Building Futures Together

The Circle Trust

St. Crispin's Secondary School
Solar Photovoltaic Proposal

Photovoltaic Structural Report

P25-0111

March 2025

Barker

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Solar Photovoltaic Proposal
Photovoltaic Structural Report

Proposal for Installation of Photovoltaic Panels
St. Crispin's Secondary School,
London Road, Wokingham, Berkshire, RG40 1SS

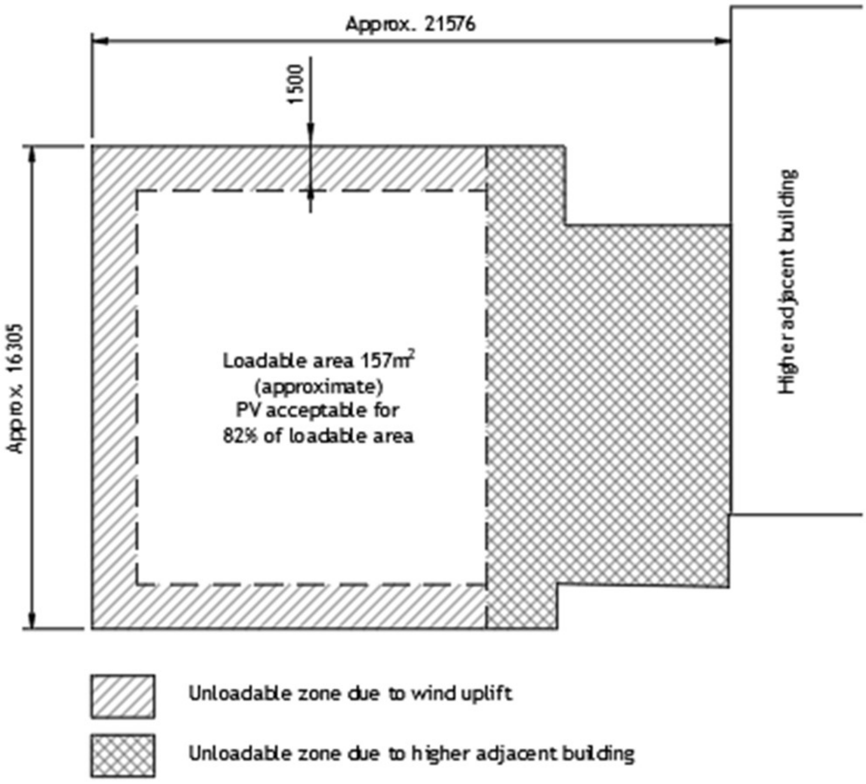
The Circle Trust
The Oval Offices, C/O St Crispin's School,
London, Wokingham, Berkshire, RG40 1SS

BA Job No.	P25-0111
Document Type	Photovoltaic Structural Report
Version & Revision	Original
Electronic File Name	St. Crispin's Secondary School
Prepared by	Simon Harris BSc (Hons)
Authorised for Issue by	Martin Vinter
Date of Issue	27/03/2025

Barker Majesty House, Avenue West, Skyline 120, Braintree, Essex. CM77 7AA	Project			Job No.	
	Proposal for Installation of Photovoltaic Panels			P25-0111	
	School			Sheet No./Rev.	
	St. Crispin's Secondary School			P/1	
	Calc. By	Date	Checked By	Date	Approved By	Date
	SH	27/03/25	DC			

Barker Majesty House, Avenue West, Skyline 120, Braintree, Essex. CM77 7AA	Project Proposal for Installation of Photovoltaic Panels			Job No. P25-0111	
	School St. Crispin's Secondary School			Sheet No./Rev. P/2	
	Calc. By SH	Date 27/03/25	Checked By DC	Date	Approved By	Date

St. Crispin's Secondary School Roof 1



Panels Proposed XXNo. = XXXm² = less than area allowed (XXXm²) Therefore OK

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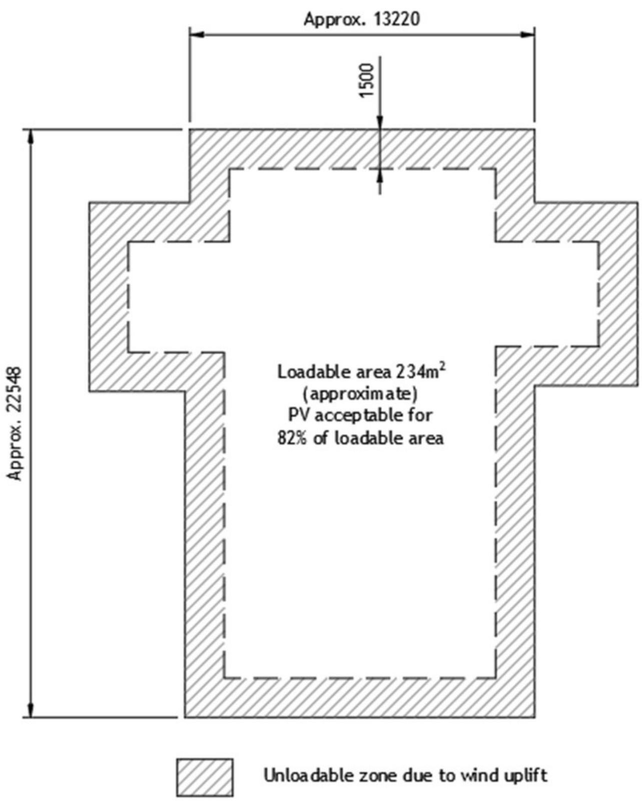
St. Crispin's Secondary School Roof 2



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Therefore OK

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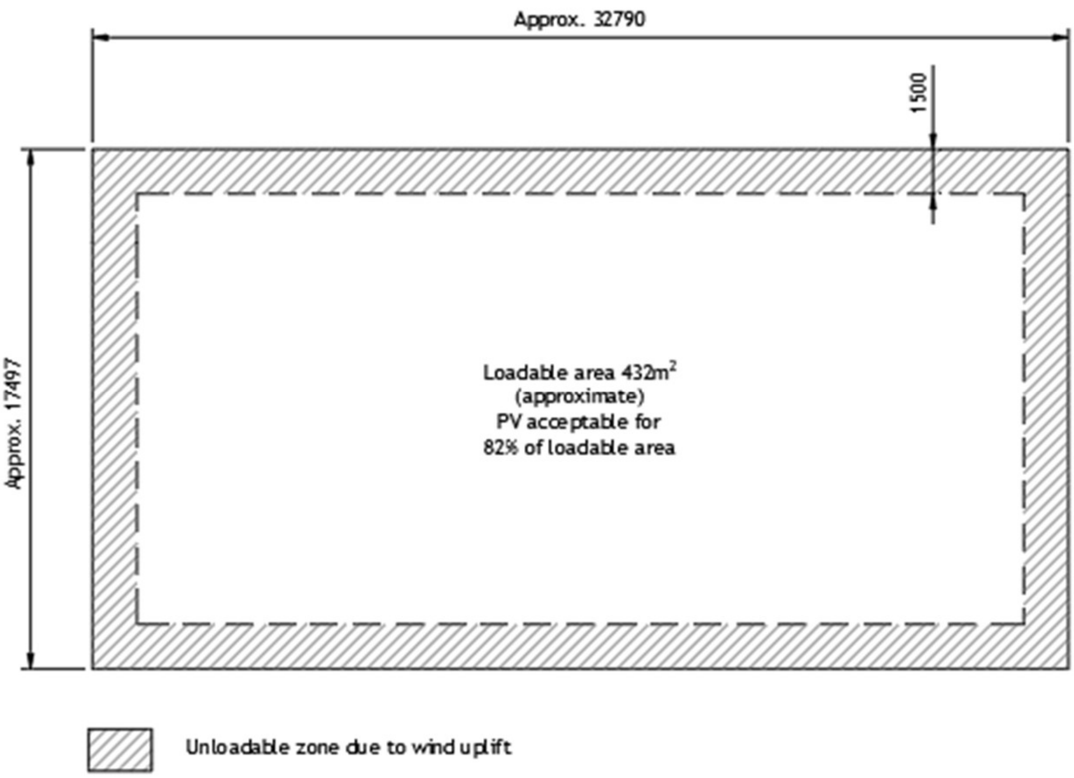
St. Crispin's Secondary School Roof 3



