



GREEN LEAF
SUSTAINABLE ENERGY

Green Leaf Engineering

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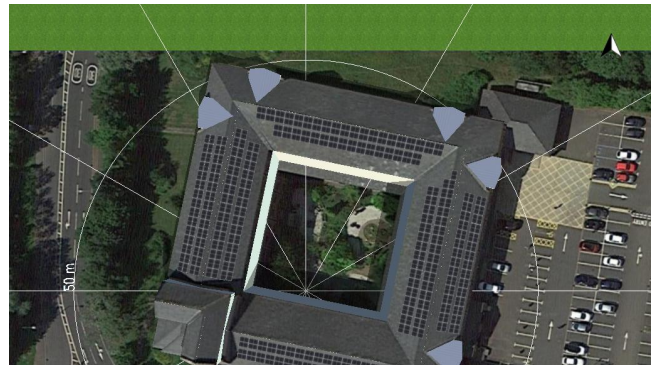
Project Name: Boldon House

12/02/2024

Your PV system from Green Leaf Engineering

Address of Installation

Wheatlands Way, Pity Me, Durham DH1 5FA



Project Description:

Photovoltaic Roof System

Project Overview

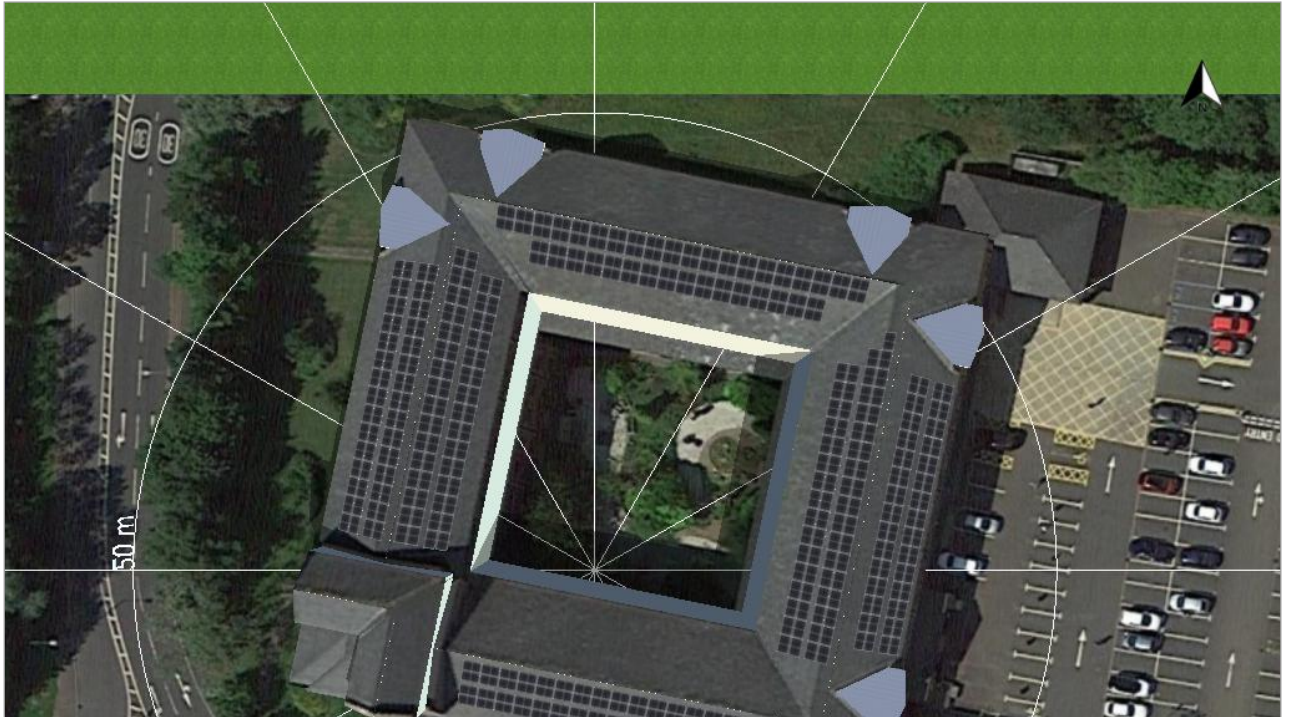


Figure: Overview Image, 3D Design

PV System

3D, Grid-connected PV System with Electrical Appliances

Climate Data	Durham, GBR (1996 - 2015)
Values source	Meteonorm 8.1(i)
PV Generator Output	170.44 kWp
PV Generator Surface	765.3 m ²
Number of PV Modules	383
Number of Inverters	4

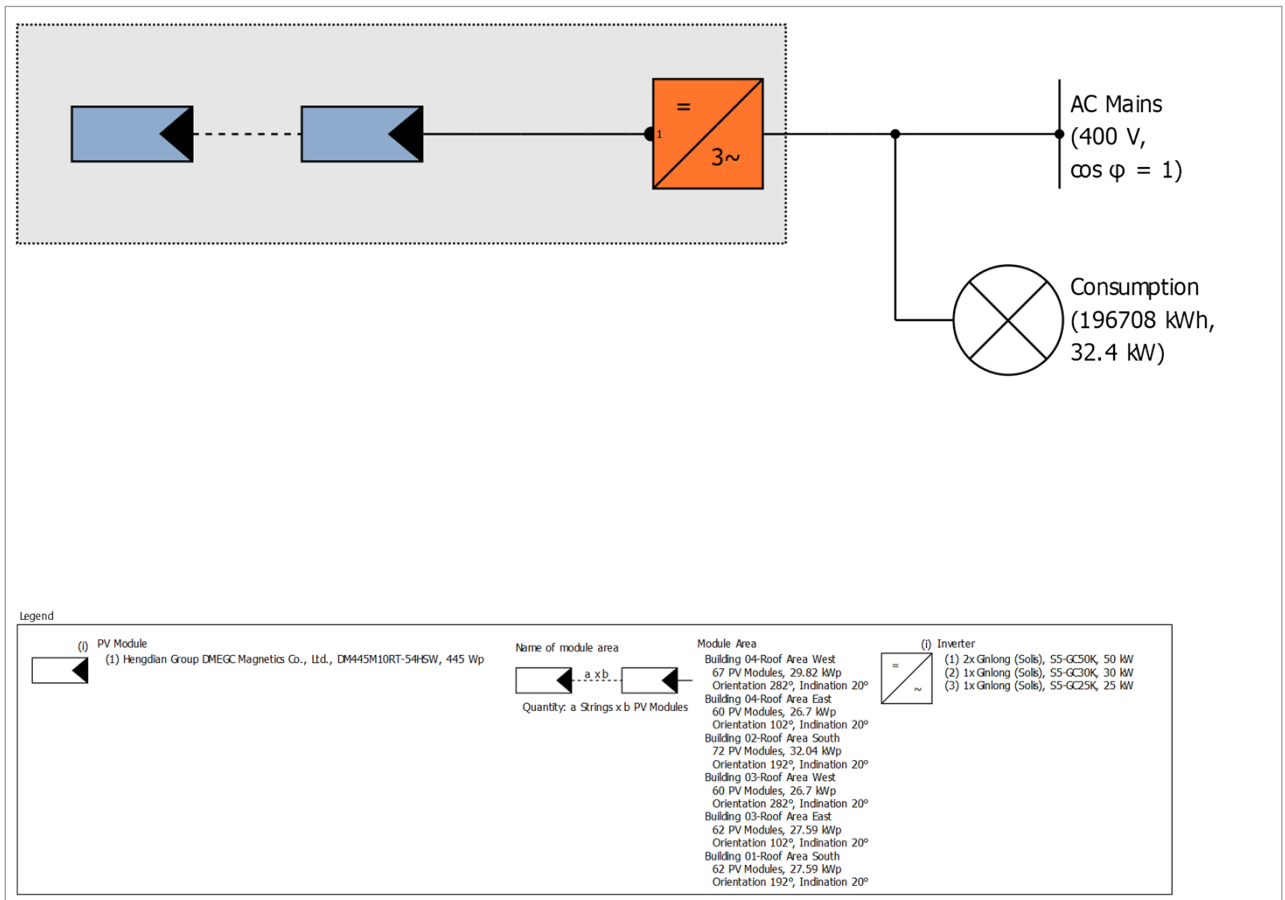


Figure: Schematic diagram

Production Forecast

Production Forecast

PV Generator Output	170.44 kWp
Spec. Annual Yield	927.82 kWh/kWp
Performance Ratio (PR)	91.31 %
Yield Reduction due to Shading	3.0 %
PV Generator Energy (AC grid)	158,191 kWh/Year
Own Consumption	87,261 kWh/Year
Clipping at Feed-in Point	0 kWh/Year
Grid Export	70,930 kWh/Year
Own Power Consumption	55.1 %
CO ₂ Emissions avoided	74,323 kg / year
Level of Self-sufficiency	44.3 %

Financial Analysis

Your Gain

Total investment costs	0.00 £
Internal Rate of Return (IRR)	268.25 %
Amortization Period	0.0 Years
Electricity Production Costs	0 £/kWh
Energy Balance/Feed-in Concept	Surplus Feed-in

The results have been calculated with a mathematical model calculation from Valentin Software GmbH (PV*SOL algorithms). The actual yields from the solar power system may differ as a result of weather variations, the efficiency of the modules and inverter, and other factors.

Set-up of the System

Overview

System Data

Type of System 3D, Grid-connected PV System with Electrical Appliances

Climate Data

Location Durham, GBR (1996 - 2015)

Values source Meteonorm 8.1(i)

Resolution of the data 1 h

Simulation models used:

- Diffuse Irradiation onto Horizontal Plane Hofmann

- Irradiance onto tilted surface Hay & Davies

Consumption

Total Consumption 196708 kWh

Office building 16000 m² 196708 kWh

Load Peak 32.4 kW

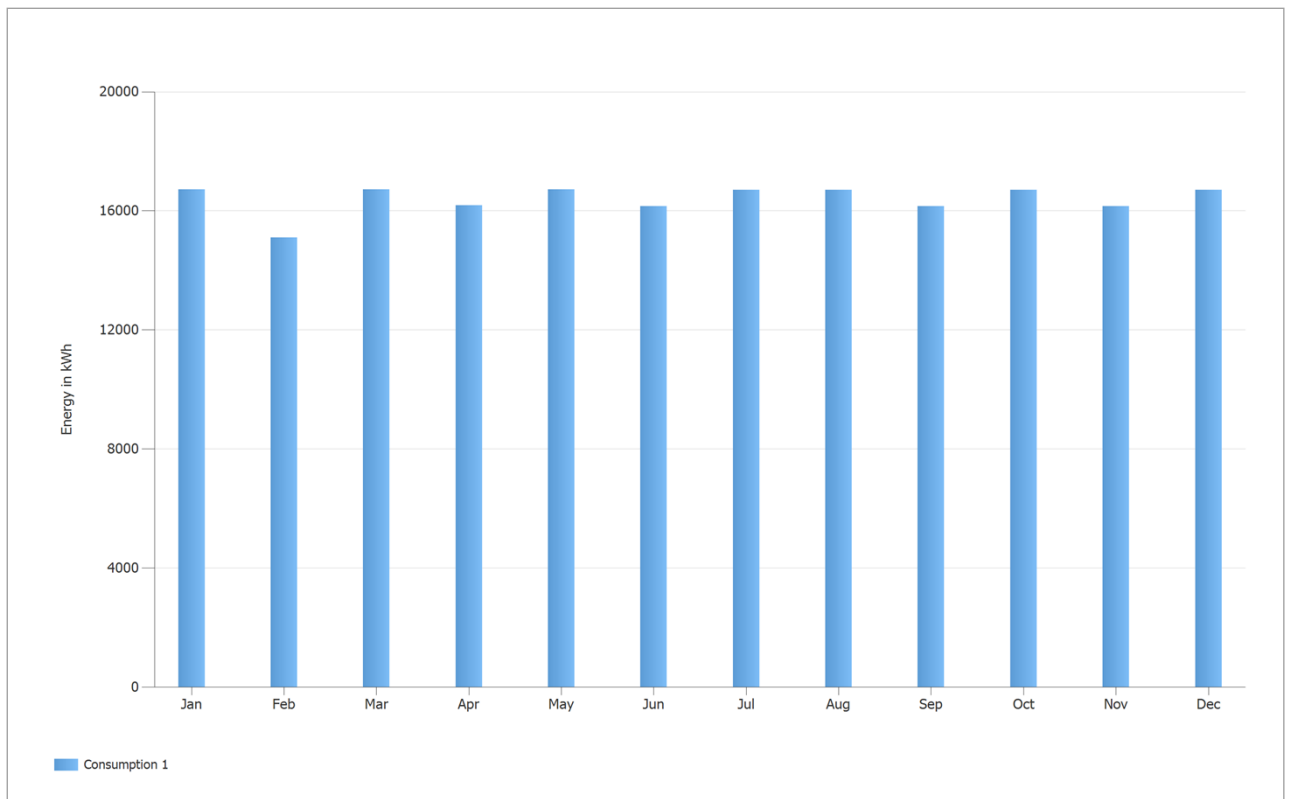


Figure: Consumption

Module Areas

1. Module Area - Building 04-Roof Area West

PV Generator, 1. Module Area - Building 04-Roof Area West

Name	Building 04-Roof Area West
PV Modules	67 x DM445M10RT-54HSW (v1)
Manufacturer	Hengdian Group DMEGC Magnetics Co., Ltd.
Inclination	20 °
Orientation	West 282 °
Installation Type	Roof parallel
PV Generator Surface	133.9 m ²

