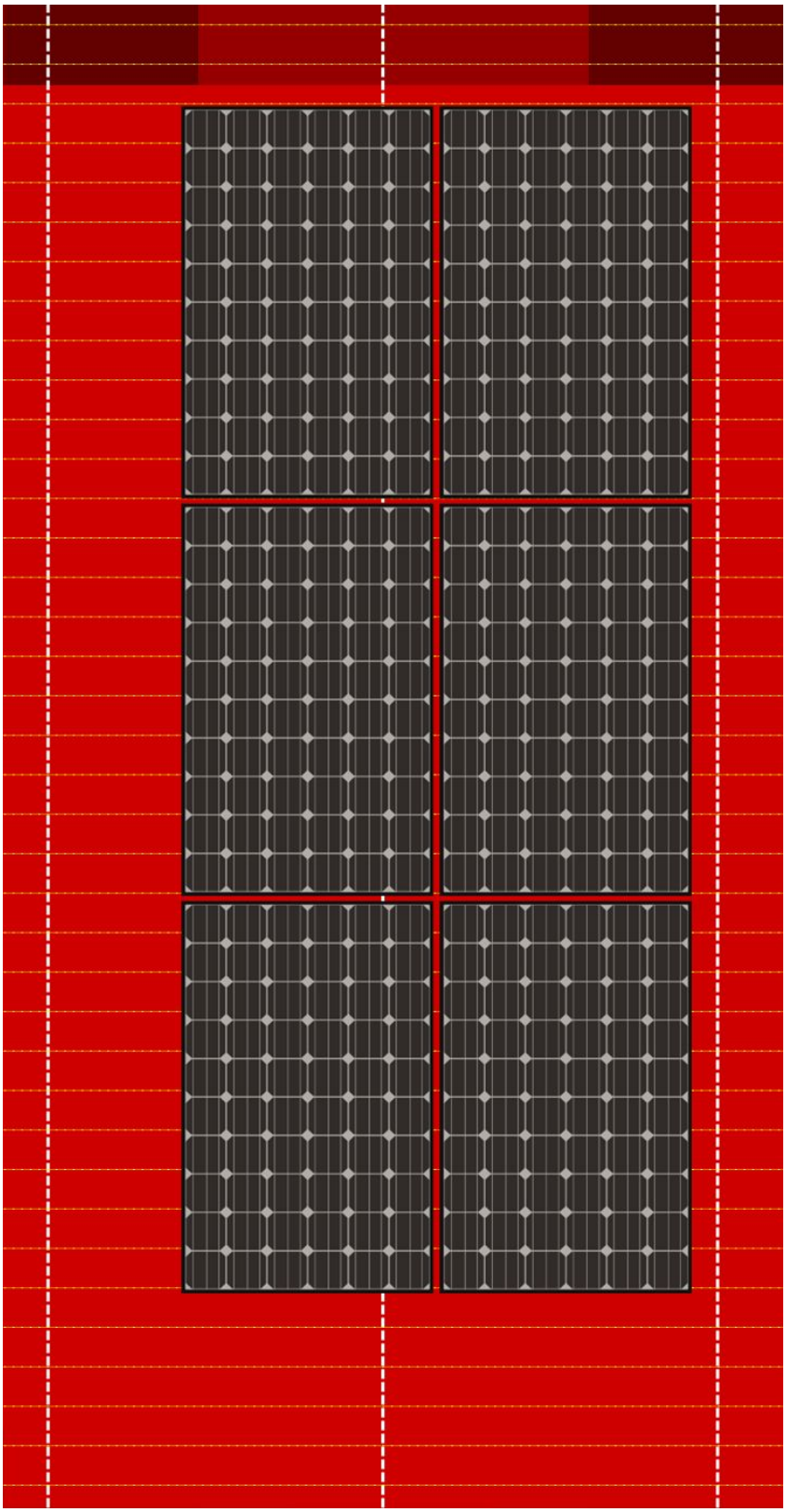
Allocated Roof Area	**11.99 m²**
Load on Allocated Area	**33.44 kN**
Max. Pressure (design):	**0.71 kN/m²**
Max. Tension (design):	**-3.66 kN/m²**
Total System weight	**168.23 kg**
Pressure on allocated Area	**0.14 kN/m²**

MODULE LAYOUT PLAN [ROOF_9]