Panels Proposed XXNo. = XXXm^2 = less than area allowed (XXXm^2)
Therefore OK

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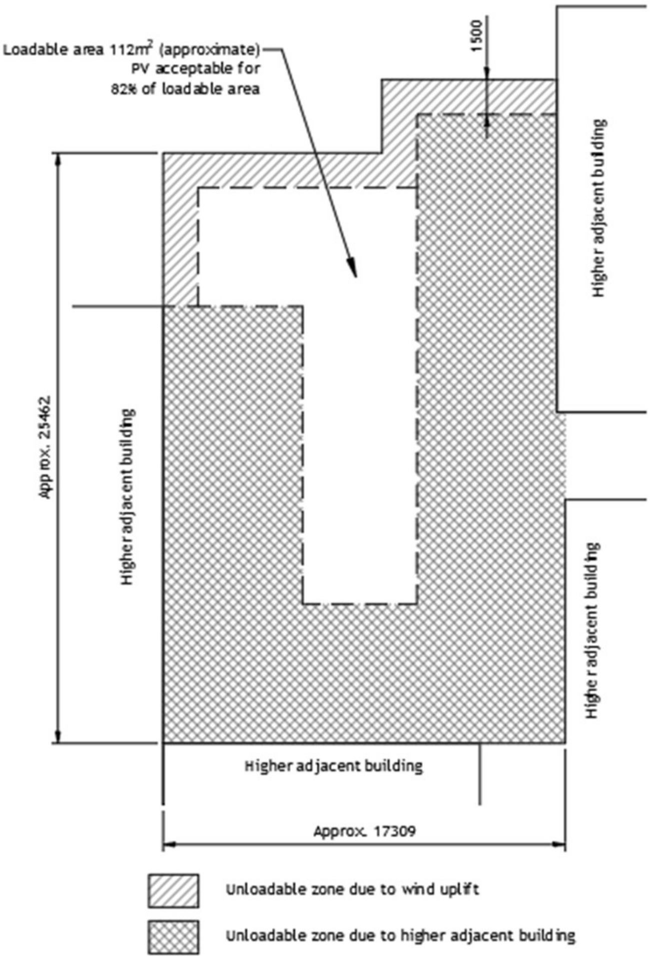
St. Crispin's Secondary School Roof 4



Panels Proposed XXNo. = XXXm² = less than area allowed (XXXm²)
Therefore OK

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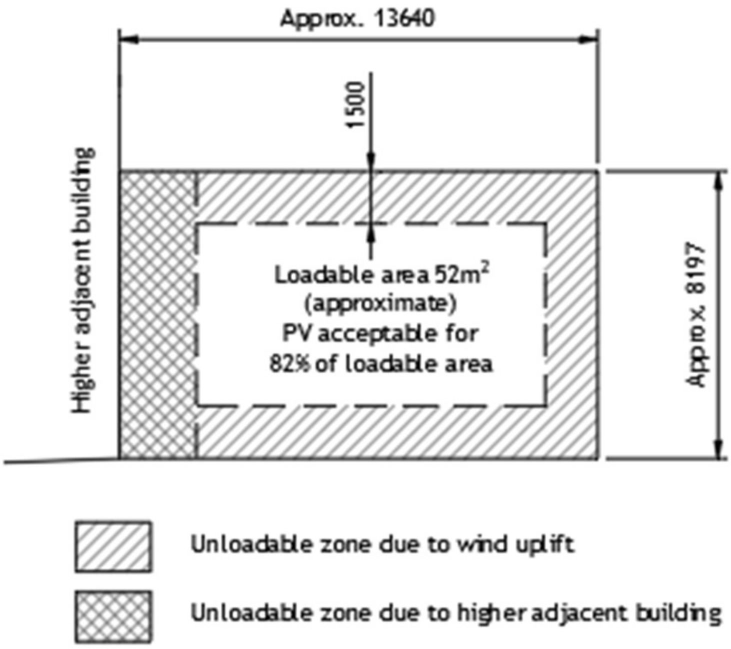
	SH	27/03/25	DC			

St. Crispin's Secondary School Roof 5



Panels Proposed XXNo. = XXXm^2 = less than area allowed (XXXm^2)
Therefore OK

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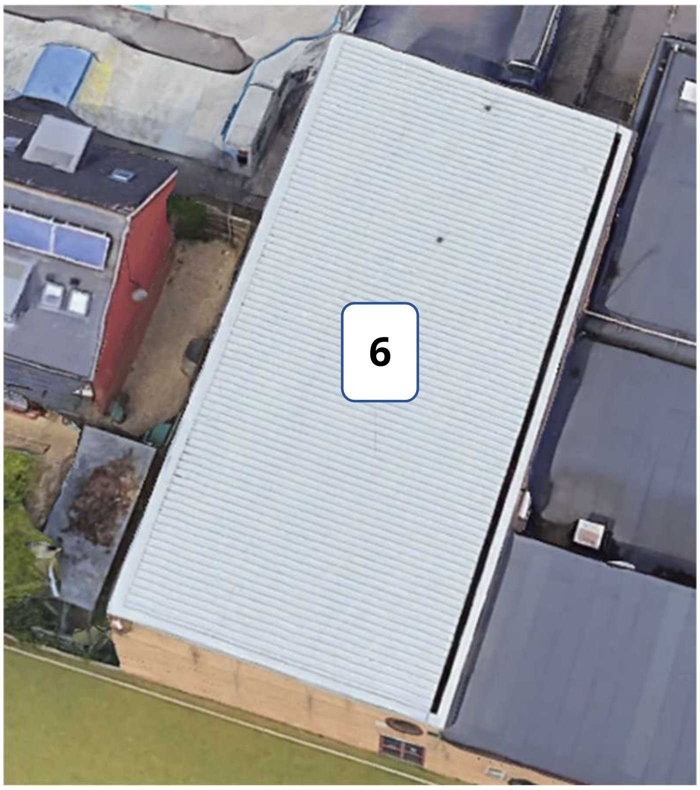
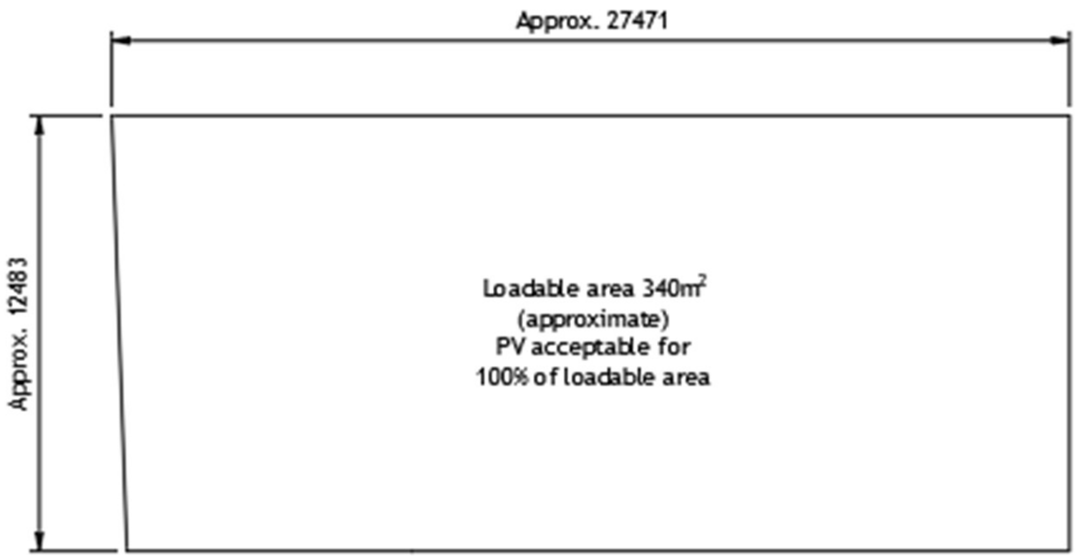