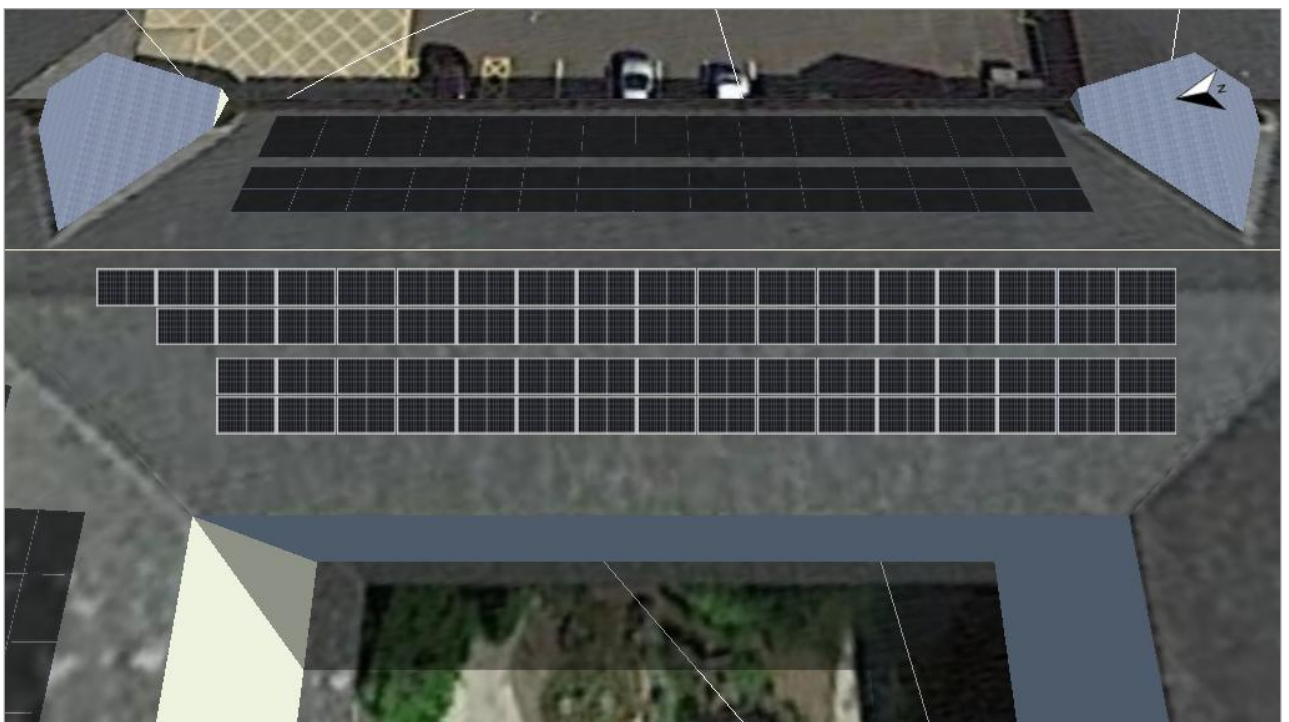


Figure: 1. Module Area - Building 04-Roof Area West

2. Module Area - Building 04-Roof Area East

PV Generator, 2. Module Area - Building 04-Roof Area East

Name	Building 04-Roof Area East
PV Modules	60 x DM445M10RT-54HSW (v1)
Manufacturer	Hengdian Group DMEGC Magnetics Co., Ltd.
Inclination	20 °
Orientation	East 102 °
Installation Type	Roof parallel
PV Generator Surface	119.9 m ²

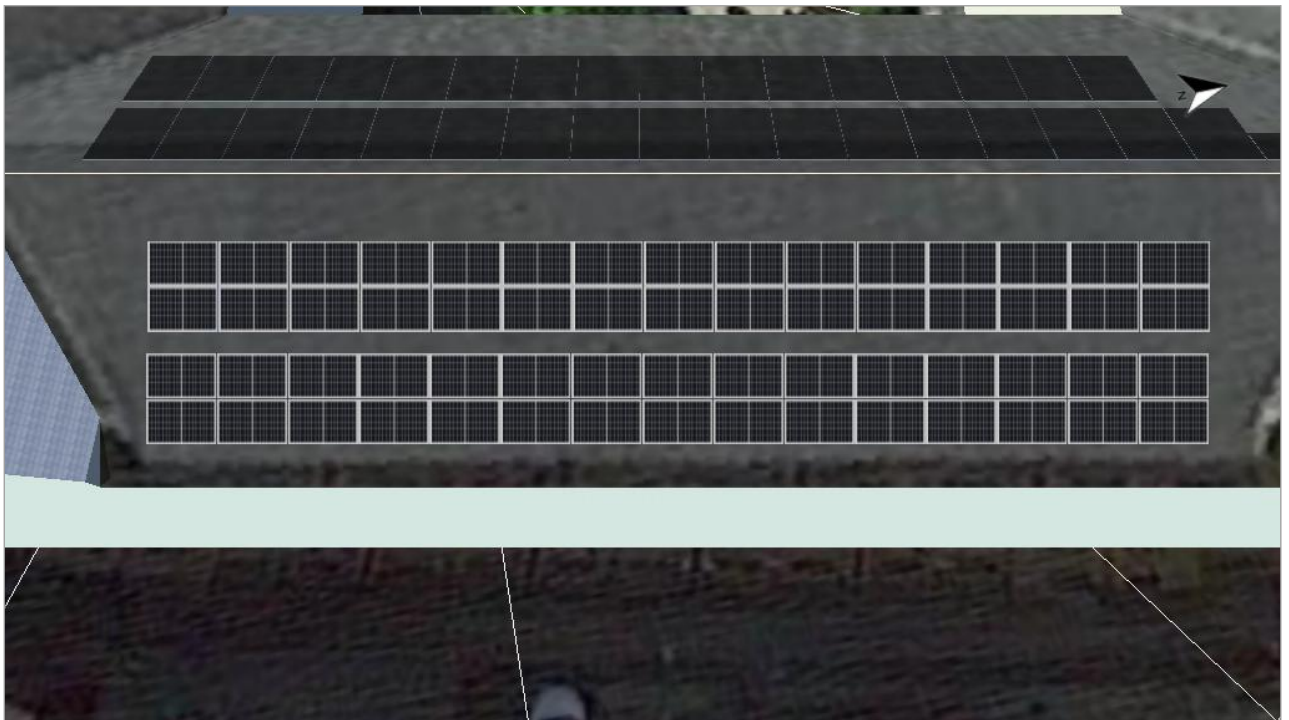


Figure: 2. Module Area - Building 04-Roof Area East

3. Module Area - Building 02-Roof Area South

PV Generator, 3. Module Area - Building 02-Roof Area South

Name	Building 02-Roof Area South
PV Modules	72 x DM445M10RT-54HSW (v1)
Manufacturer	Hengdian Group DMEGC Magnetics Co., Ltd.
Inclination	20 °
Orientation	South 192 °
Installation Type	Roof parallel
PV Generator Surface	143.9 m ²

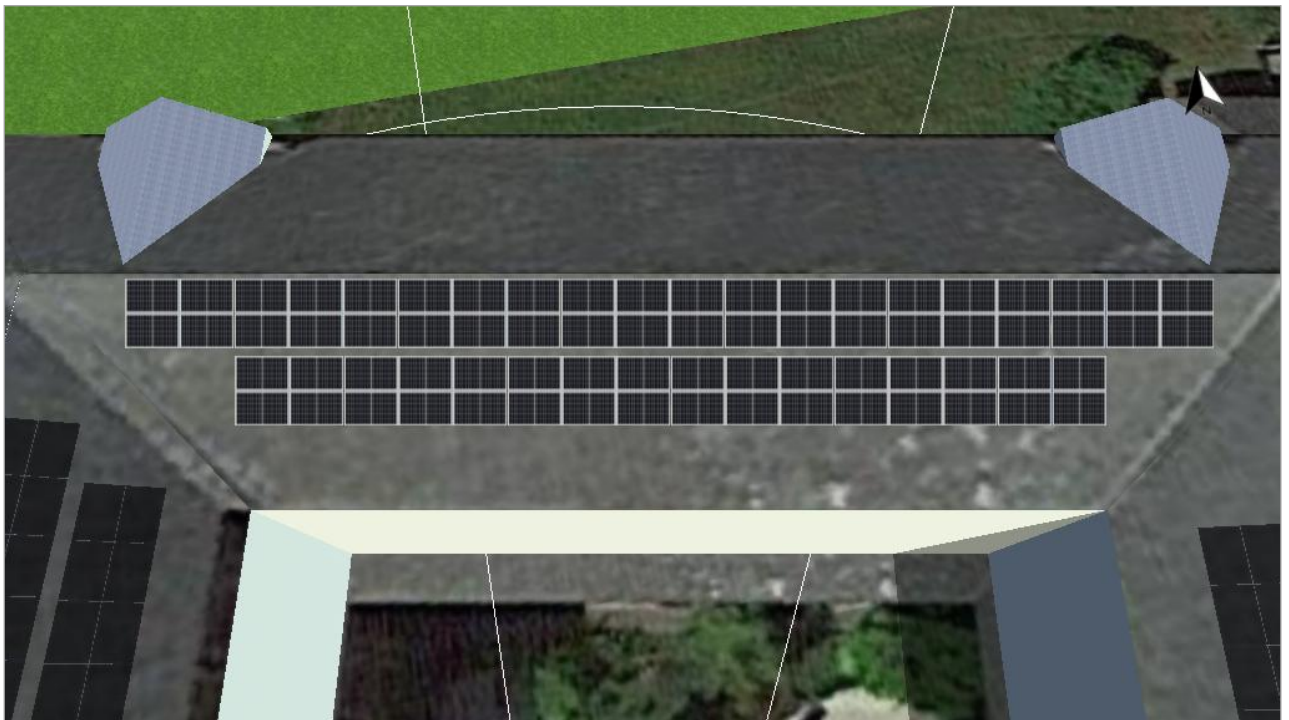


Figure: 3. Module Area - Building 02-Roof Area South

4. Module Area - Building 03-Roof Area West

PV Generator, 4. Module Area - Building 03-Roof Area West

Name	Building 03-Roof Area West
PV Modules	60 x DM445M10RT-54HSW (v1)
Manufacturer	Hengdian Group DMEGC Magnetics Co., Ltd.
Inclination	20 °
Orientation	West 282 °
Installation Type	Roof parallel
PV Generator Surface	119.9 m ²



Figure: 4. Module Area - Building 03-Roof Area West

5. Module Area - Building 03-Roof Area East

PV Generator, 5. Module Area - Building 03-Roof Area East

Name	Building 03-Roof Area East
PV Modules	62 x DM445M10RT-54HSW (v1)
Manufacturer	Hengdian Group DMEGC Magnetics Co., Ltd.
Inclination	20 °
Orientation	East 102 °
Installation Type	Roof parallel
PV Generator Surface	123.9 m ²

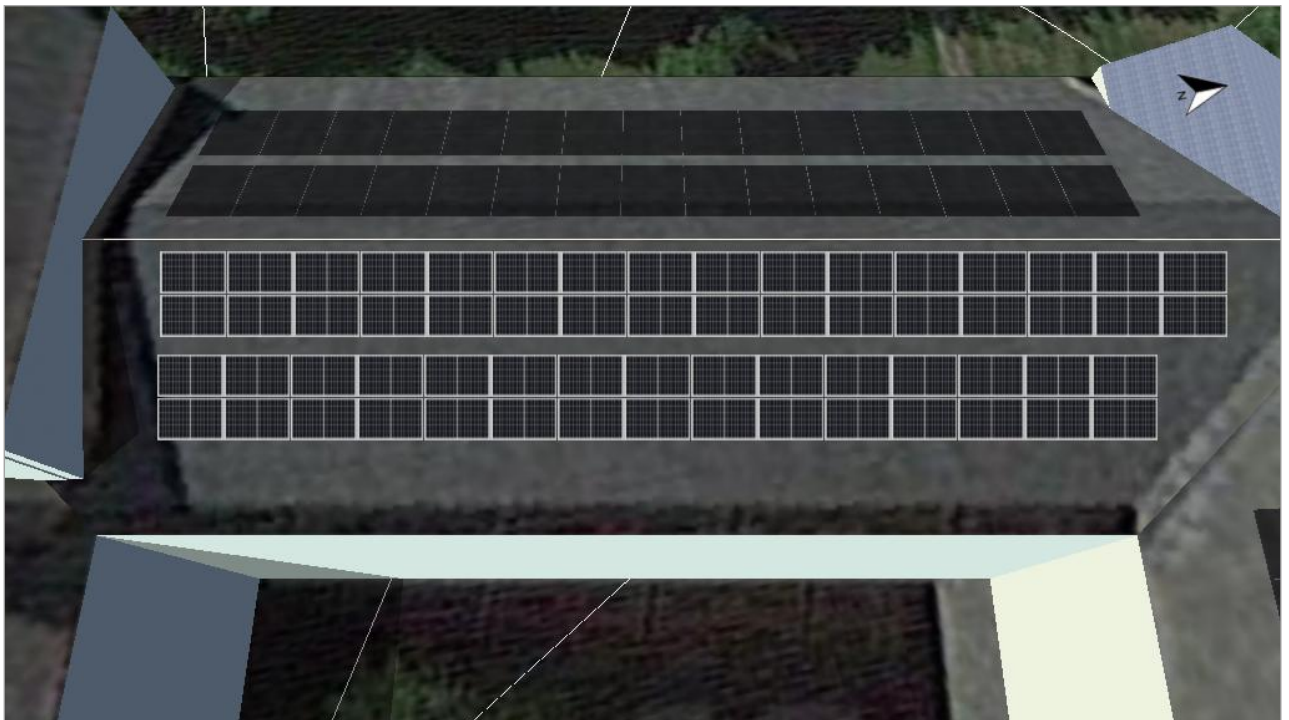


Figure: 5. Module Area - Building 03-Roof Area East

6. Module Area - Building 01-Roof Area South

PV Generator, 6. Module Area - Building 01-Roof Area South

Name	Building 01-Roof Area South
PV Modules	62 x DM445M10RT-54HSW (v1)
Manufacturer	Hengdian Group DMEGC Magnetics Co., Ltd.
Inclination	20 °
Orientation	South 192 °
Installation Type	Roof parallel
PV Generator Surface	123.9 m ²