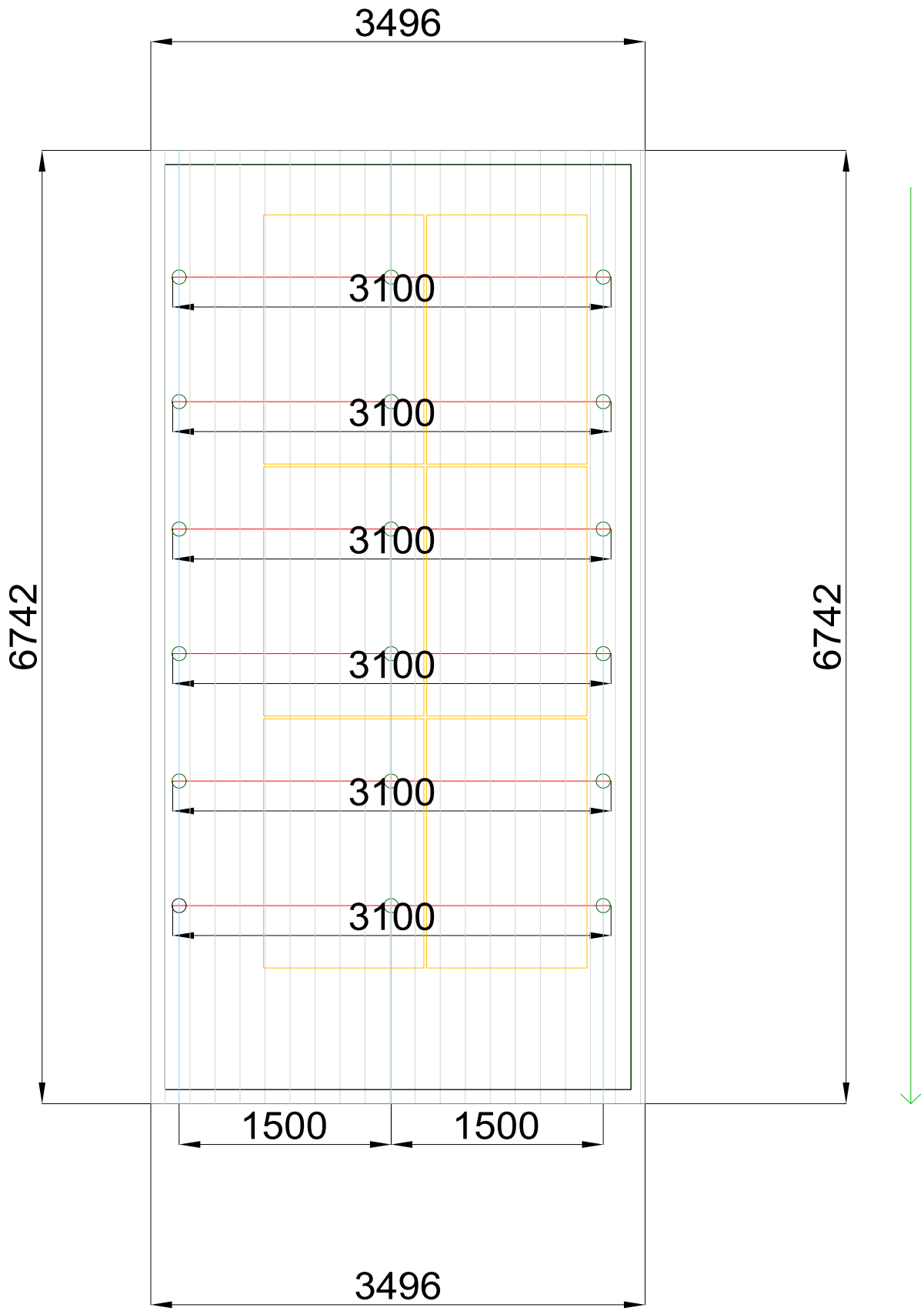
Alignment:	**Portrait**
Horizontal module distance [mm]:	**20**
Vertical module distance [mm]:	**20**
Horizontal starting point (left bottom mm):	**300**
Vertical starting point (left bottom in mm):	**300**