St. Crispin's Secondary School Roof 6



**Panels Proposed XXNo. = XXXm^2 = less than area allowed (XXXm^2)
Therefore OK**

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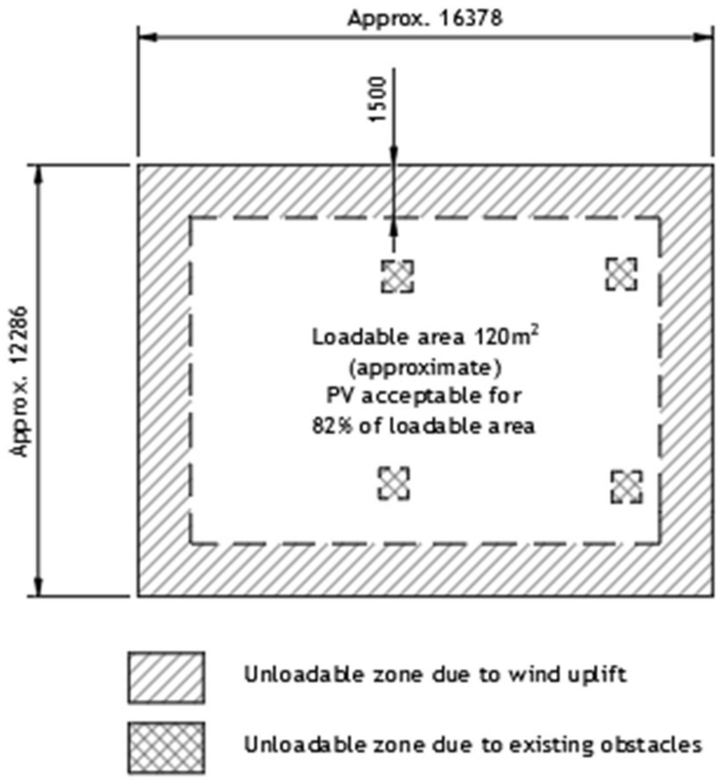
St. Crispin's Secondary School Roof 7



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Therefore OK

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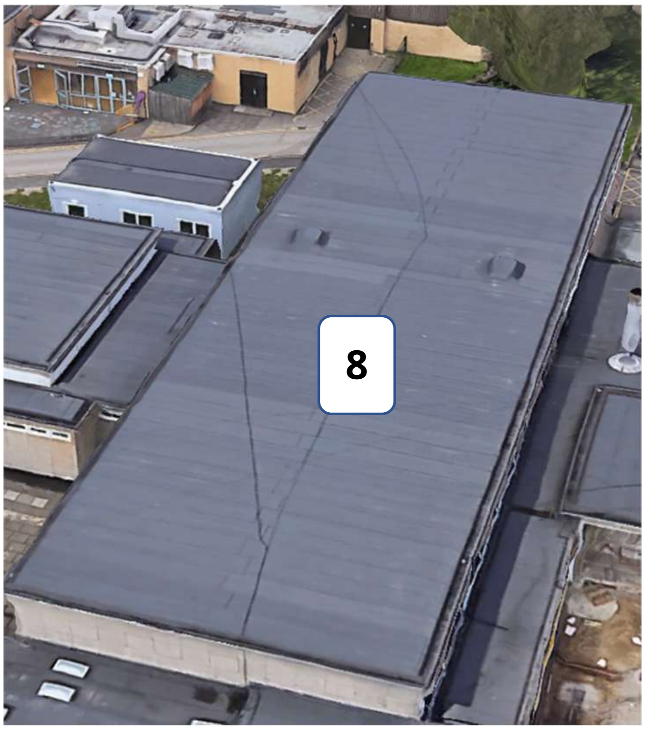
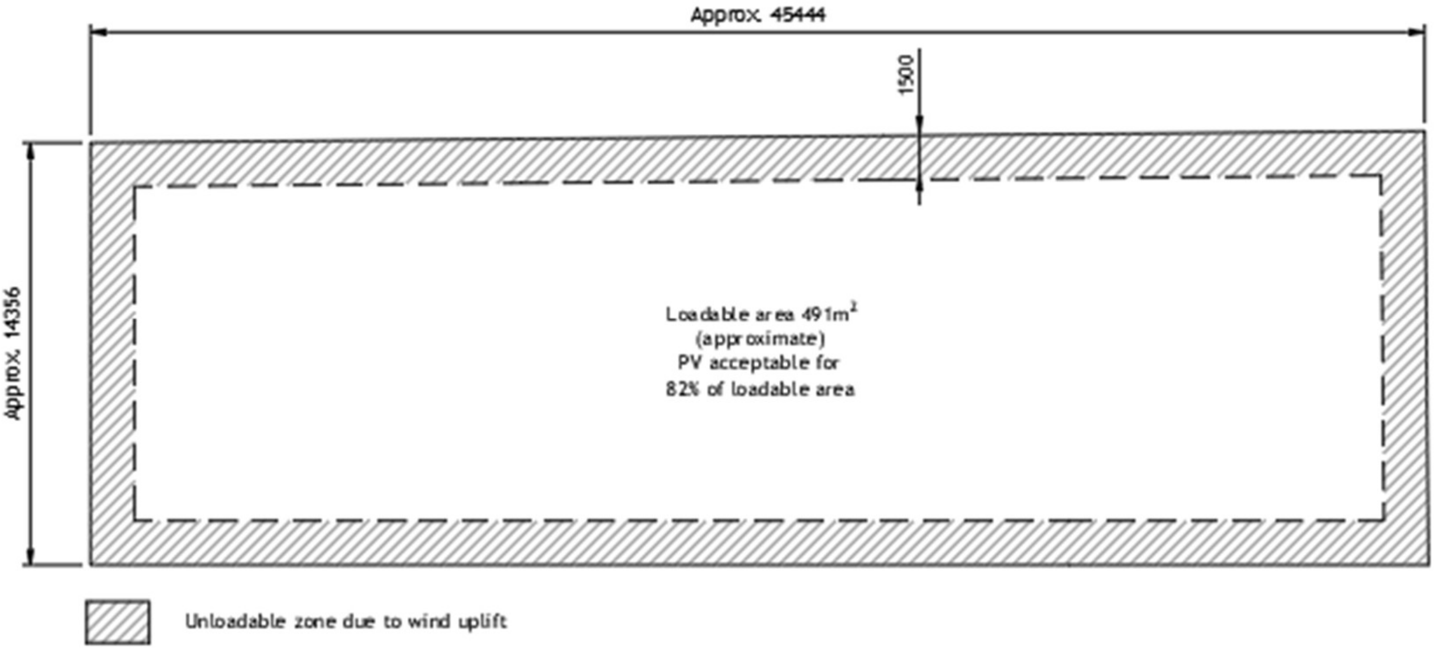