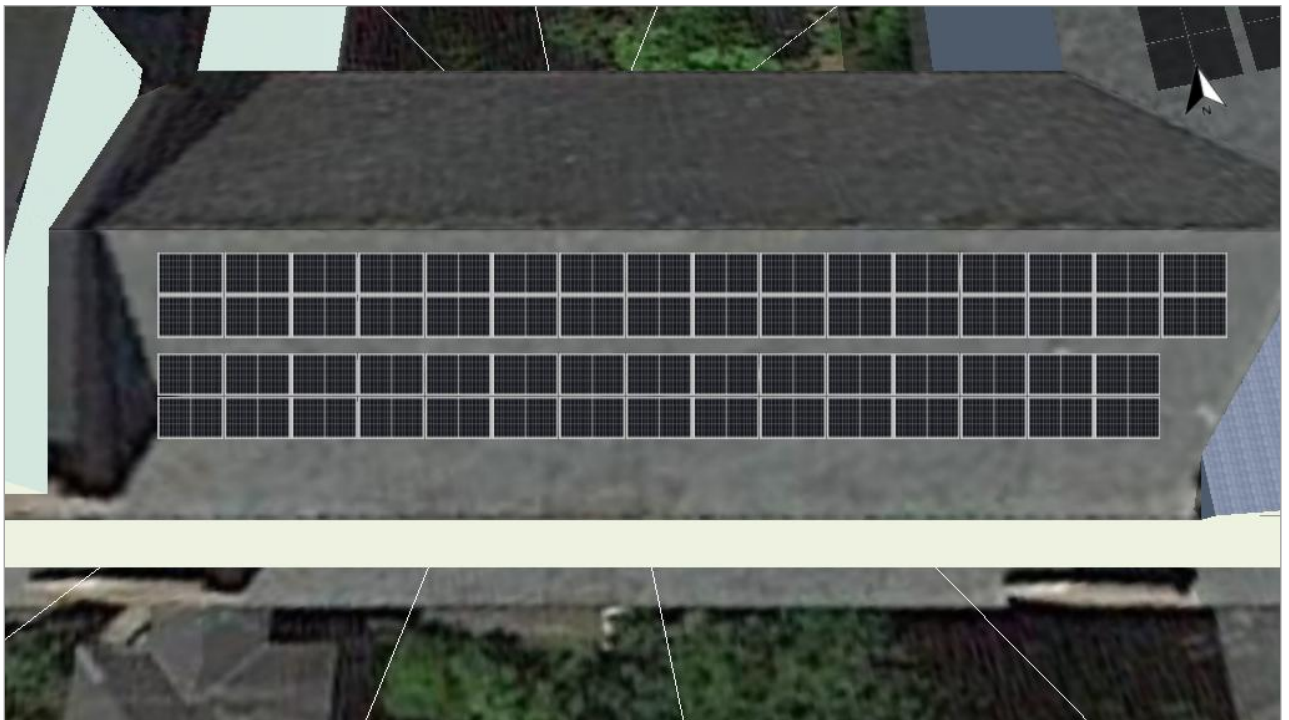


Figure: 6. Module Area - Building 01-Roof Area South

Horizon Line, 3D Design

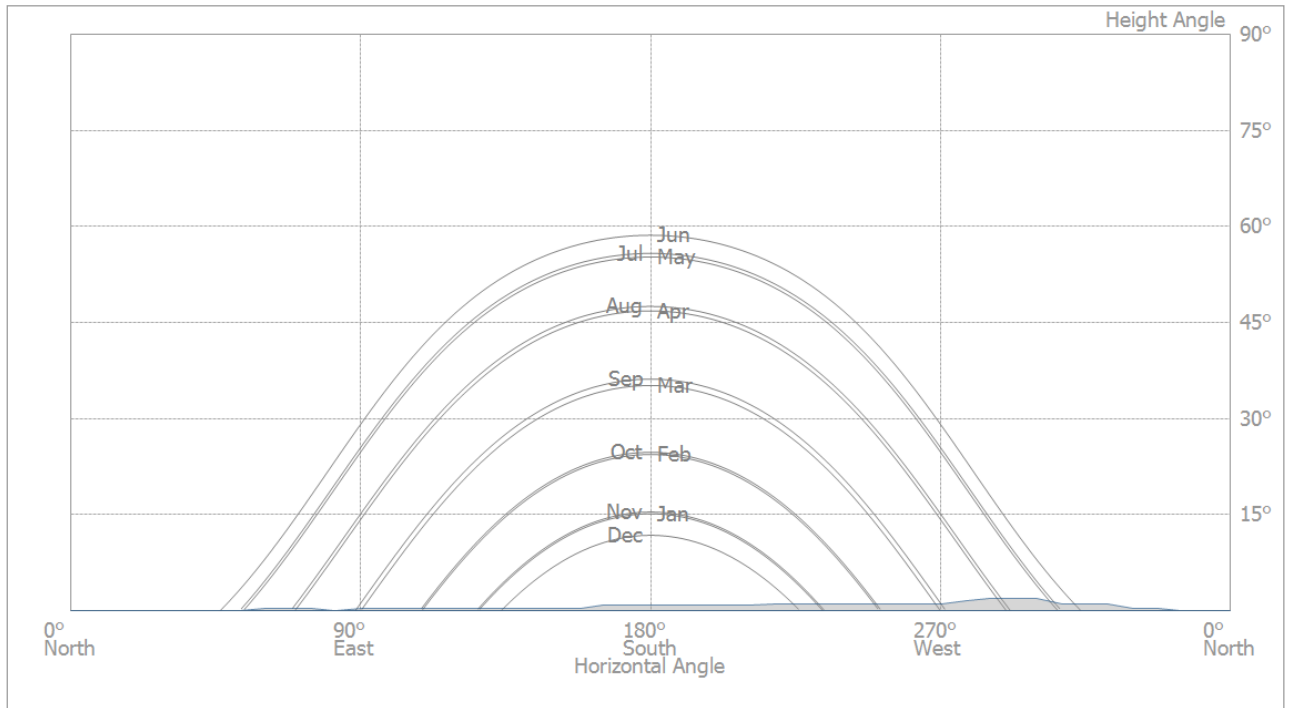


Figure: Horizon (3D Design)

Inverter configuration

Configuration 1

Module Areas	Building 04-Roof Area West + Building 04-Roof Area East
Inverter 1	
Model	S5-GC50K (v2)
Manufacturer	Ginlong (Solis)
Quantity	1
Sizing Factor	113 %
Configuration	MPP 1: 2 x 18
	MPP 2: 1 x 18
	MPP 3: 1 x 13
	MPP 4: 2 x 19
	MPP 5: 1 x 22

Configuration 2

Module Area	Building 02-Roof Area South
Inverter 1	
Model	S5-GC30K (v2)
Manufacturer	Ginlong (Solis)
Quantity	1
Sizing Factor	106.8 %
Configuration	MPP 1: 2 x 12
	MPP 2: 2 x 12
	MPP 3: 2 x 12

Configuration 3

Module Areas	Building 03-Roof Area West + Building 03-Roof Area East
Inverter 1	
Model	S5-GC50K (v2)
Manufacturer	Ginlong (Solis)
Quantity	1
Sizing Factor	108.6 %
Configuration	MPP 1: 2 x 18
	MPP 2: 2 x 12
	MPP 3: 2 x 12
	MPP 4: 1 x 20
	MPP 5: 1 x 18

Configuration 4

Module Area	Building 01-Roof Area South
Inverter 1	
Model	S5-GC25K (v2)
Manufacturer	Ginlong (Solis)
Quantity	1
Sizing Factor	110.4 %
Configuration	MPP 1: 1 x 22
	MPP 2: 1 x 20
	MPP 3: 1 x 20

AC Mains

AC Mains

Number of Phases	3
Mains voltage between phase and neutral	400 V
Displacement Power Factor (cos phi)	+/- 1

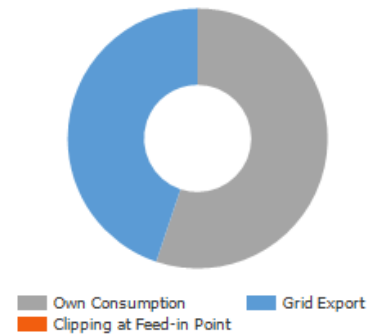
Simulation Results

Results Total System

PV System

PV Generator Output	170.44 kWp
Spec. Annual Yield	927.82 kWh/kWp
Performance Ratio (PR)	91.31 %
Yield Reduction due to Shading	3.0 %
PV Generator Energy (AC grid)	158,191 kWh/Year
Own Consumption	87,261 kWh/Year
Clipping at Feed-in Point	0 kWh/Year
Grid Export	70,930 kWh/Year
Own Power Consumption	55.1 %
CO ₂ Emissions avoided	74,323 kg / year

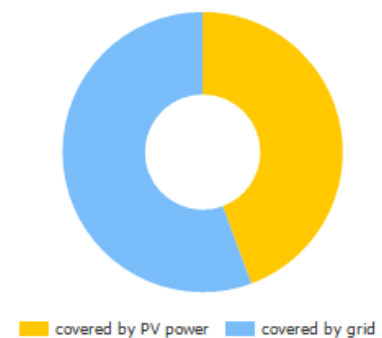
PV Generator Energy (AC grid)



Appliances

Appliances	196,708 kWh/Year
Standby Consumption (Inverter)	57 kWh/Year
Total Consumption	196,765 kWh/Year
covered by PV power	87,261 kWh/Year
covered by grid	109,505 kWh/Year
Solar Fraction	44.3 %

Total Consumption

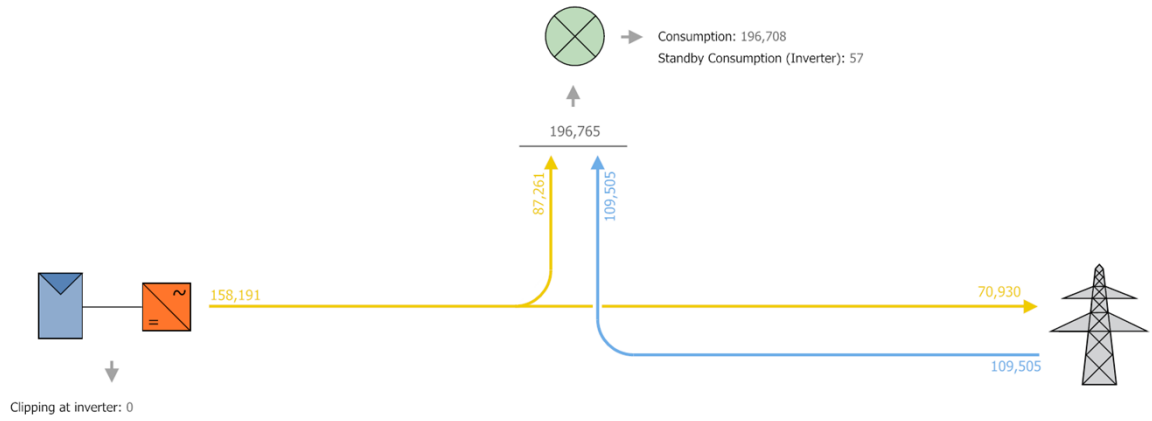


Level of Self-sufficiency

Total Consumption	196,765 kWh/Year
covered by grid	109,505 kWh/Year
Level of Self-sufficiency	44.3 %

Energy Flow Graph

Project: Boldon House



All values in kWh
Small deviations in the totals can occur due to rounding
created with PV*SOL.