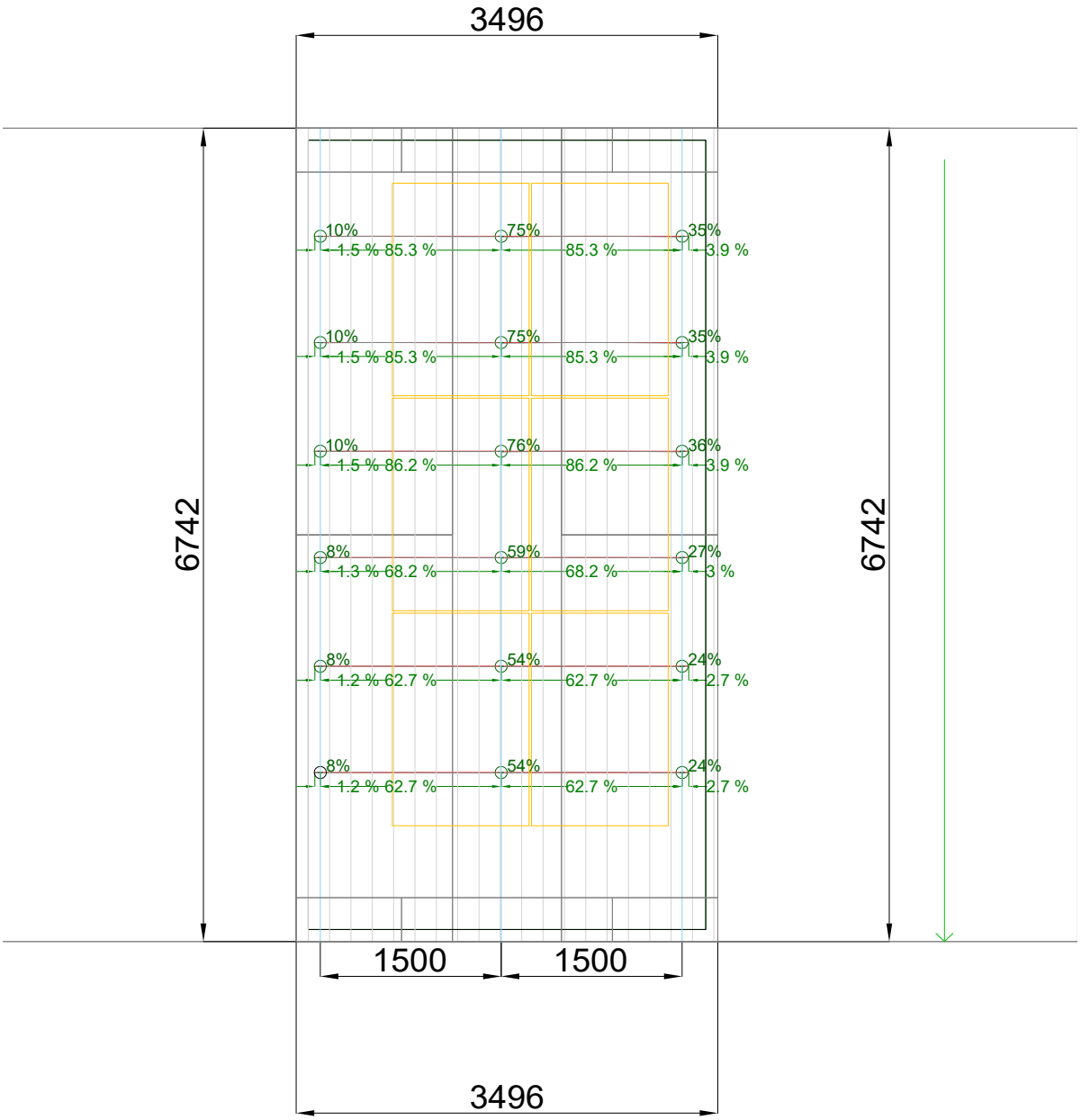
POSITION [ROOF_9]