St. Crispin's Secondary School Roof 8



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Therefore OK

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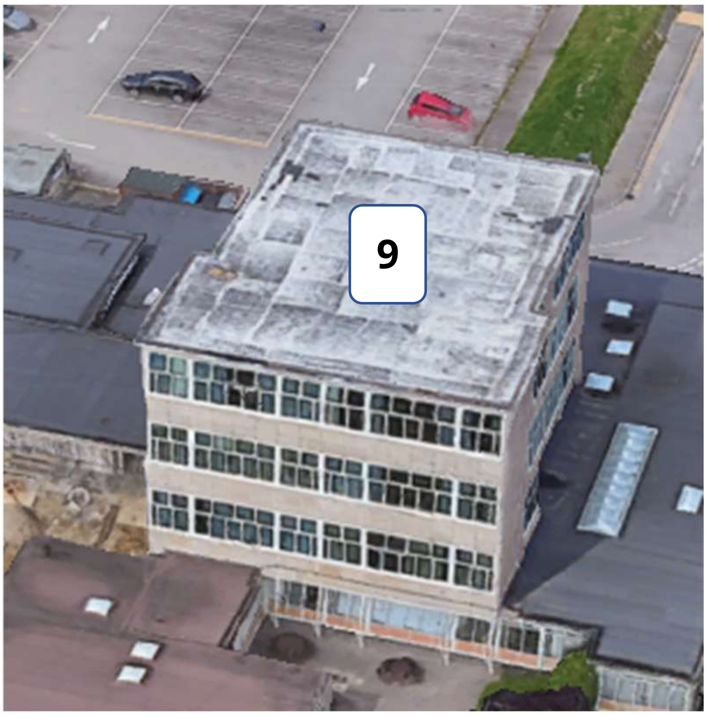
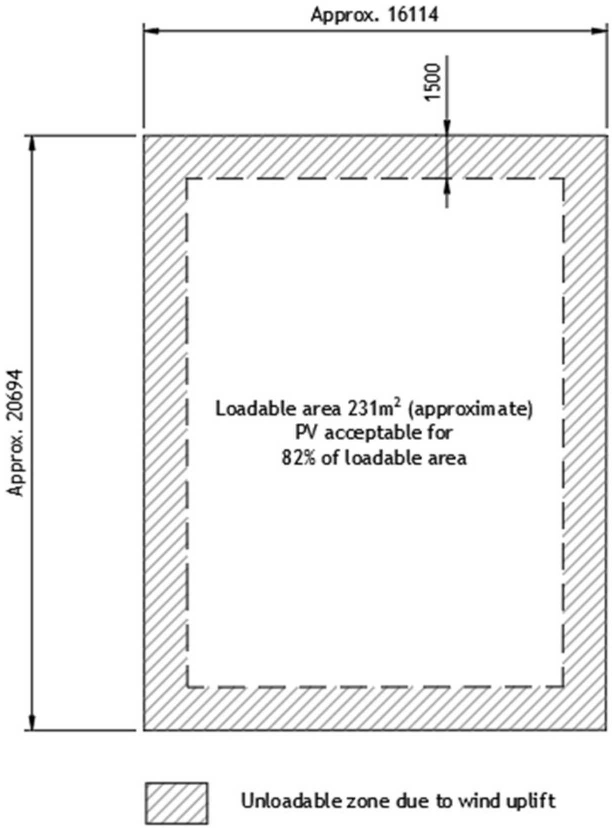


St. Crispin's Secondary School Roof 9



Panels Proposed XXNo. = XXXm² = less than area allowed (XXXm²)
Therefore OK

Roof Loading Feasibility

It is proposed to undertake a loading assessment for a number of roofs at the above school.

The loading assessment will provide an indication of any load capacity for the roof structure to provide support for new photovoltaic panels/ associated framing and any ballast requirements.

The existing roof constructions have been assumed based on worst case loadings.

It is assumed that each roof will be designed for a minimum roof loading of 0.6kN/m^2, applied as a live loading.

The installation of new photovoltaic panels would not change the overall geometry of the existing roof structure and therefore the design wind loading will not be amended.

It is proposed to undertake detailed snow loads for each roof structure under consideration, with general roof snow loadings and localized drift loadings calculated.

It is then proposed to consider the total existing loadings against proposed loadings on the assumptions that a live load is not applied to the photovoltaic panels and only a snow loading is applied in areas where the photovoltaic panels are positioned.

All loadings are based on British Standard BS6399 Part 1, Part 2 and Part 3, with roof dead loads based on traditional forms of construction.

Allowance is to be made for a 7.5-10% increase in the existing loads in accordance with industry good practice for the assessment of existing structures.

A review of images available including online aerial images have been used to assess the roof types under consideration. In this case roofs 1 to 5 and roofs 7 to 9 have been considered as flat roofs. Roof 6 has been considered as a mono pitched standing seam metal roof.

Photovoltaic Panel Installation

Typical Solar Panels (JA Solar JAM72S20-460/MR) noted in reports weigh approximately 25kg. When fixed to pitched roofs they are typically fixed back to the existing structure with suitable fixings. Therefore, consider loadings to existing pitched roof structure 15kg/m^2 + 15kg/m^2 (allowance for fixings and framing) = 30kg/m^2 say.

Where the solar panels are to be fitted to an existing flat roof, typically on an independent framing at a pitch between 10-30 degrees, further calculations are undertaken by the supplier to confirm the potential wind uplift and therefore the requirement for any ballast / kentledge requirements.

See Wind Loading Calculations: -

General Roof areas (excluding edge zones) – Zones C&D.

Max Uplift = 0.40kN/m^2

Therefore, preliminary assumptions for Kentledge with FOS of 1.5 = 0.60kN/m^2 (61kg/m^2)

Roof 1 – By Inspection Roofs 2 to 5 and 7 to 9 as Roof 1

All roof make up and design loads to be confirmed

Flat Roof (Timber Construction)

Dead Loads:-

Waterproof Finishes	0.15kN/m^2
Decking	0.25kN/m^2
Joists	0.20kN/m^2
Ceiling and Services	0.30kN/m^2
	0.90kN/m^2

Live Loads:-

Maintenance Access Only – 0.6kN/m^2 say.