Figure: Energy flow

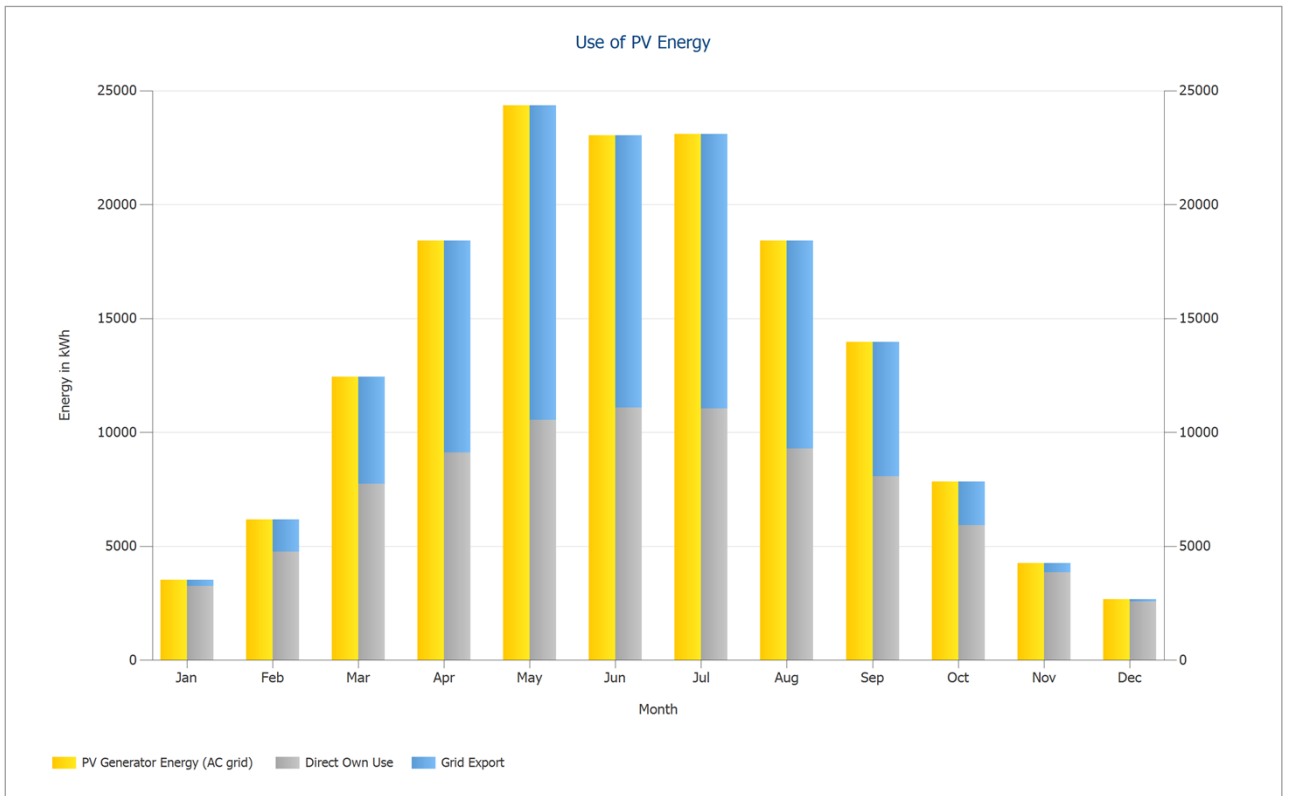


Figure: Use of PV Energy

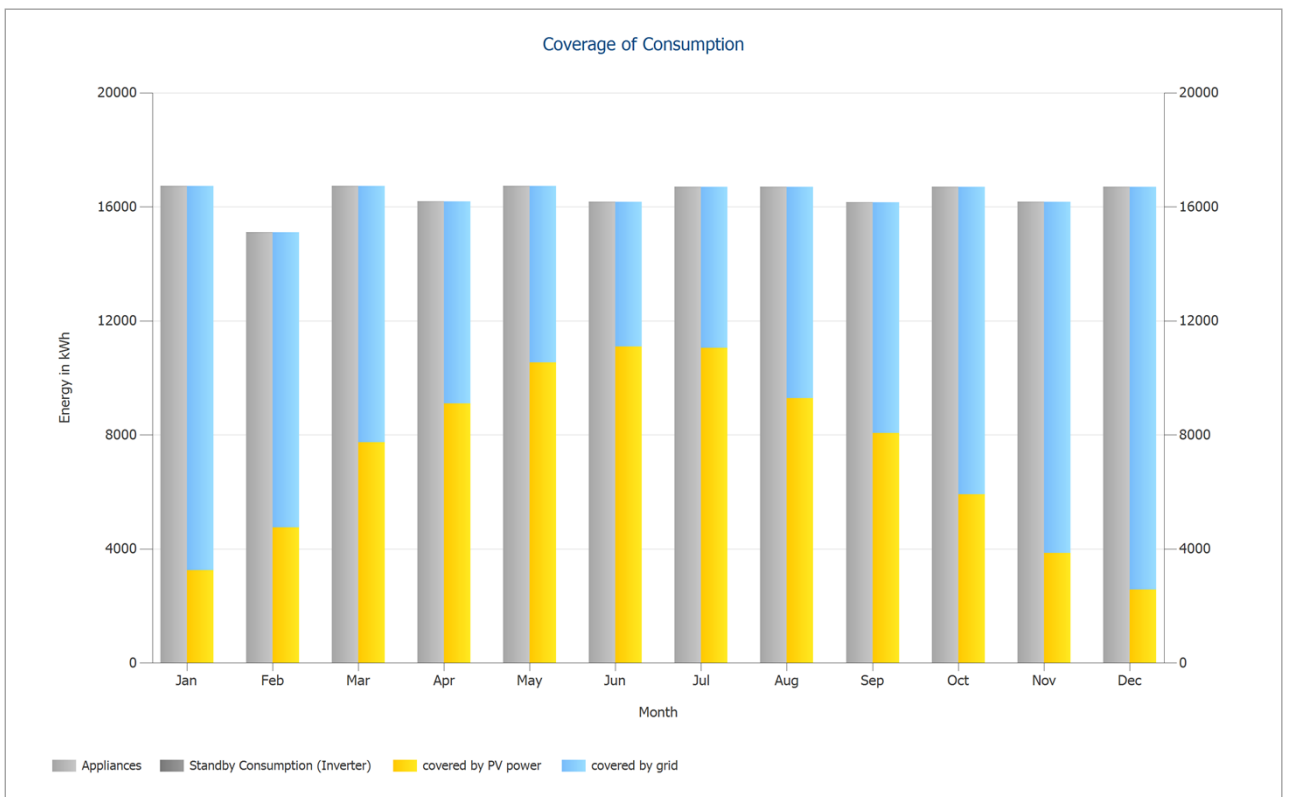


Figure: Coverage of Consumption

Financial Analysis

Overview

System Data

Grid Export in the first year (incl. module degradation)	70,930 kWh/Year
PV Generator Output	170.4 kWp
Start of Operation of the System	23/05/2023
Assessment Period	25 Years
Interest on Capital	1 %

Economic Parameters

Internal Rate of Return (IRR)	268.25 %
Accrued Cash Flow (Cash Balance)	1,771,246.58 £
Amortization Period	0.0 Years
Electricity Production Costs	0 £/kWh

Payment Overview

Specific Investment Costs	0.00 £/kWp
Investment Costs	0.00 £
One-off Payments	0.00 £
Incoming Subsidies	0.00 £
Annual Costs	0.00 £/Year
Other Revenue or Savings	0.00 £/Year

Remuneration and Savings

Total Payment from Utility in First Year	15,604.64 £/Year
First year savings	34,881.25 £/Year

GLE Tariff (Example)

Energy Price	0.4 £/kWh
Inflation Rate for Energy Price	5 %/Year

Remuneration of Electricity sold to Third Party

Price of Electricity sold to Third Party	0.22 £/kWh
Remuneration of Electricity sold to Third Party	15,604.64 £/Year

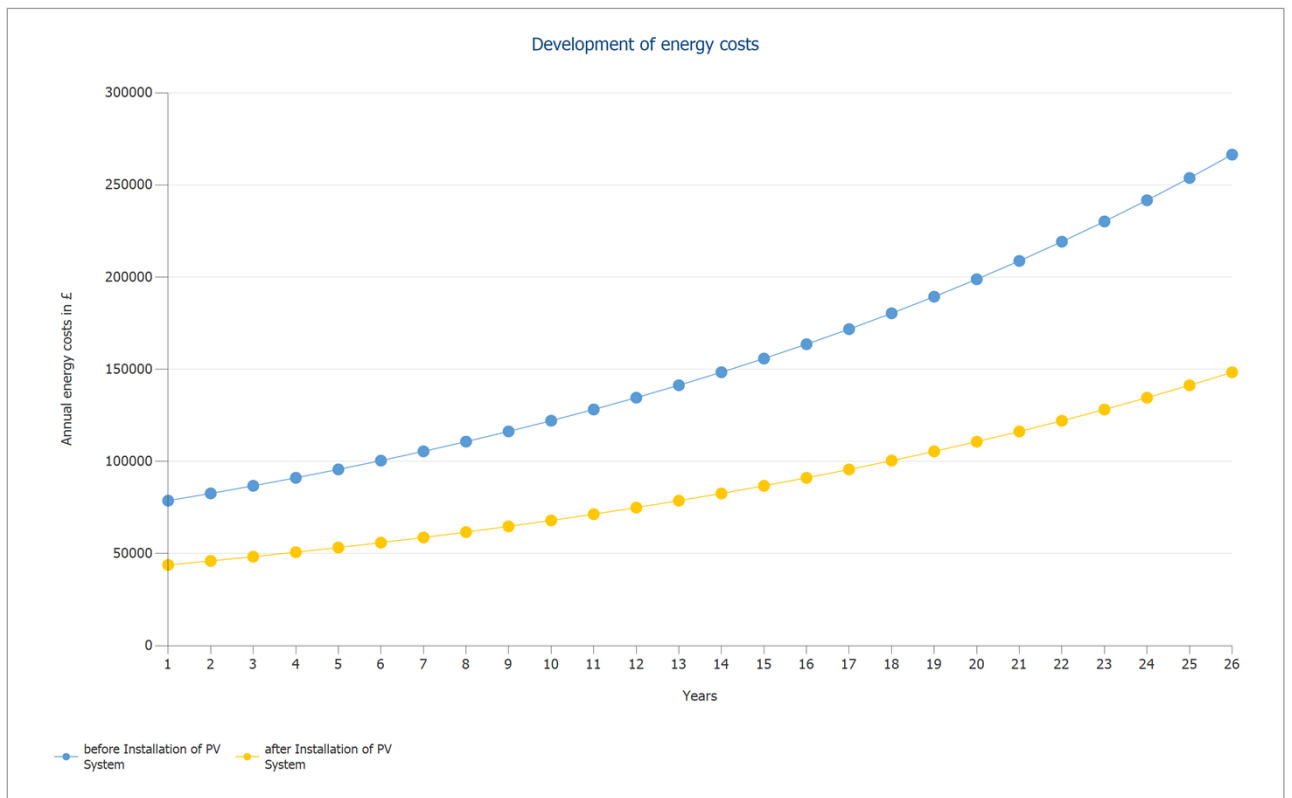


Figure: Development of energy costs

Cash flow

Cash flow

	Year 1	Year 2	Year 3	Year 4	Year 5
Feed-in / Export Tariff	£13,314.19	£15,297.17	£15,145.71	£14,995.75	£14,847.28
Electricity Savings	£33,624.23	£35,903.65	£37,325.58	£38,803.82	£40,340.60
Annual Cash Flow	£46,938.42	£51,200.82	£52,471.29	£53,799.57	£55,187.88
Accrued Cash Flow (Cash Balance)	£46,938.42	£98,139.24	£150,610.53	£204,410.10	£259,597.98

Cash flow

	Year 6	Year 7	Year 8	Year 9	Year 10
Feed-in / Export Tariff	£14,700.28	£14,554.73	£14,410.62	£14,267.94	£14,126.68
Electricity Savings	£41,938.27	£43,599.18	£45,325.86	£47,120.94	£48,987.13
Annual Cash Flow	£56,638.54	£58,153.91	£59,736.48	£61,388.89	£63,113.80
Accrued Cash Flow (Cash Balance)	£316,236.52	£374,390.43	£434,126.92	£495,515.80	£558,629.61

Cash flow

	Year 11	Year 12	Year 13	Year 14	Year 15
Feed-in / Export Tariff	£13,986.81	£13,848.33	£13,711.21	£13,575.46	£13,441.05
Electricity Savings	£50,927.23	£52,944.12	£55,040.92	£57,220.77	£59,486.95
Annual Cash Flow	£64,914.04	£66,792.45	£68,752.14	£70,796.23	£72,928.00
Accrued Cash Flow (Cash Balance)	£623,543.64	£690,336.10	£759,088.23	£829,884.46	£902,812.47

Cash flow

	Year 16	Year 17	Year 18	Year 19	Year 20
Feed-in / Export Tariff	£13,307.97	£13,176.21	£13,045.75	£12,916.58	£12,788.70
Electricity Savings	£61,842.85	£64,292.09	£66,838.29	£69,485.36	£72,237.26
Annual Cash Flow	£75,150.82	£77,468.30	£79,884.04	£82,401.94	£85,025.95
Accrued Cash Flow (Cash Balance)	£977,963.29	£1,055,431.59	£1,135,315.64	£1,217,717.58	£1,302,743.53

Cash flow

	Year 21	Year 22	Year 23	Year 24	Year 25
Feed-in / Export Tariff	£12,662.08	£12,536.71	£12,412.58	£12,289.69	£12,168.01
Electricity Savings	£75,098.15	£78,072.34	£81,164.31	£84,378.73	£87,720.46
Annual Cash Flow	£87,760.23	£90,609.05	£93,576.89	£96,668.42	£99,888.47
Accrued Cash Flow (Cash Balance)	£1,390,503.76	£1,481,112.81	£1,574,689.70	£1,671,358.12	£1,771,246.58

Degradation and inflation rates are applied on a monthly basis over the entire observation period. This is done in the first year.