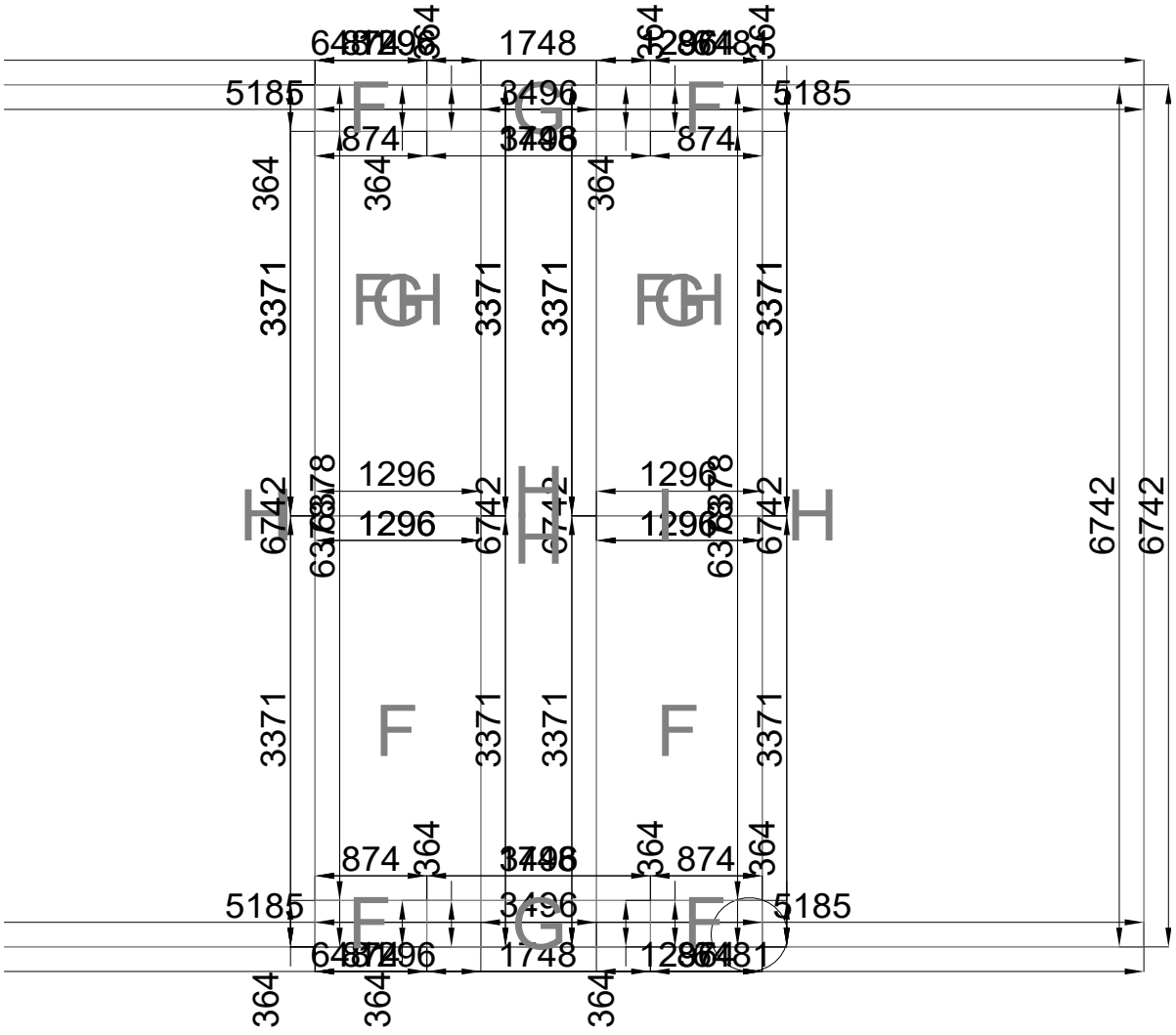
INSTALLATION-PLAN [ROOF_9]