Snow Loads – Calculated over leaf

Uniform Snow Load = 0.32kN/m^2 (Excluding drift loading to edge parapets)

Consider original load case

1.4 DL + 1.6 LL = (1.4x0.90) + (1.6x0.6) = 2.220kN/m^2

Consider 7.5% increase

Design Load = 2.220x1.075 = 2.387kN/m^2

Consider capacity with Dead and Snow Load omitted

Capacity = (2.387 – (1.4x (0.90+0.32))/1.4 = 0.485kN/m^2

Equates to 50kg/m^2 over the entire roof.

Allowing for a max Uplift Load (General Areas) – Kentledge Loads = 61kg/m^2

Therefore allow 82% area loaded.

Roof 6

All roof make up and design loads to be confirmed

Mono Pitched Standing Seam Metal Roof (Steel Frame)

Dead Loads:-

Finishes and Sheeting	0.20kN/m^2
Insulation	0.10kN/m^2
Purlins/Secondary Support	0.30kN/m^2
	0.60kN/m^2

Live Loads:-

Maintenance Access Only – 0.6kN/m^2 say.

Snow Loads – Calculated over leaf

Uniform Snow Load = 0.32kN/m^2 (Excluding drift loads)

Consider original load case

1.4 DL + 1.6 LL = (1.4x0.60) + (1.6x0.6) = 1.800kN/m^2

Consider 7.5% increase

Design Load = 1.800x1.075 = 1.935kN/m^2

Consider capacity with Dead and Snow Load omitted

Capacity = (1.935 – (1.4x (0.60+0.32))/1.4 = 0.462kN/m^2

Equates to 47kg/m^2 over the entire roof > 30kg/m^2 Therefore use 100% coverage

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Snow Loadings

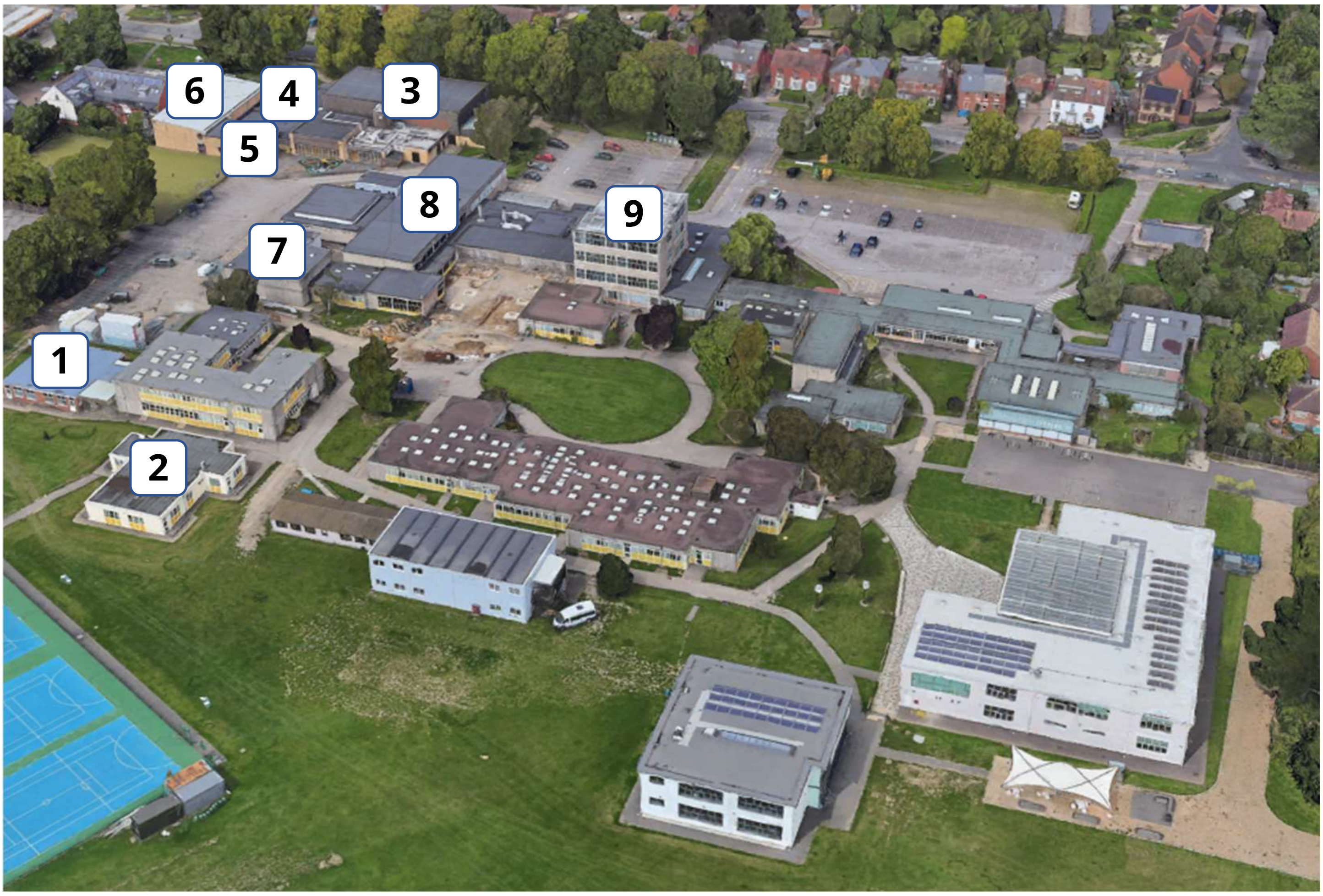
Consider site snow loads and roof snow loads to roof for proposed photovoltaic panel installation.

St. Crispin's Secondary School, London Road, Wokingham, Berkshire, RG40 1SS

A review of Google Earth indicates the site to be approximately 60m elevation.

Figure 1 BS6399-3:1988 indicates Basic Site Snow Load = 0.40kN/m^2.

Consider roofs based on layout provided below:-



Note – No allowance for loadable area has been made for roof lights or similar unless shown

Note – Due to age of building check as built drawings/O&M manual to determine whether photovoltaic panels have been allowed for

Barker

Roof 1 – Flat Roof – By Inspection Roofs 2 to 5 and 7 to 9 as Roof 1

SNOW LOADING TO BS6399:PART 3:1988

TEDDS calculation version 1.0.03

Site location

Location of site — **Wokingham**

Site altitude — $A = 60$ m

Calculate site snow load

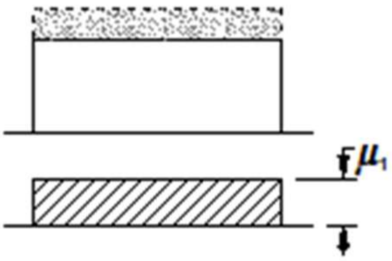
From BS6399:Part 3: 1988 - Figure 1. Basic snow load on the ground

Basic snow load — $s_b = 0.40$ kN/m²

$s_{al} = 0.1 \times s_b + (0.09 \text{ kN/m}^2) = 0.13$ kN/m²

Site snow load — $s_0 = \max(s_b, s_b + s_{al} \times (A - (100 \text{ m})) / 100 \text{ m}) = 0.40$ kN/m²

BS6399:Part3:1988 Cl.6.2



Uniform loading

Roof geometry

Roof type — **Flat**

Angle of pitch of roof — $\alpha = 0.0$ deg

Calculate uniform snow load

From BS6399:Part 3: 1988 - Figure 2. Snow load shape coefficients for flat or monopitch roofs