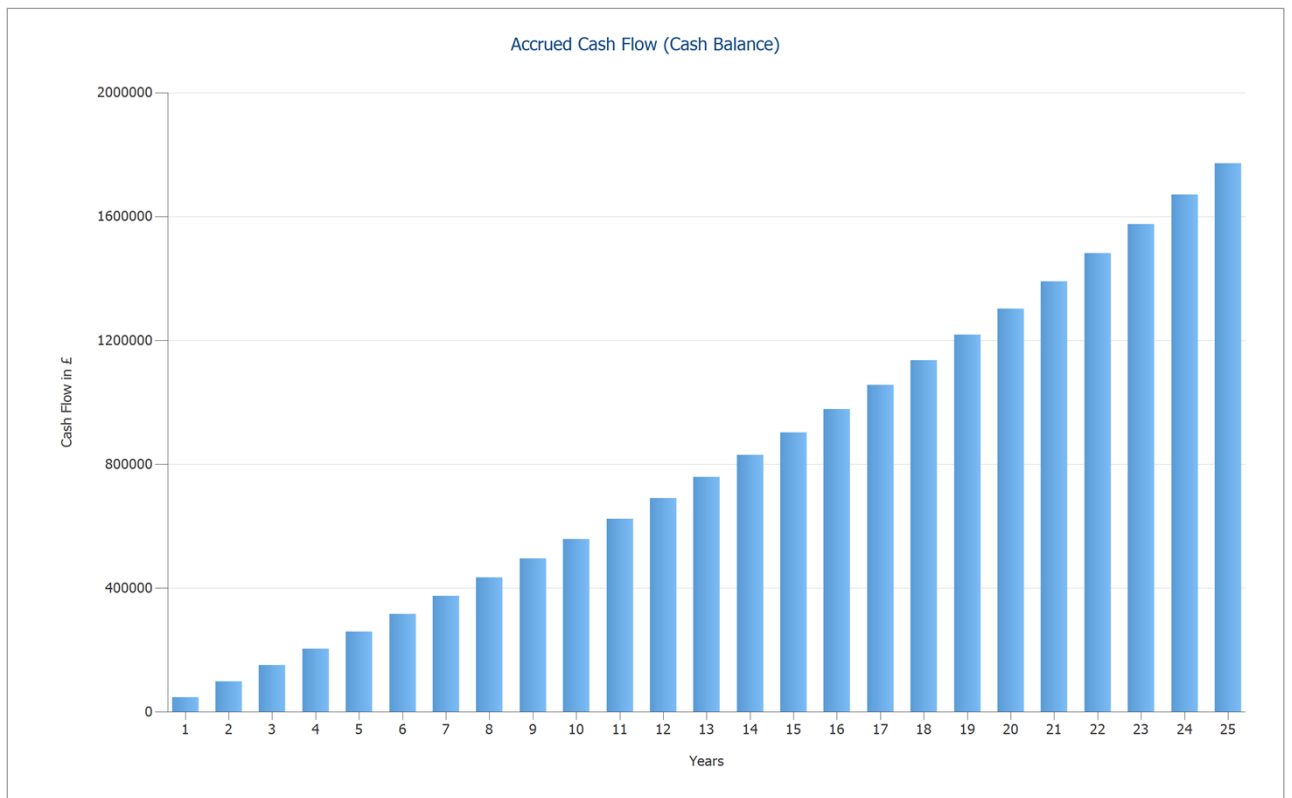


Figure: Accrued Cash Flow (Cash Balance)