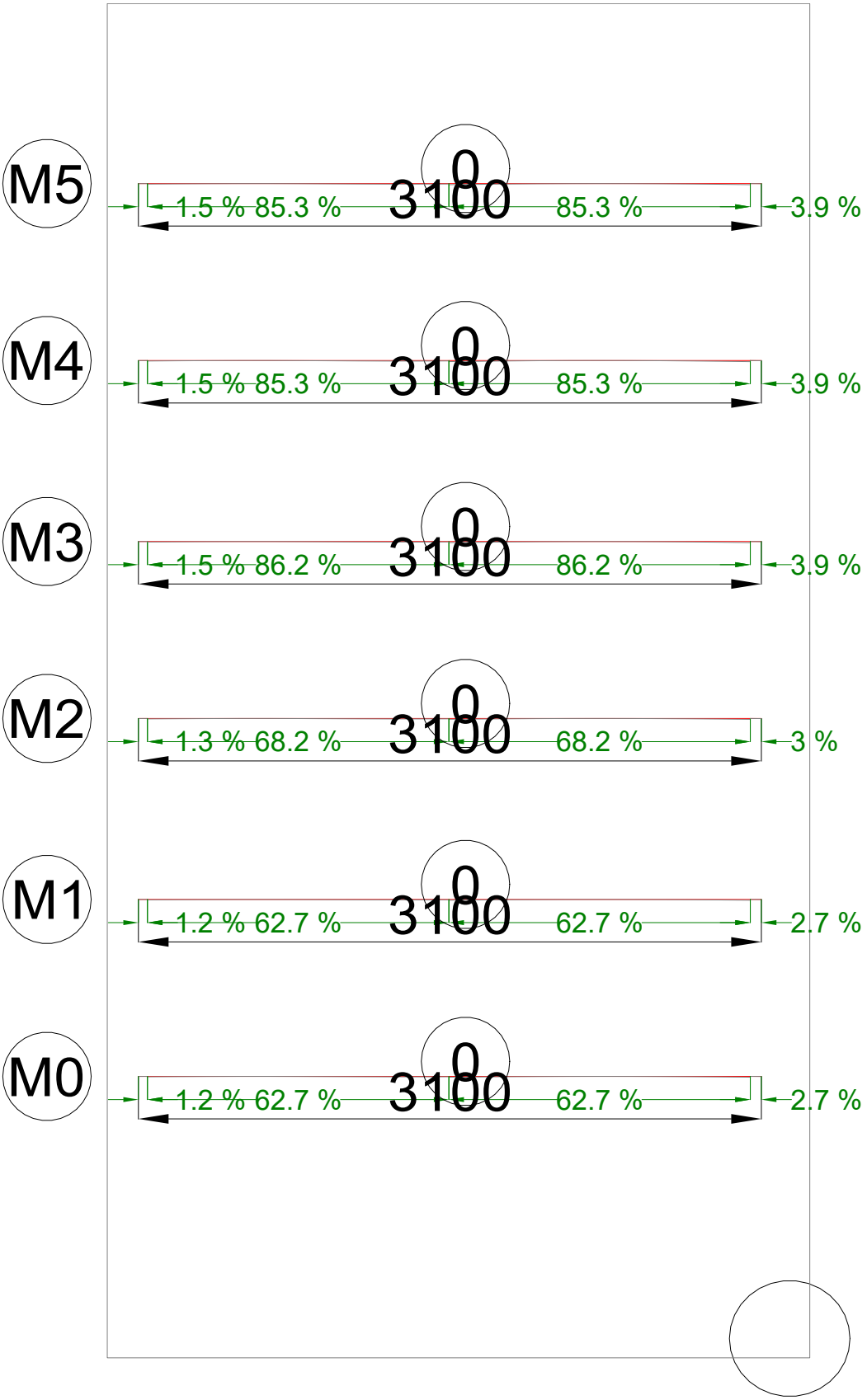
STATIC INFORMATION: UTILISED CAPACITY OF FASTENERS [ROOF_9]



STATIC INFORMATION: AREAS [ROOF_9]



RAIL CAPACITY [ROOF_9]



RESULTING SURFACE STRESSES BASICS

Roof pitch	α	16 °
Snow load	Q_s	0.23 kN/m²
Wind load	Q_w	1.22 kN/m²
Dead load (1)	G_m	0.12 kN/m²
Safety coefficient stat., max.	γ_{G+}	1.35
Safety coefficient stat., min.	γ_{G-}	0.9
Safety coefficient dyn., max.	γ_{Q+}	1.5
Safety coefficient dyn., min.	γ_{Q-}	0
Combination coefficient Wind	ψ_w	0.6
Combination coefficient Snow	ψ_s	0.5
$G_{mUpright}$	$= G_m \cdot \cos(\alpha)$	0.11 kN/m²
$G_{mParallel}$	$= G_m \cdot \sin(\alpha)$	0.032 kN/m²
$Q_{s\ Upright}$	$= Q_s \cdot \cos^2(\alpha)$	0.22 kN/m²
$Q_{s\ Parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	0.062 kN/m²
LC 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	

1. Assumed weight of the modules and construction elements, overall. Is chosen in advance with 150 N/m² (~ 15 kg/m²) to optimize the assembly effort

RESULTING SURFACE STRESSES [ROOF_9]

AREA F 90

Tributary area	**10 m²**
Cpe Suction	**-1.58**
Max. Suction	**2.79 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-2.79 kN/m²	0.029 kN/m²	2.79 kN/m²	180.6 °

AREA FH 90

Tributary area	**10 m²**
Cpe Suction	**-2.38**
Max. Suction	**4.25 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-4.25 kN/m²	0.029 kN/m²	4.25 kN/m²	180.39 °

AREA G 90

Tributary area	**10 m²**
Cpe Suction	**-1.873**
Max. Suction	**3.33 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-3.33 kN/m²	0.029 kN/m²	3.33 kN/m²	180.5 °

RESULTING SURFACE STRESSES [ROOF_9]

AREA H 90

Tributary area	**10 m²**
Cpe Suction	**-0.813**
Max. Suction	**1.39 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:

LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.39 kN/m²	0.029 kN/m²	1.39 kN/m²	181.21 °

AREA I 90

Tributary area	**10 m²**
Cpe Suction	**-0.707**
Max. Suction	**1.19 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.19 kN/m²	0.029 kN/m²	1.19 kN/m²	181.41 °