Snow load shape coefficient — $\mu_1 = 0.80$

Uniform roof snow load — $s_{d1} = \mu_1 \times s_0 = 0.32$ kN/m²

BS6399:Part3:1988 Cl.5

Roof 6 – Mon Pitched Standing Seam Metal Roof

SNOW LOADING TO BS6399:PART 3:1988

TEDDS calculation version 1.0.03

Site location

Location of site **Wokingham**

Site altitude $A = 60$ m

Calculate site snow load

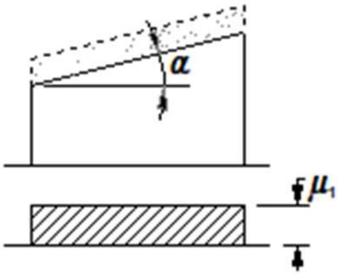
From BS6399:Part 3: 1988 - Figure 1. Basic snow load on the ground

Basic snow load $s_b = 0.40$ kN/m^2

$s_{ad} = 0.1 \times s_b + (0.09$ kN/m$^2) = 0.13$ kN/m^2

Site snow load $s_0 = \max(s_b, s_b + s_{ad} \times (A - (100\text{ m})) / 100\text{ m}) = 0.40$ kN/m^2

BS6399:Part3:1988 Cl.6.2



Uniform loading

Roof geometry

Roof type **Monopitch**

Angle of pitch of roof $\alpha = 15.0$ deg

Calculate uniform snow load

From BS6399:Part 3: 1988 - Figure 2. Snow load shape coefficients for flat or monopitch roofs

Snow load shape coefficient $\mu_1 = 0.80$

Uniform roof snow load $s_{d1} = \mu_1 \times s_0 = 0.32$ kN/m^2

BS6399:Part3:1988 Cl.5

Roof 4 – Flat Roof – By Inspection Roof 5 as Roof 4

SNOW LOADING TO BS6399:PART 3:1988

TEDDS calculation version 1.0.03

Site location

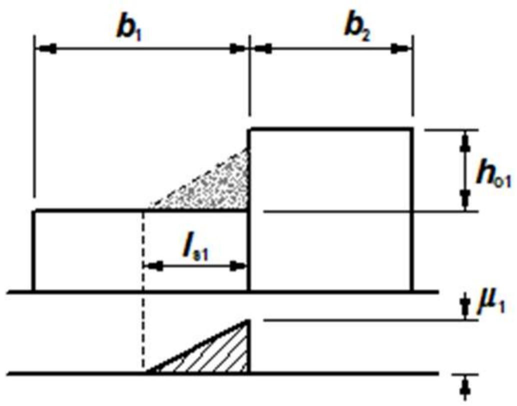
Location of site	**Wokingham**
Site altitude	A = **60** m

Calculate site snow load

From BS6399:Part 3: 1988 - Figure 1. Basic snow load on the ground

Basic snow load	s_b = **0.40** kN/m^2
	s_{alt} = 0.1 × s_b + (0.09 kN/m^2) = **0.13** kN/m^2
Site snow load	s_0 = max(s_b, s_b + s_{alt} × (A - (100 m)) / 100 m) = **0.40** kN/m^2

BS6399:Part3:1988 Cl.6.2



Roof geometry

Length of lower level roof	b_1 = **10.380** m
Length of upper level roof	b_2 = **45.570** m
Increase in roof height	h_{o1} = **1.500** m

Calculate snow load

From BS6399:Part 3:1988 - Figure 6. Snow load shape coefficients and drift lengths at abrupt changes in roof height and parapets

Length of drift	l_{s1} = min(5 × h_{o1}, b_1, 15 m) = **7.500** m
Snow load shape coefficient	μ_1 = min(2 × h_{o1} / (s_0 × 1 m^3/kN), 2 × max(b_1, b_2) / l_{s1}, 8) = **7.50**
Roof snow load	s_{d1} = μ_1 × s_0 = **3.00** kN/m^2

BS6399:Part3:1988 Cl.7.4.3

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Roof 1 – Flat Roof

SNOW LOADING TO BS6399:PART 3:1988

TEDDS calculation version 1.0.03

Site location

Location of site **Wokingham**

Site altitude **A = 60 m**

Calculate site snow load

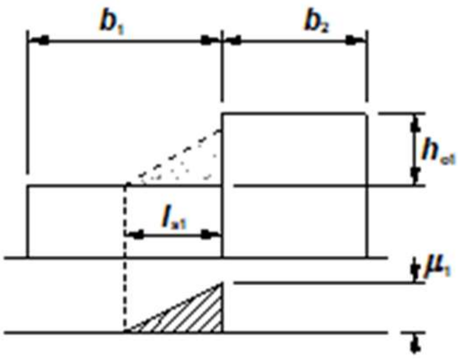
From BS6399:Part 3: 1988 - Figure 1. Basic snow load on the ground

Basic snow load s_b = **0.40** kN/m²

s_{ad} = 0.1 × s_b + (0.09 kN/m²) = **0.13** kN/m²

Site snow load s_0 = max(s_b, s_b + s_{ad} × (A - (100 m)) / 100 m) = **0.40** kN/m²

BS6399:Part3:1988 Cl.6.2



Roof geometry

Length of lower level roof b_1 = **21.500** m

Length of upper level roof b_2 = **30.000** m

Increase in roof height h_{o1} = **3.000** m

Calculate snow load

From BS6399:Part 3:1988 - Figure 6. Snow load shape coefficients and drift lengths at abrupt changes in roof height and parapets

Length of drift l_{s1} = min(5 × h_{o1}, b_1, 15 m) = **15.000** m

Snow load shape coefficient μ_1 = min(2 × h_{o1} / (s_0 × 1 m³/kN), 2 × max(b_1, b_2) / l_{s1}, 8) = **4.00**

Roof snow load s_{d1} = μ_1 × s_0 = **1.60** kN/m²

BS6399:Part3:1988 Cl.7.4.3

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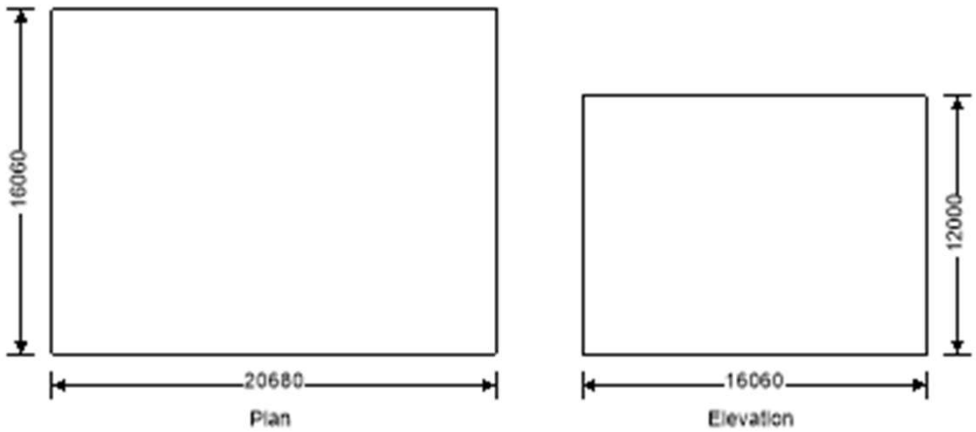
Roof 1 – Flat Roof – By Inspection Roofs 2 to 5 and 7 to 9 as Roof 1