Plans and parts list

Circuit Diagram

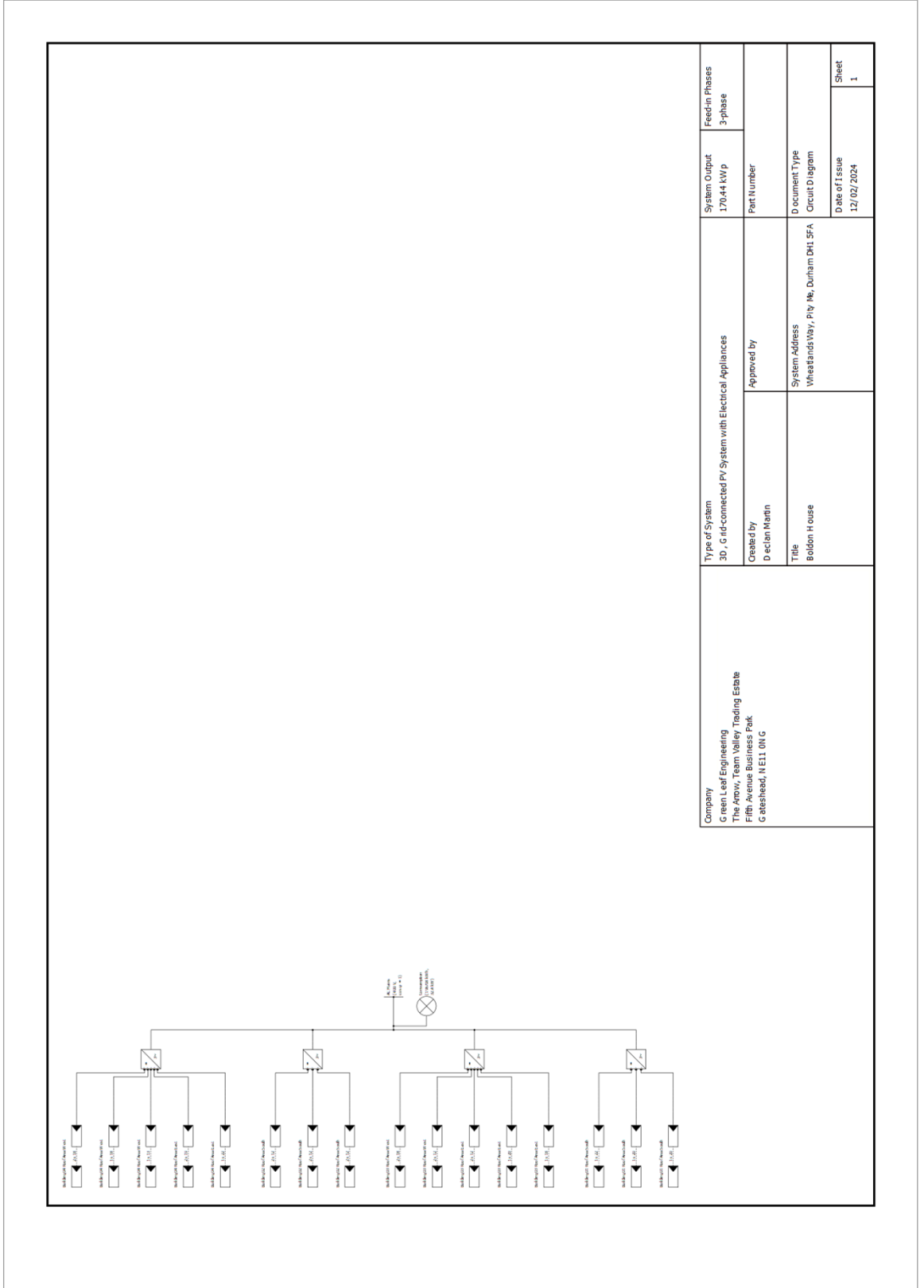


Figure: Circuit Diagram

Overview plan

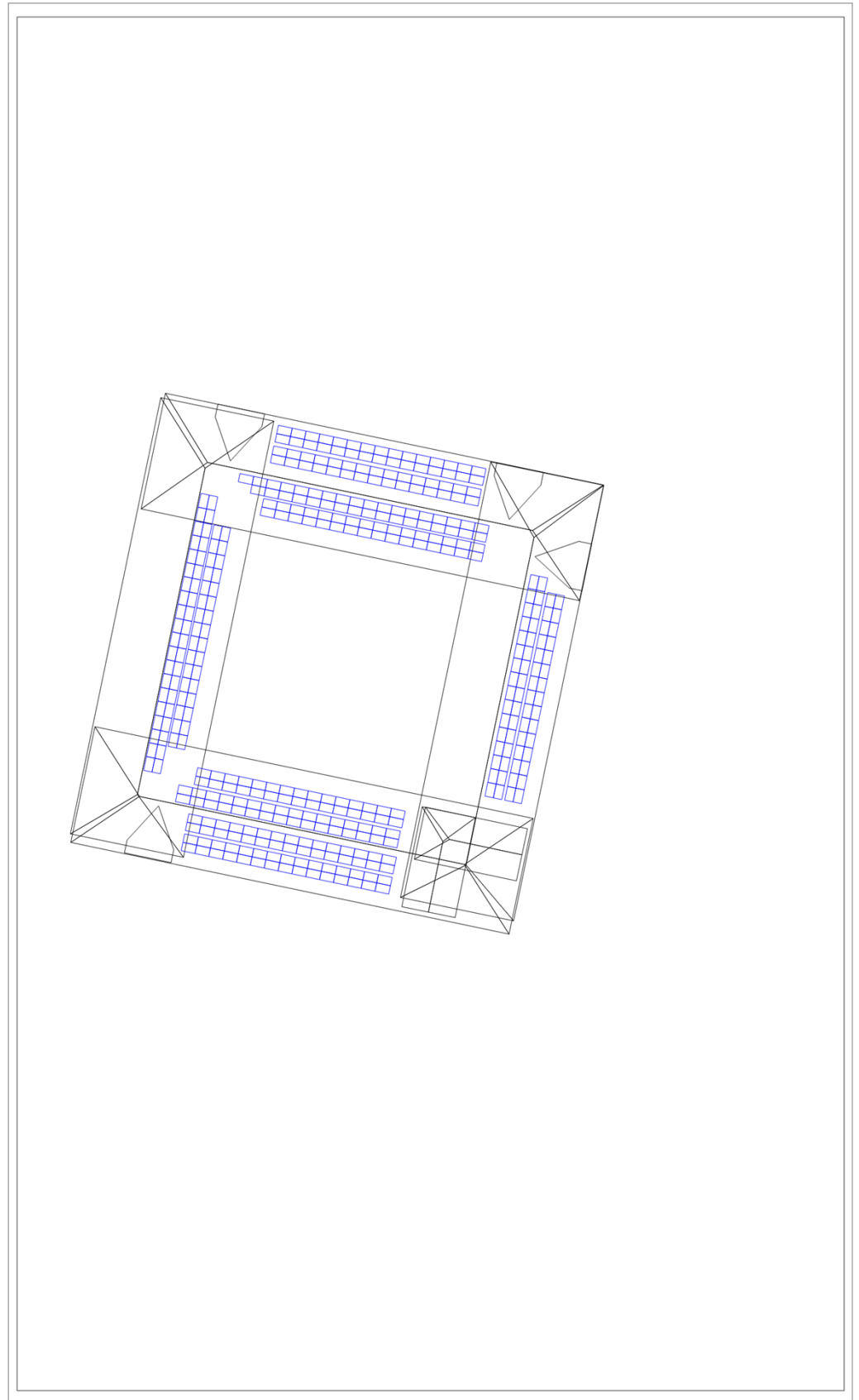


Figure: Overview plan

Dimensioning Plan

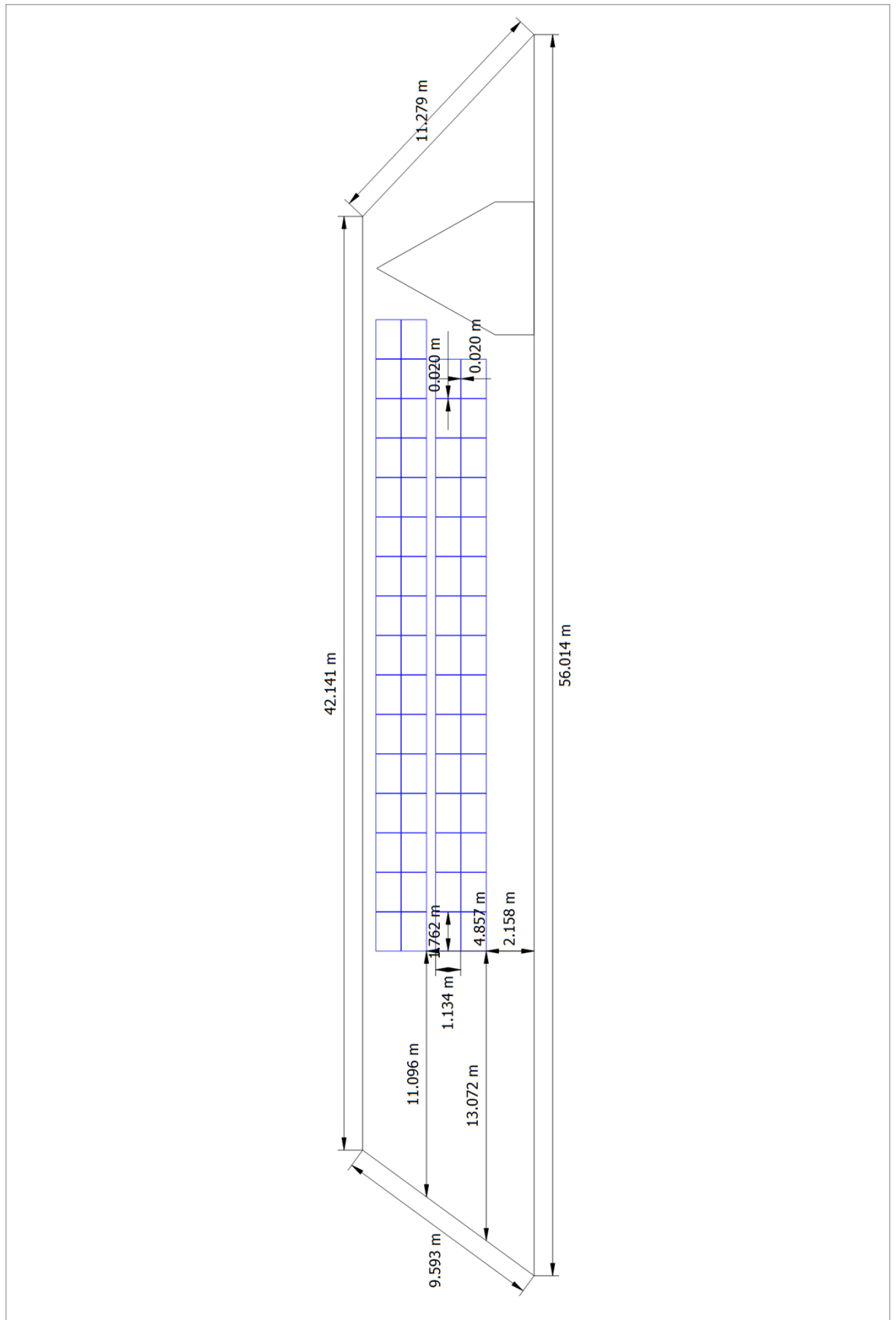


Figure: Building 01 - Roof Area South

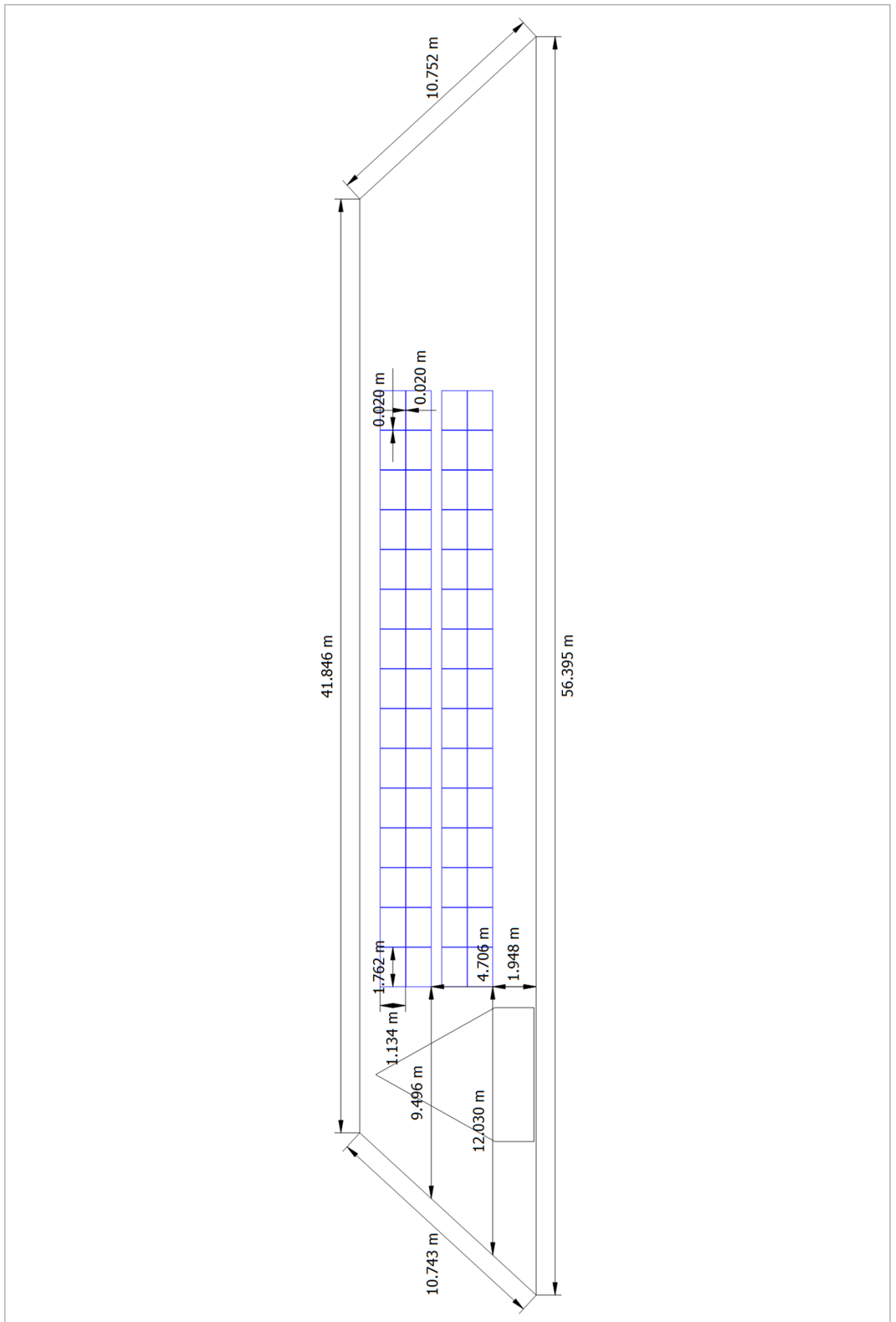


Figure: Building 03 - Roof Area West

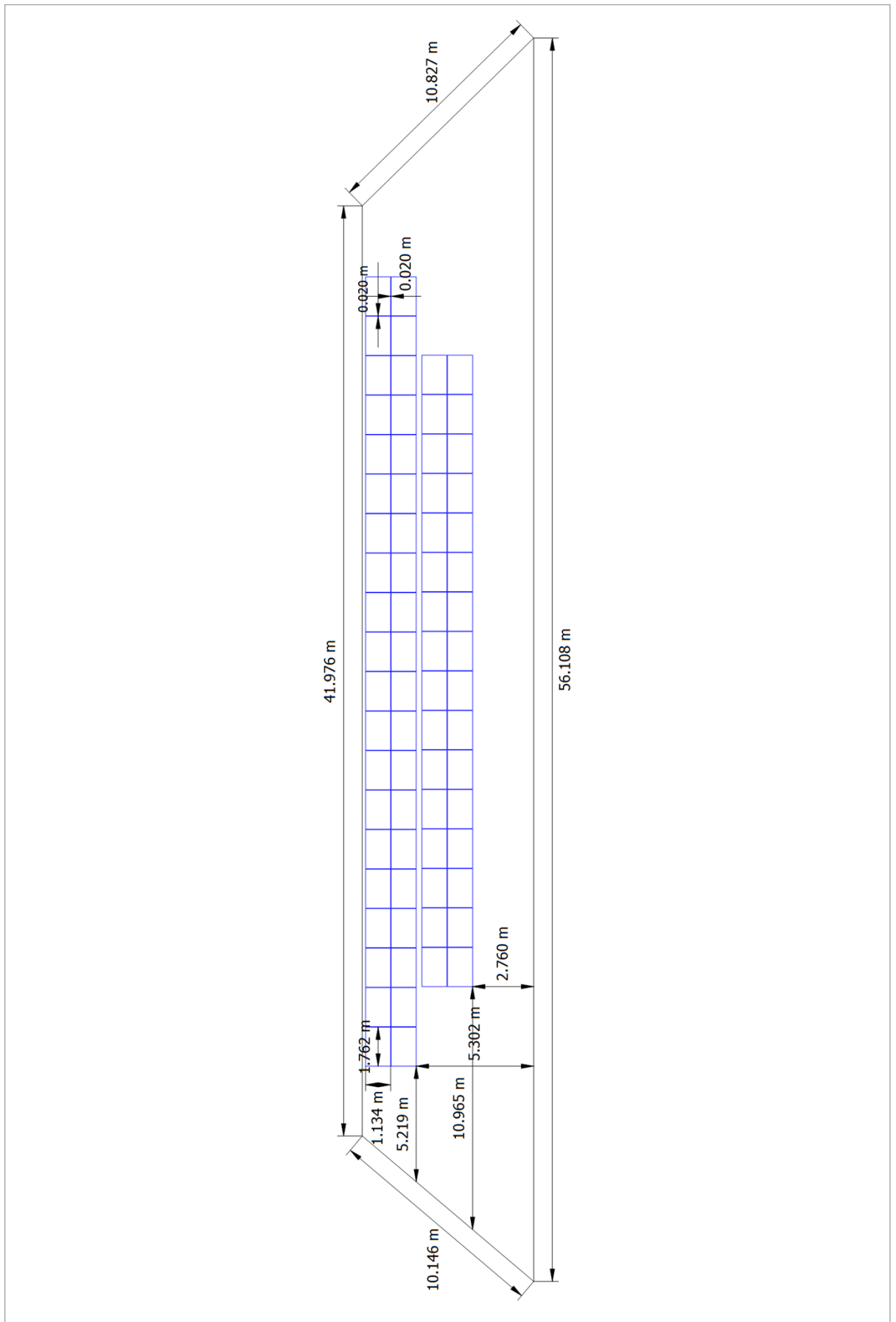


Figure: Building 02 - Roof Area South