AREA H 0

Tributary area	**10 m²**
Cpe Suction	**-0.293**
Max. Suction	**0.44 kN/m²**
Cpe Pressure	**0.213**
Max. downward load	**0.72 kN/m²**

LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.71 kN/m²	0.14 kN/m²	0.72 kN/m²	10.89 °
LC 2	0.71 kN/m²	0.09 kN/m²	0.71 kN/m²	7.3 °
LC 3	-0.43 kN/m²	0.029 kN/m²	0.44 kN/m²	183.84 °

RESULTING SURFACE STRESSES [ROOF_9]

AREA H 180

Tributary area	**10 m²**
Cpe Suction	**-0.893**
Max. Suction	**1.53 kN/m²**
Cpe Pressure	**0**
Max. downward load	**0.5 kN/m²**

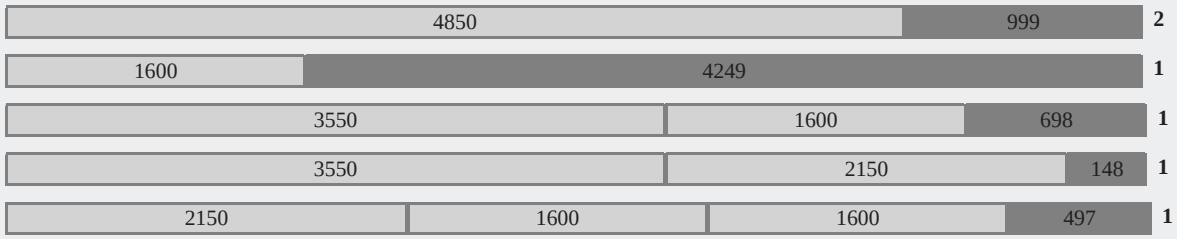
LC	Upright:	Parallel:	Combined:	Resulting angle:
LC 1	0.48 kN/m²	0.14 kN/m²	0.5 kN/m²	16 °
LC 2	0.31 kN/m²	0.09 kN/m²	0.33 kN/m²	16 °
LC 3	-1.53 kN/m²	0.029 kN/m²	1.53 kN/m²	181.09 °

MATERIAL LIST [ROOF_9]

Image	Part number	Description	Pck	Total Nr.	Required number of pieces (single item)	Total weight (kg)
	701902	CLP-M Cable-tie clip module	1	**100**	**6**	0.012
	705125-5850	X60-5850 mounting rail 5850mm (230.3")	1	**6**	**6**	31.650
	705226	XCL60 side-lid left for rail X60	1	**6**	**6**	0.030
	705227	XCR60 side-lid right for rail X60	1	**6**	**6**	0.030
	705446	XWS12250CL Hanger bolt M12x250 Click	1	**18**	**18**	9.198
	706457	CLP-R cable clip rail	1	**150**	**6**	0.024
	707003	CLE10 End clamp Click 30-46	1	**20**	**12**	0.900
	707011	CLM10 Middle clamp Click 30-46	1	**10**	**6**	0.384
						42.23