WIND LOADING (BS6399)

In accordance with BS6399

Todds calculation version 3.0.18



Building data

Type of roof	Flat
Length of building	L = **20680 mm**
Width of building	W = **16060 mm**
Height to eaves	H = **12000 mm**
Eaves type	Sharp
Reference height	H_r = **12000 mm**

Dynamic classification

Building type factor (Table 1)	K_b = **1.0**
Dynamic augmentation factor (1.6.1)	$C_r = [K_b \times (H_r / (0.1\ m))^{0.75}] / (800 \times \log(H_r / (0.1\ m)))$ = **0.02**

Site wind speed

Location	Wokingham
Basic wind speed (Figure 6 BS6399:Pt 2)	V_b = **20.7 m/s**
Site altitude	Δ_S = **60 m**
Upwind distance from sea to site	d_{sea} = **66 km**
Direction factor	S_d =**1.00**
Seasonal factor	S_s = **1.00**
Probability factor	S_p = **1.00**
Critical gap between buildings	g = **5000 mm**
Topography not significant	
Altitude factor	$S_a = 1 + 0.001 \times \Delta_S / 1m$ = **1.06**
Site wind speed	$V_s = V_b \times S_a \times S_d \times S_s \times S_p$ = **21.9 m/s**
Terrain category	Country
Displacement height (sheltering effect excluded)	H_d = 0mm

The velocity pressure for the windward face of the building with a 0 degree wind is to be considered as 1 part as the height h is less than b (cl.2.2.3.2)

The velocity pressure for the windward face of the building with a 90 degree wind is to be considered as 1 part as the height h is less than b (cl.2.2.3.2)

Dynamic pressure - windward wall - Wind 0 deg and roof

Reference height (at which q is sought)	H_{ref} = **12000mm**

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Effective height $H_e = \max(H_{ref} - H_{dis}, 0.4 \times H_{ref}) = \mathbf{12000mm}$

Fetch factor (Table 22) $S_c = \mathbf{1.059}$

Turbulence factor (Table 22) $S_t = \mathbf{0.175}$

Gust peak factor $g_t = \mathbf{3.44}$

Terrain and building factor $S_b = S_c \times (1 + (g_t \times S_t) + S_h) = \mathbf{1.70}$

Effective wind speed $V_e = V_s \times S_b = \mathbf{37.2\ m/s}$

Dynamic pressure $q_s = 0.613\ kg/m^3 \times V_e^2 = \mathbf{0.850\ kN/m^2}$

Dynamic pressure - windward wall - Wind 90 deg and roof

Reference height (at which q is sought) $H_{ref} = \mathbf{12000mm}$

Effective height $H_e = \max(H_{ref} - H_{dis}, 0.4 \times H_{ref}) = \mathbf{12000mm}$

Fetch factor (Table 22) $S_c = \mathbf{1.059}$

Turbulence factor (Table 22) $S_t = \mathbf{0.175}$

Gust peak factor $g_t = \mathbf{3.44}$

Terrain and building factor $S_b = S_c \times (1 + (g_t \times S_t) + S_h) = \mathbf{1.70}$

Effective wind speed $V_e = V_s \times S_b = \mathbf{37.2\ m/s}$

Dynamic pressure $q_s = 0.613\ kg/m^3 \times V_e^2 = \mathbf{0.850\ kN/m^2}$

Size effect factors

Diagonal dimension for gablewall $a_{eg} = \mathbf{20.0\ m}$

External size effect factor gablewall $C_{aeg} = \mathbf{0.895}$

Diagonal dimension for side wall $a_{es} = \mathbf{23.9\ m}$

External size effect factor side wall $C_{aes} = \mathbf{0.882}$

Diagonal dimension for roof $a_{er} = \mathbf{26.2\ m}$

External size effect factor roof $C_{aer} = \mathbf{0.875}$

Room/storey volume for internal size effect factor $V_i = \mathbf{0.125\ m^3}$

Diagonal dimension for internal size effect factors $a_i = 10 \times (V_i)^{1/3} = \mathbf{5.000\ m}$

Internal size effect factor $C_{ai} = \mathbf{1.000}$

Pressures and forces

Net pressure $p = q_s \times c_{pe} \times C_{ae} - q_s \times c_{pi} \times C_{ai}$

Net force $F_w = p \times A_{ref}$

Roof load case 1 - Wind 0, c_{pi} -0.3, $+c_{pe}$

Zone	Ext pressure coefficient, c_{pe}	Dynamic pressure, q_s (kN/m²)	External size factor, C_{ae}	Net Pressure, p (kN/m²)	Area, A_{ref} (m²)	Net force, F_w (kN)
A (+ve)	-2.00	0.85	0.875	-1.23	21.38	-26.37
B (+ve)	-1.40	0.85	0.875	-0.79	21.38	-16.82
C (+ve)	-0.70	0.85	0.875	-0.27	171.06	-45.47
D (+ve)	0.20	0.85	0.875	0.40	118.29	47.79

Total vertical net force $F_{w,v} = \mathbf{-40.87\ kN}$

Total horizontal net force $F_{w,h} = \mathbf{0.00\ kN}$

Walls load case 1 - Wind 0, c_{pi} -0.3, $+c_{pe}$

Zone	Ext pressure coefficient, c_{pe}	Dynamic pressure, q_p (kN/m²)	External size factor, C_{se}	Net Pressure, p (kN/m²)	Area, A_{ref} (m²)	Net force, F_w (kN)
A	-1.30	0.85	0.895	-0.73	49.63	-36.46
B	-0.80	0.85	0.895	-0.35	143.09	-50.64
w	0.82	0.85	0.882	0.87	248.16	216.27
l	-0.50	0.85	0.882	-0.12	248.16	-29.74

Overall loading

Equiv leeward net force for overall section — $F_l = F_{w,wl}$ = **-29.7 kN**

Net windward force for overall section — $F_w = F_{w,ww}$ = **216.3 kN**

Overall loading overall section — $F_{w,w} = 0.85 \times (1 + C_r) \times (F_w - F_l + F_{w,h})$ = **213.7 kN**

Roof load case 2 - Wind 90, c_{pi} -0.3, $+c_{pe}$

Zone	Ext pressure coefficient, c_{pe}	Dynamic pressure, q_p (kN/m²)	External size factor, C_{se}	Net Pressure, p (kN/m²)	Area, A_{ref} (m²)	Net force, F_w (kN)
A (+ve)	-2.00	0.85	0.875	-1.23	12.90	-15.90
B (+ve)	-1.40	0.85	0.875	-0.79	12.90	-10.15
C (+ve)	-0.70	0.85	0.875	-0.27	103.17	-27.42
D (+ve)	0.20	0.85	0.875	0.40	203.16	82.07

Total vertical net force — $F_{w,v}$ = **28.60 kN**

Total horizontal net force — $F_{w,h}$ = **0.00 kN**

Walls load case 2 - Wind 90, c_{pi} -0.3, $+c_{pe}$

Zone	Ext pressure coefficient, c_{pe}	Dynamic pressure, q_p (kN/m²)	External size factor, C_{se}	Net Pressure, p (kN/m²)	Area, A_{ref} (m²)	Net force, F_w (kN)
A	-1.37	0.85	0.882	-0.78	38.54	-29.87
B	-0.82	0.85	0.882	-0.36	154.18	-56.01
C	-0.60	0.85	0.882	-0.19	55.44	-10.73
w	0.79	0.85	0.895	0.86	192.72	165.04
l	-0.50	0.85	0.895	-0.13	192.72	-24.19