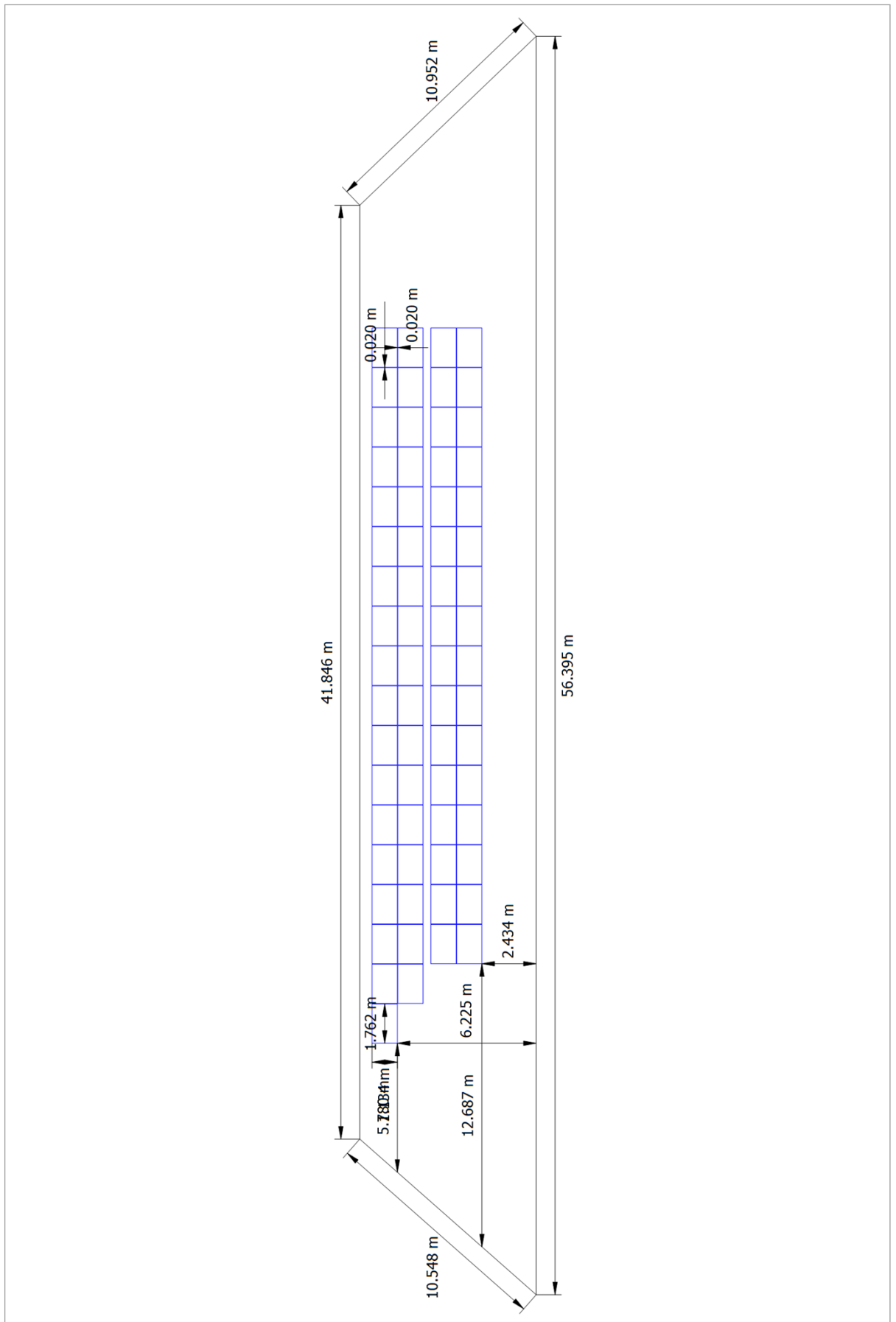


Figure: Building 04 - Roof Area West

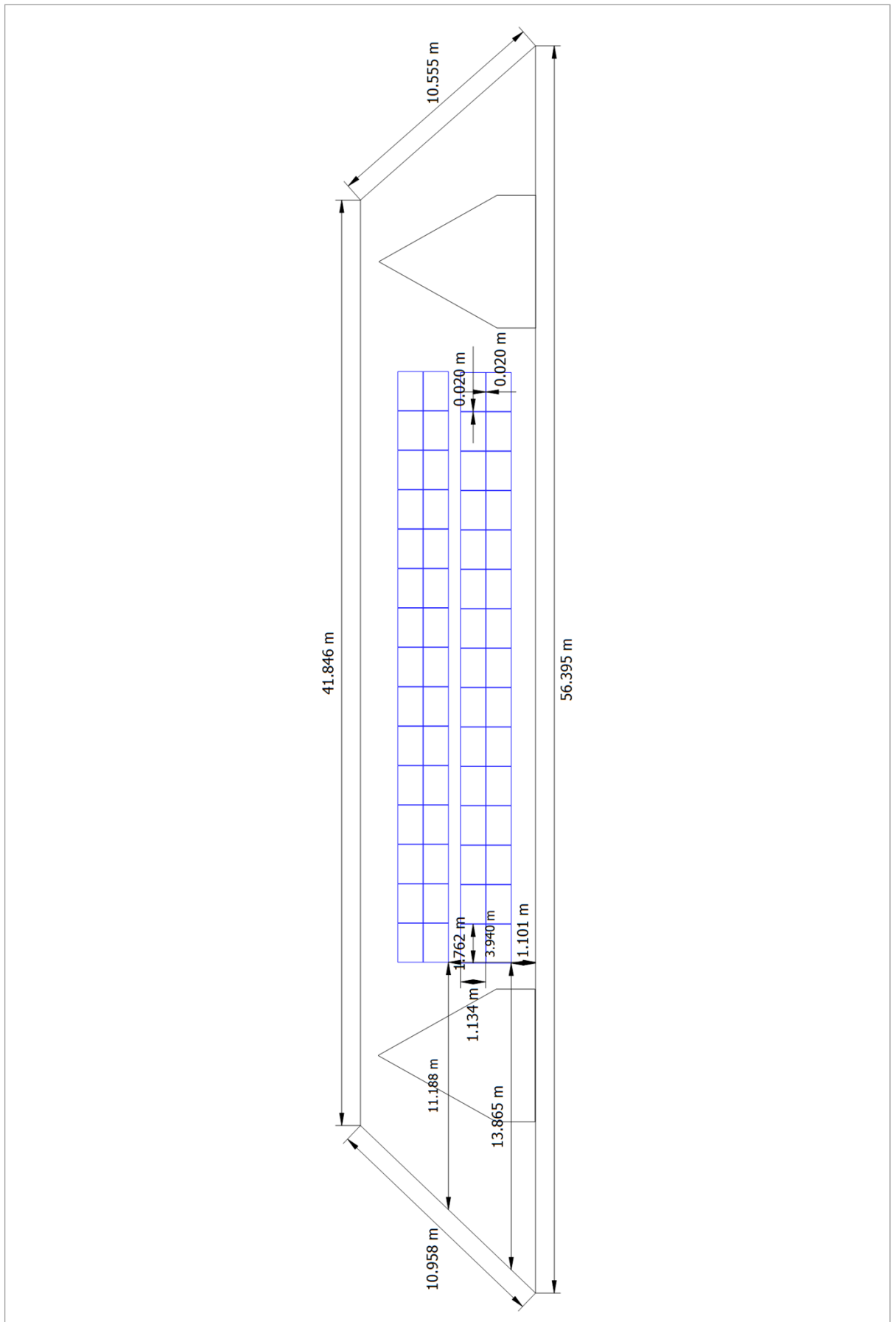


Figure: Building 04 - Roof Area East

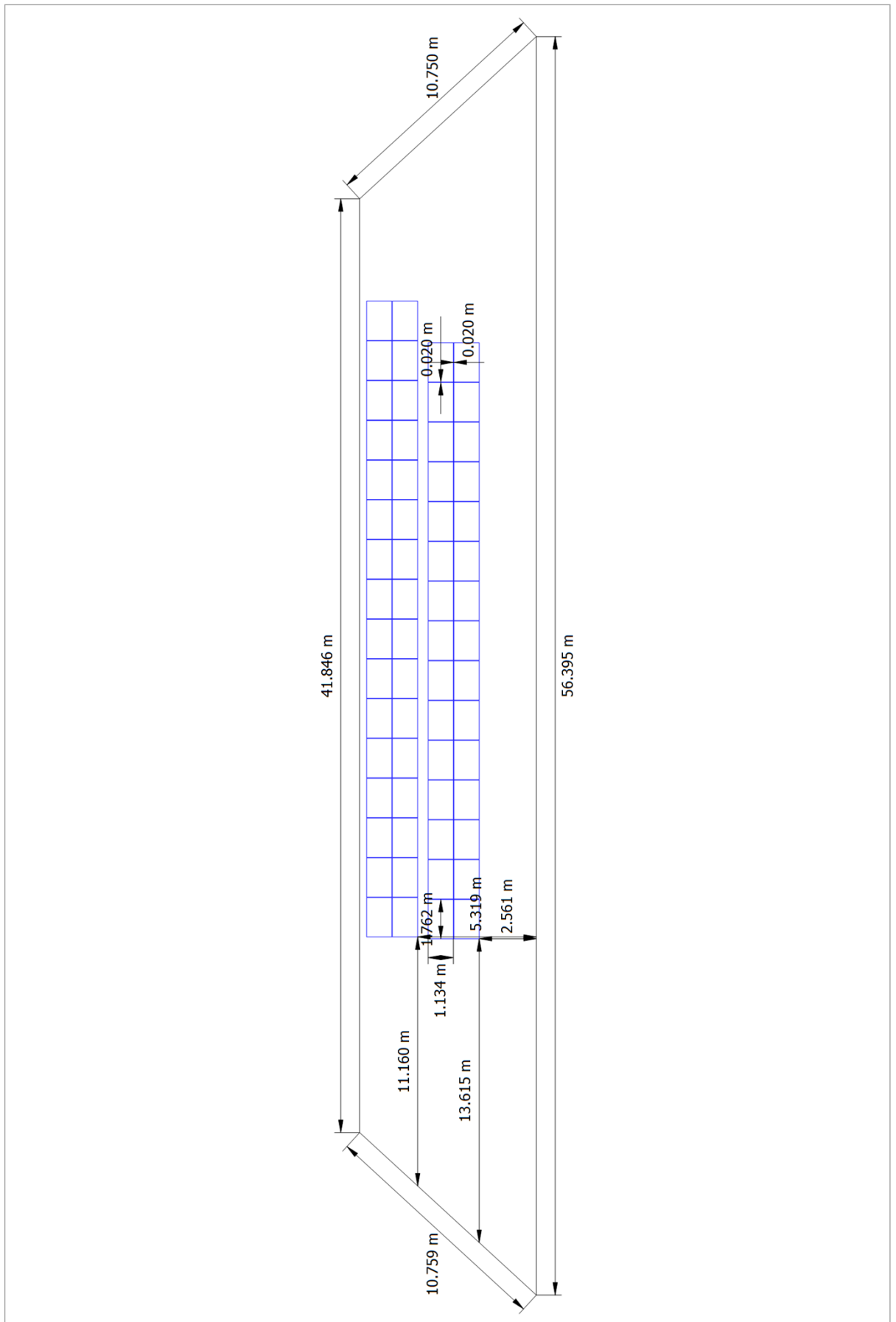


Figure: Building 03 - Roof Area East

String Plan

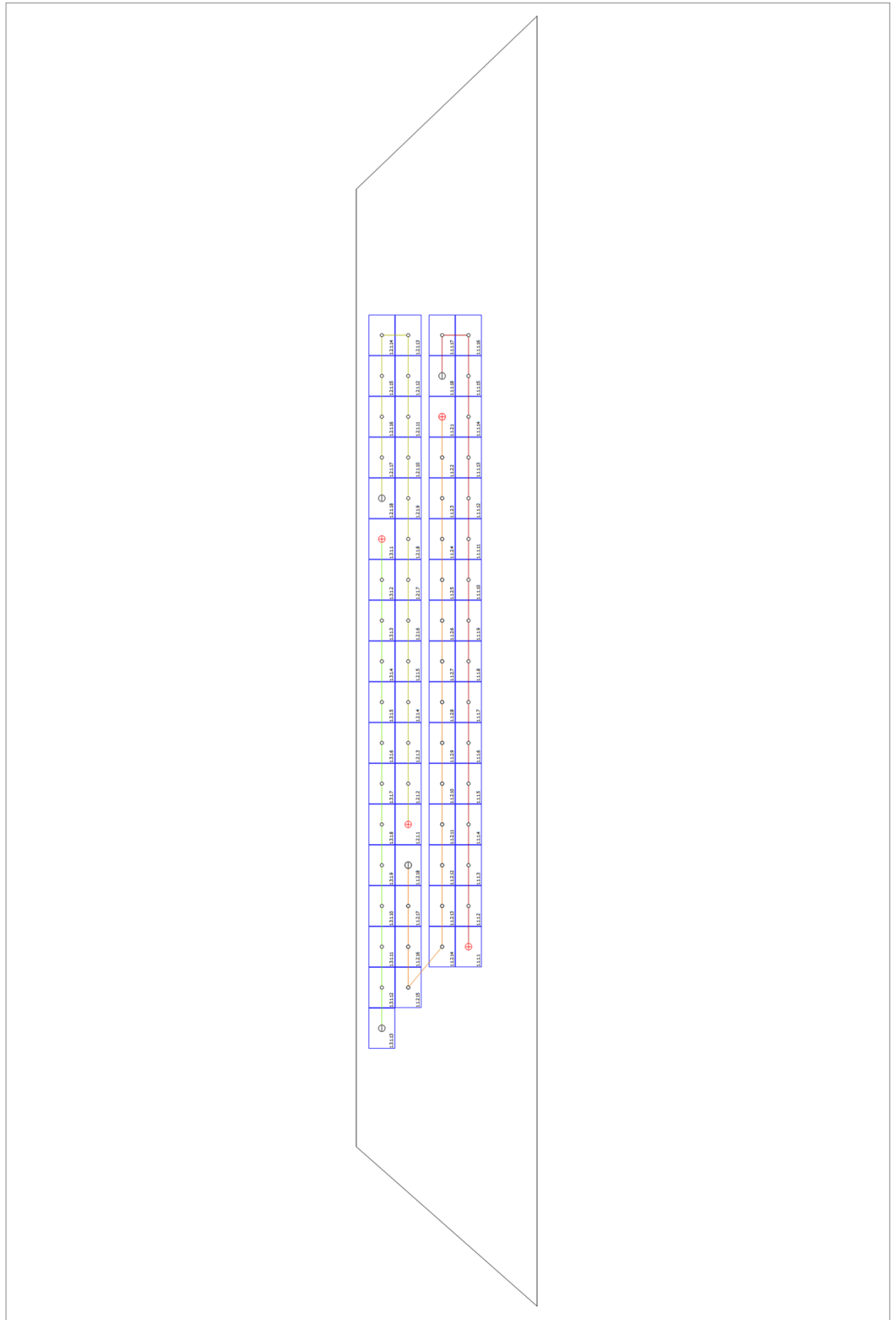


Figure: Building 04 - Roof Area West

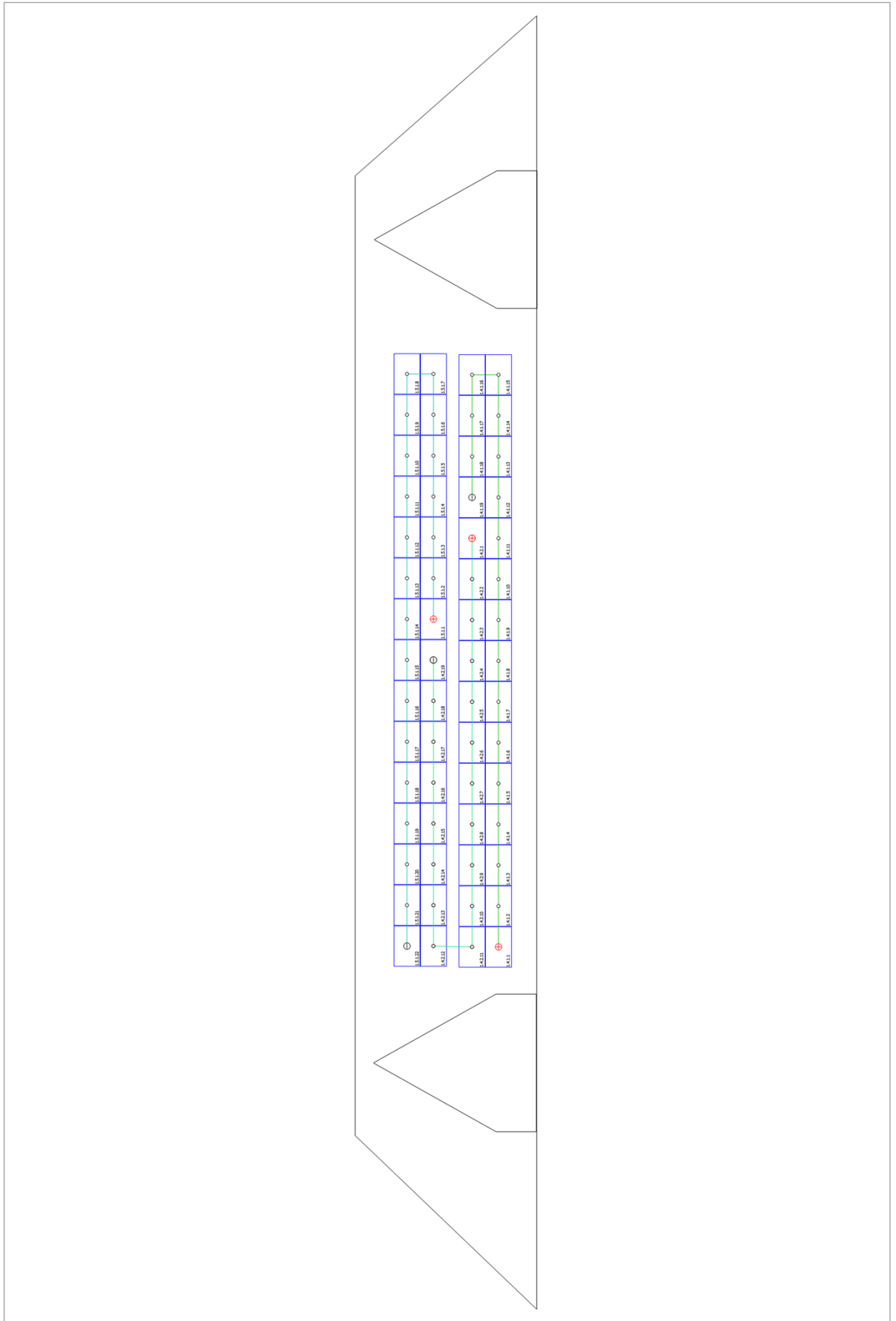


Figure: Building 04 - Roof Area East

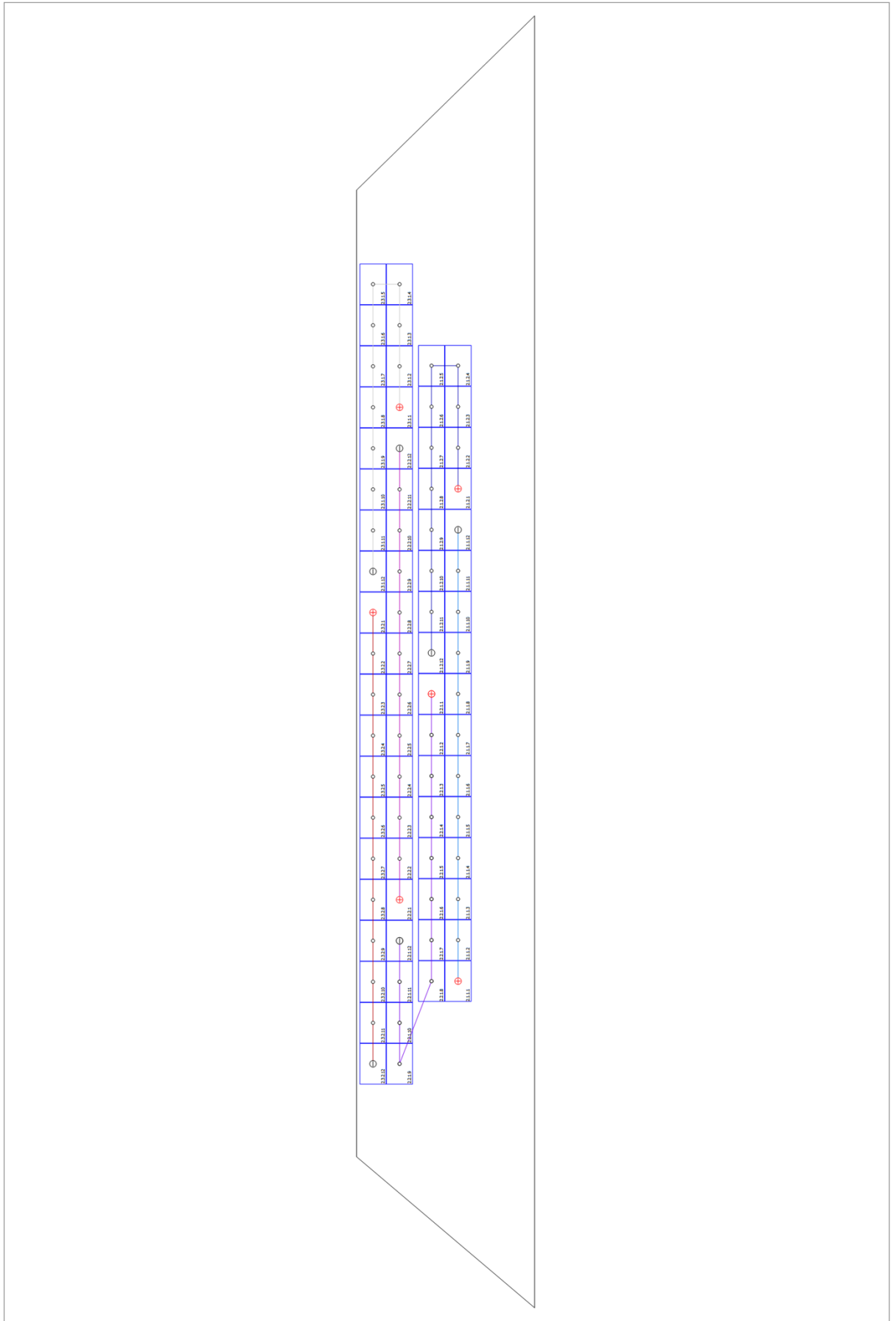


Figure: Building 02 - Roof Area South