ROOF_3

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



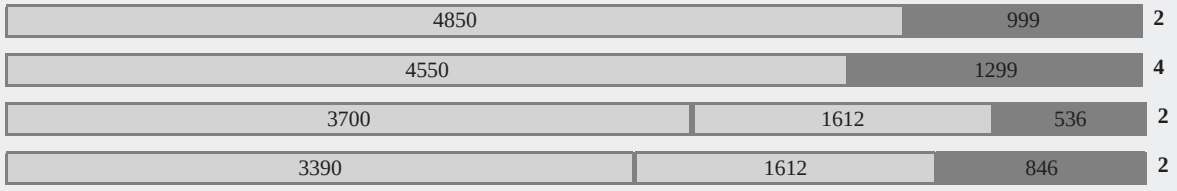
ROOF_6

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



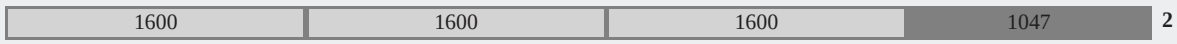
ROOF_4

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



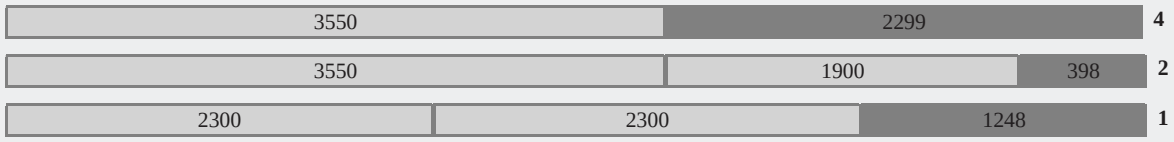
ROOF_11

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



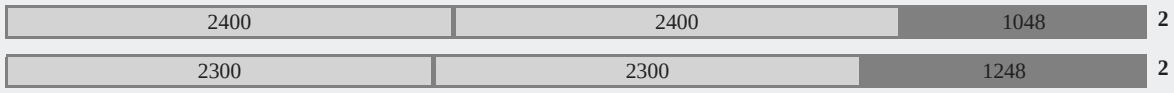
ROOF_10

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



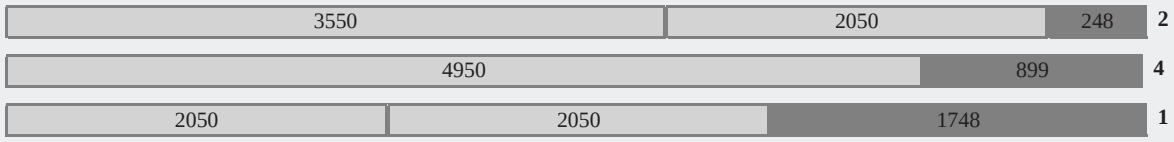
ROOF_7

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



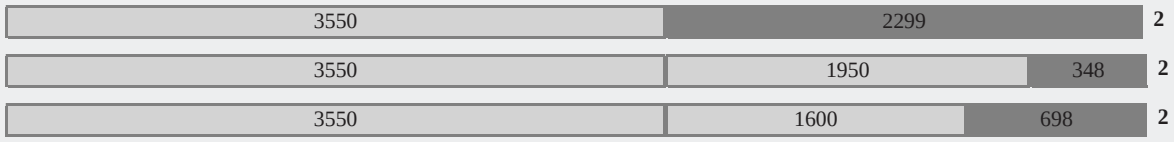
ROOF_2

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



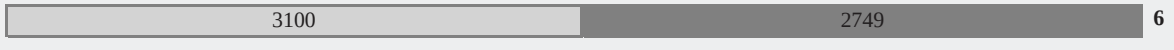
ROOF_12

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



ROOF_9

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



ROOF_8

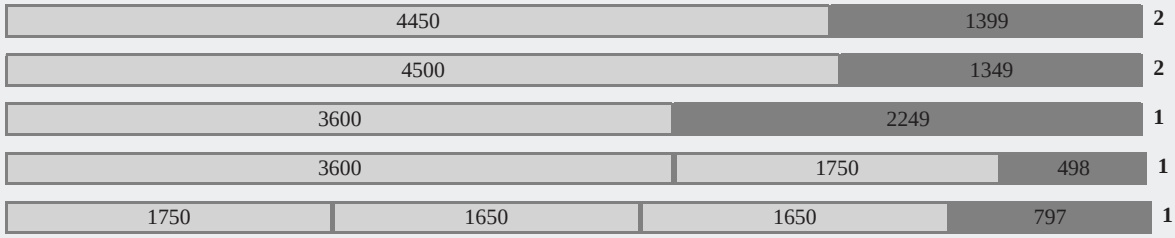
Important remark: The accuracy of a proper layout is not guaranteed. Depending on the level of complexity, more than one ideal layout may exist.