Overall loading

Equiv leeward net force for overall section — $F_l = F_{w,wl}$ = **-24.2 kN**

Net windward force for overall section — $F_w = F_{w,ww}$ = **165.0 kN**

Overall loading overall section — $F_{w,w} = 0.85 \times (1 + C_r) \times (F_w - F_l + F_{w,h})$ = **164.4 kN**

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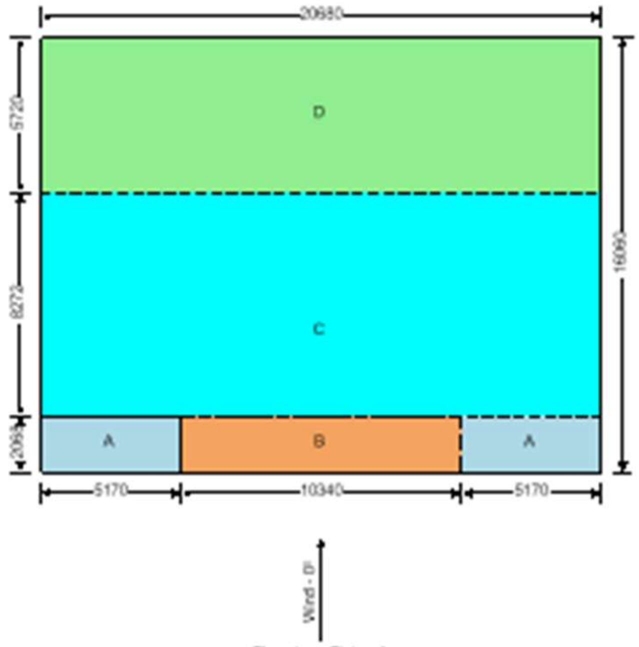
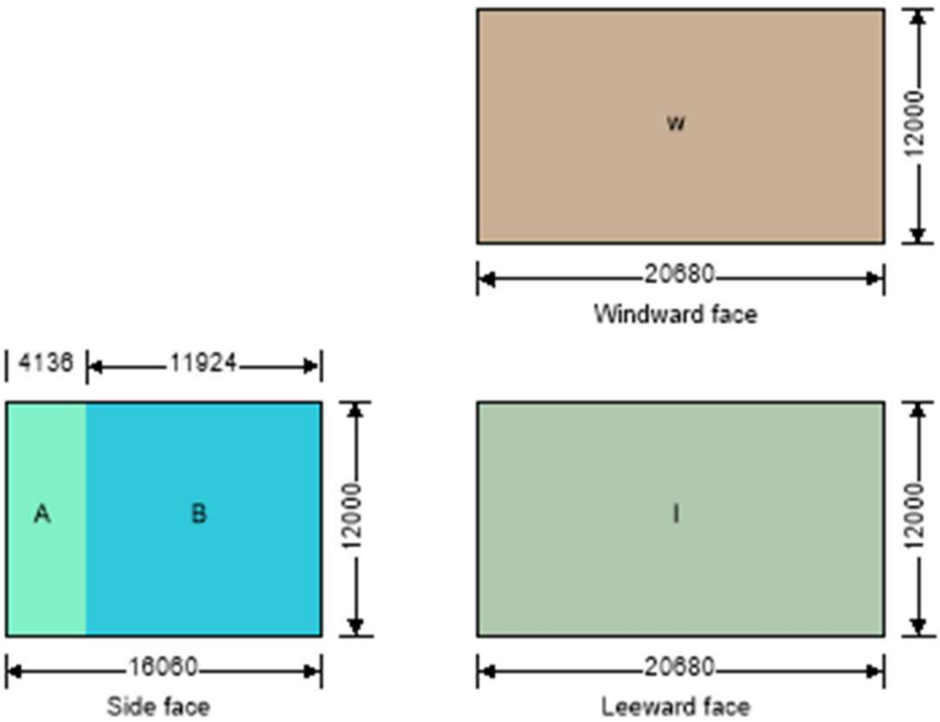
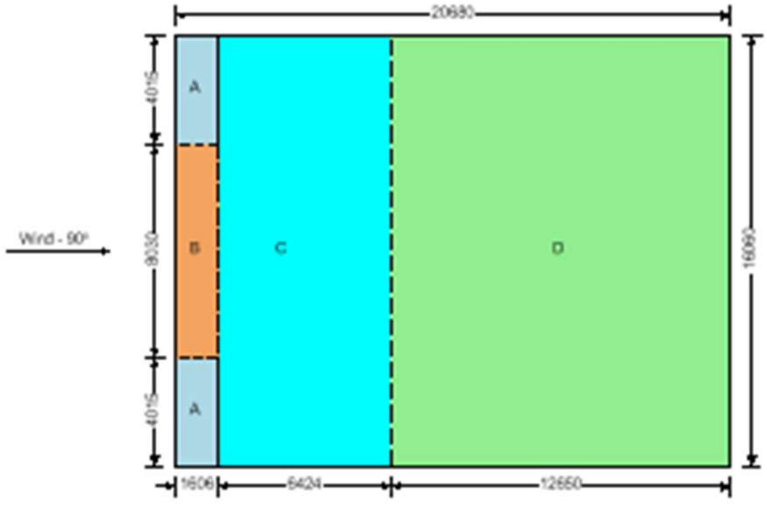
	School St. Crispin's Secondary School			Sheet No./Rev. P/23	
	Calc. By SH	Date 27/03/25	Checked By DC	Date	Approved By	Date



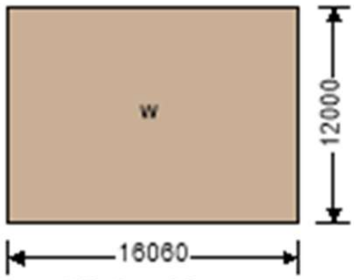
Plan view - Flat roof



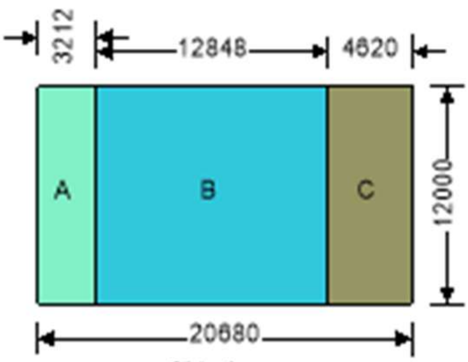
Barker Majesty House, Avenue West, Skyline 120, Braintree, Essex. CM77 7AA	Project Proposal for Installation of Photovoltaic Panels				Job No. P25-0111	
	School St. Crispin's Secondary School				Sheet No./Rev. P/24	
	Calc. By SH	Date 27/03/25	Checked By DC	Date	Approved By	Date



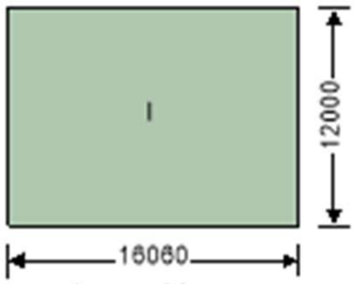
Plan view - Flat roof



Windward face



Side face



Leeward face

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