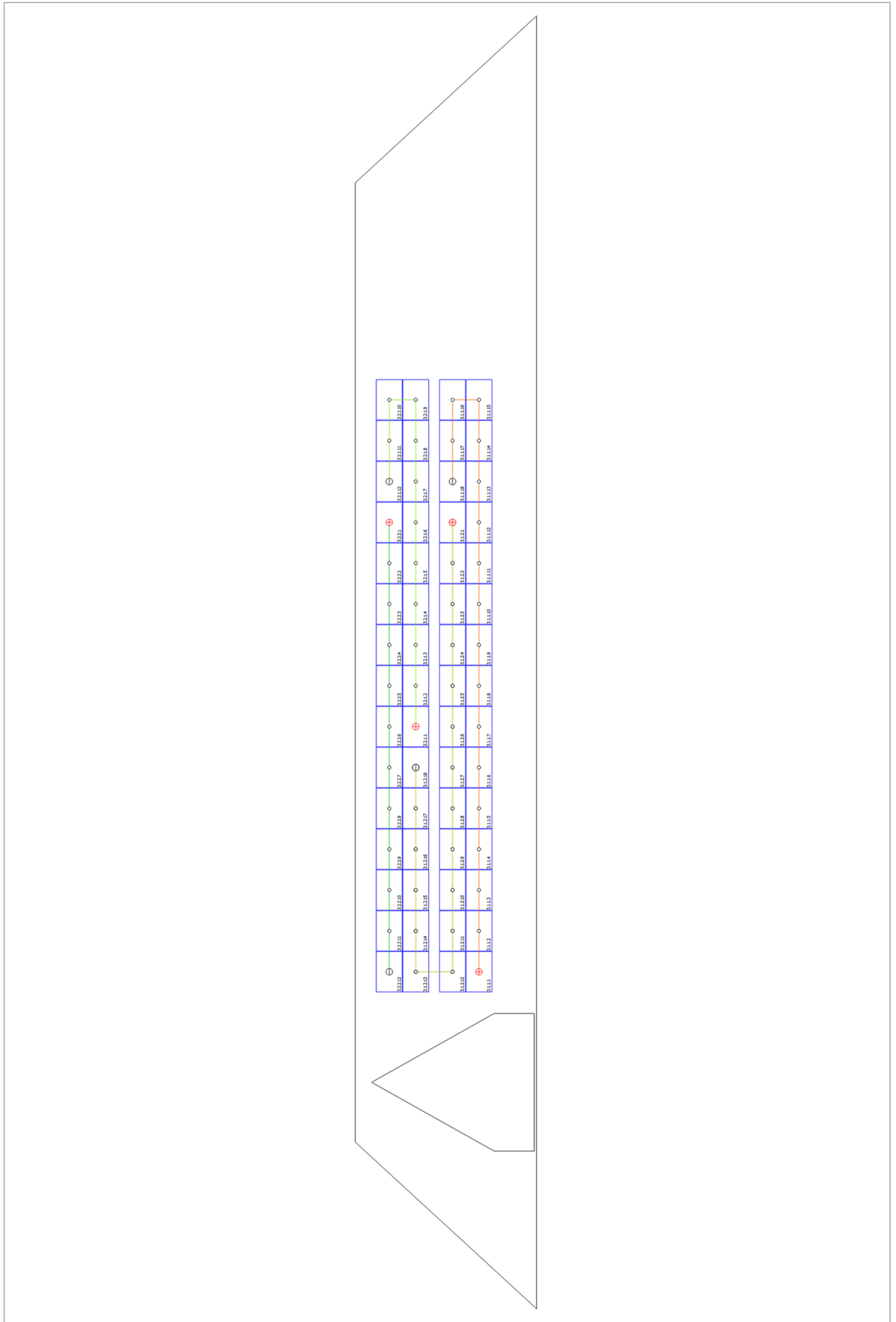


Figure: Building 03 - Roof Area West

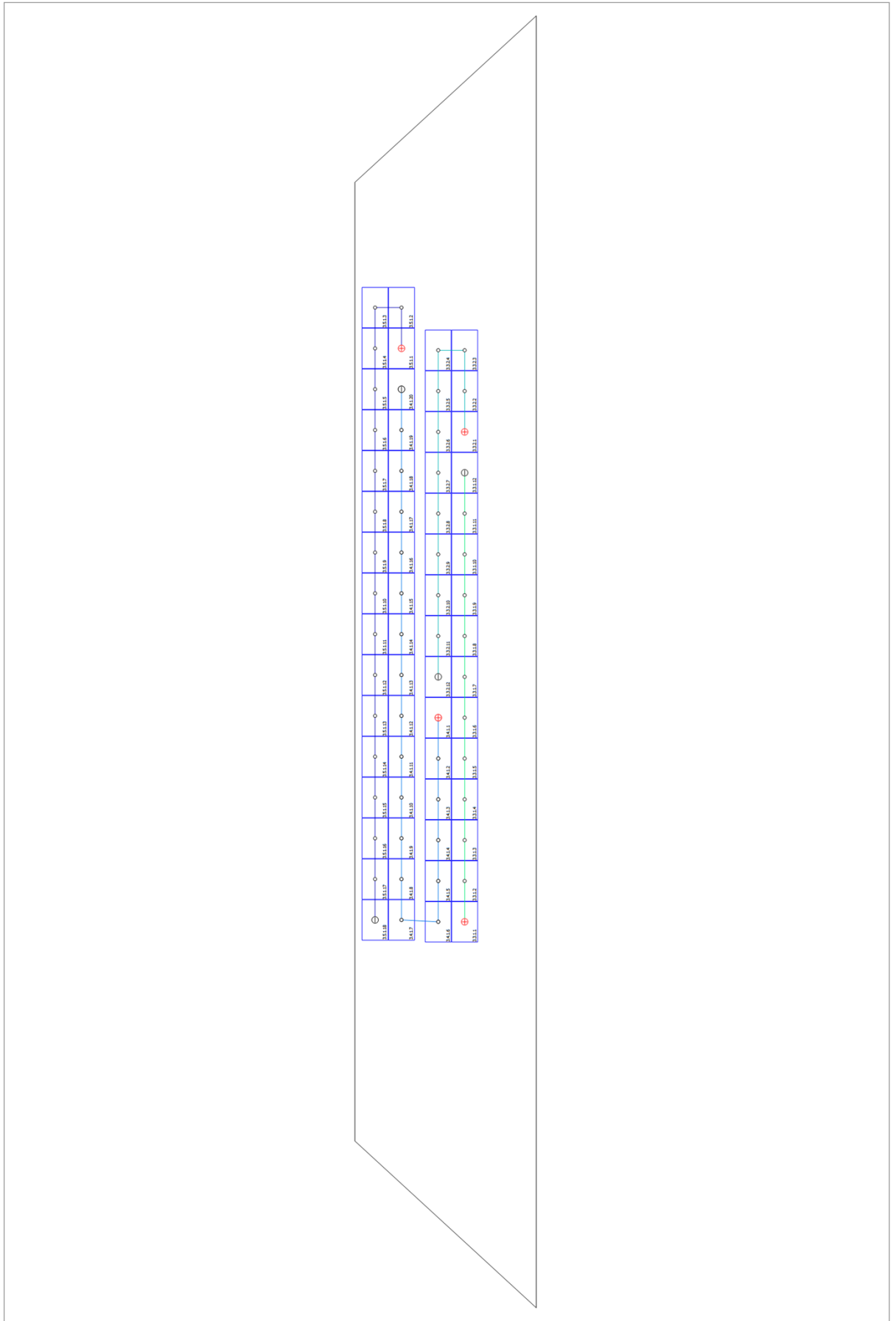


Figure: Building 03 - Roof Area East

Parts list

Parts list

#	Type	Item number	Manufacturer	Name	Quantity	Unit
1	PV Module		Hengdian Group DMEGC Magnetics Co., Ltd.	DM445M10RT- 54HSW	383	Piece
2	Inverter		Ginlong (Solis)	S5-GC50K	2	Piece
3	Inverter		Ginlong (Solis)	S5-GC30K	1	Piece
4	Inverter		Ginlong (Solis)	S5-GC25K	1	Piece