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



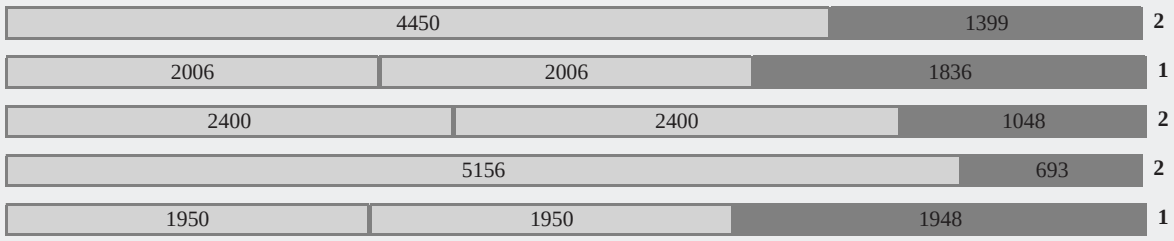
ROOF_1

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



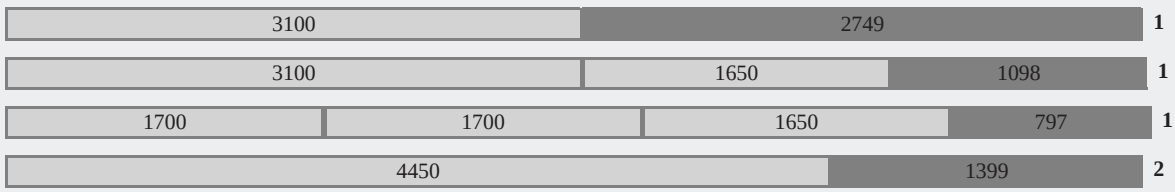
ROOF_13

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



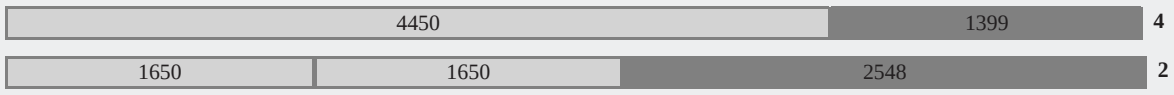
ROOF_5

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



ROOF_14

RAIL CUTS FOR SCHIENE X60 5850MM [705125-5850]



DISCLAIMER/OTHER LIABILITY

1. This current order specifies expressly no review of any information provided by Principal. Any pertinent review must be ordered expressly and separately in writing.

2. The current report is based on the documents or information and data received by Principal.

3. Therefore, this report can only be as good as the quality of the information of the Principal permits.

4. For these reasons, no liability whatsoever and no warranty for errors based on untrue information of the Principal can be assumed despite any applied due diligence. However, any liability toward third parties is excluded.

5. Contractor (Aerocompact) shall be liable toward Principal only in cases of gross negligence (intent or gross negligence) except for personal injuries. This applies equally to damages to third parties engaged by Contractor.

6. Principal is only entitled to file a claim for damages within six months from the date the damaged party gained knowledge of the damage but no later than within two years following the incident on which the claim is based.

7. Principal has the burden of proof, i.e. Principal must show that the damage is caused by Principal.

8. The structural design encompasses the racking (substructure) only and does not include the PV modules for which approval by the manufacturer for the Aerocompact system in question is recommended.
Anchor point attachments for solar flat roof solutions of Aerocompact are designed for Ultimate Limit States (strength) only.
For the TR rail system, roof-parallel forces are passed to the roof beams via the fixations of the sandwich panels. Their load path does not include the fixations of the TR rail system. The sheet thickness of the roof covering must not be lower than 0.5mm in countries where the Eurocode governs the design of buildings and structures. Elsewhere, a different minimum for the permissible sheet thickness may apply.
If not edited by the AeroTOOL user specific to the project, the default values for the Effective screw-in depth using CompactPITCH XW are 67mm with M10 hanger bolts and 100mm with M12 hanger bolts.
Except for the TR rail system, all Aerocompact system solutions are designed assuming a non-flexible, rigid roof covering.
The structural check of the roof covering and of the roof support structure is out of scope of the present design.
If the structural design includes utilizations exceeding 100%, the overall safety of the structure as required by the governing code is reduced. In a worst-case scenario, exceeding the permitted utilization of 100% may cause failure of the fixations of the mounting system.

9. The Supplier is not responsible for the project-related structural soundness of the roof structure and the professional realization and installation.

10. The technical specifications are an integral part of the product. AEROCOMPACT® shall not be liable for damages caused by non-compliance with the installation instructions and particularly with the safety information and from the improper use of the products. The current Terms and Conditions, Warranty Terms and Conditions and Installation Instructions will be provided on www.aerocompact.com .

11. If the roof gravel is located directly on top of the water-bearing roof membrane, Aerocompact® cannot be placed on the gravel layer. In this case the gravel must be removed in the area of the Aerocompact® bracket.

12. The required compressive strength of the roof insulation needs to be examined. An approval from the roof-membrane manufacturer is required.

13. Photovoltaic flat roof systems are not maintenance free. Maintenance, particular the right postion of the ballast blocks and the building protection pads should be conducted annually. For exceptional high-wind events, we recommend to do a Maintenance right after the storm event.

14. Place of jurisdiction, Feldkirch Austria

15. The yield forecast is based on the average annual weather data (irradiation and temperature) for locations in the vicinity of the project in the years 1996-2015.

The actual yield may vary depending on the actual solar irradiation in the following years.
In addition, the yield depends on other factors at the specific project location (e.g. the orientation and inclination of the modules as well as shading), which cannot be taken into account in detail in the forecast.