

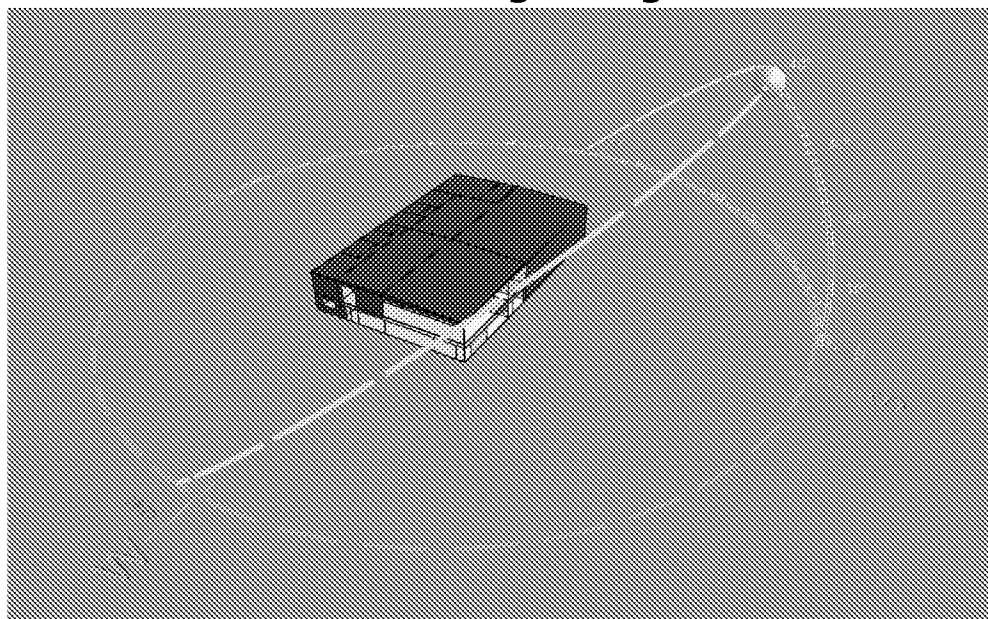
PJR

**BUILDING SERVICES
DESIGN ENGINEERS**

**Volvo Angmering Energy Study Addressing Adur District
Council Policy ECC SP2**

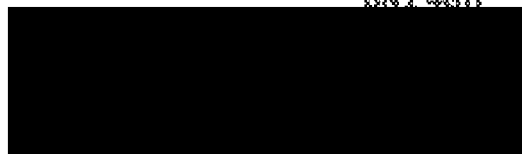
FOR

Volvo Angmering



**Date:
10th of December 2021**

**Suite 29 Level 6
New England House
New England Street
Brighton
BN1 4GH**



INDEX

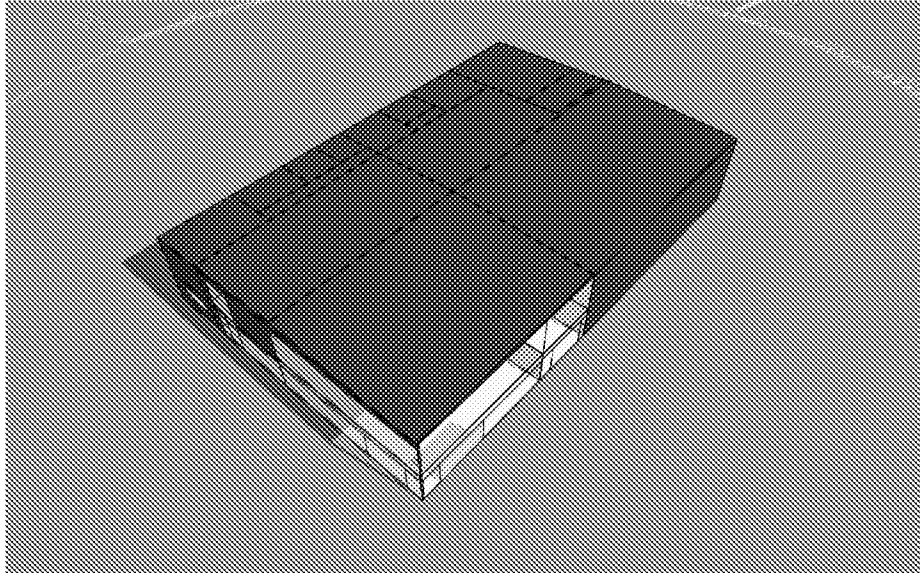
- 1.0 Introduction
- 2.0 Methodology
- 3.0 Design Stage information
- 4.0 Results (CO2 Emissions) Part L2A-2013 without renewables
- 5.0 Results (CO2 Emissions) Part L2A-2013 with Photovoltaic Panels
- 6.0 Conclusion

Appendix A BRUKL report

Appendix B BRUKL report with Photovoltaic panels

1. Introduction

PJR has been appointed to prepare an energy statement to comply with Arun District Council Plan Policy ECC SP2. An energy model has been created in IES VE 2019 following the design phase information received. The building has then been analysed as per Part L 2013 and a BRUKL report has been generated. To conform with the requirement of the 10% reduction in the CO2 emissions of the building, Photovoltaic generation system on the roof has been analysed.



2. Methodology

The Arun District Council Plan Policy ECC SP2 states the following:

Policy ECC SP2

Energy and climate change mitigation

All new residential and commercial development (including conversions, extensions and changes of use) will be expected to be energy efficient and to demonstrate how they will:

- a. Achieve energy efficiency measures that reflect the current standards applicable at the time of submission;
- b. Use design and layout to promote energy efficiency; and
- c. Incorporate decentralised, renewable and low carbon energy supply systems, for example small scale renewable energy systems such as solar panels.

All major developments⁽⁴⁷⁾ must produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site, unless it can be demonstrated that this is unviable. Energy efficiency measures will be taken into consideration when the total predicted energy requirements are calculated. The Council will consider 'allowable solutions' where it is clearly demonstrated that the provision of on site renewable or low carbon energy generation is unviable or not feasible.

Where planning permission is required to retrofit energy efficiency measures into existing development, schemes will be permitted, subject to the Design and Built Heritage policies.

In assessing the achievement of these standards the Council will consider:

- Site constraints;
- Technical viability;
- Financial viability; and
- Delivery of additional benefits.

The scheme has been designed to incorporate low and zero carbon energy sources which will reduce the predicted Co2 emissions of the development by 10%, the predicted Co2 emissions is calculated using building regulations Part L2a 2013 methodology and compared against the building regulations notional building.

Photovoltaic system has been chosen as the renewable source as there is sufficient space on the roof.

3. Design Stage information

The Part L 2013 calculations were undertaken using the following construction U-value information all to be confirmed by the design team.

Fabric Specification:

Wall Cladding: U-value 0.15

Ground Floor: U-value 0.23

Curtain Wall: U-value 1.1 g-value 0.4

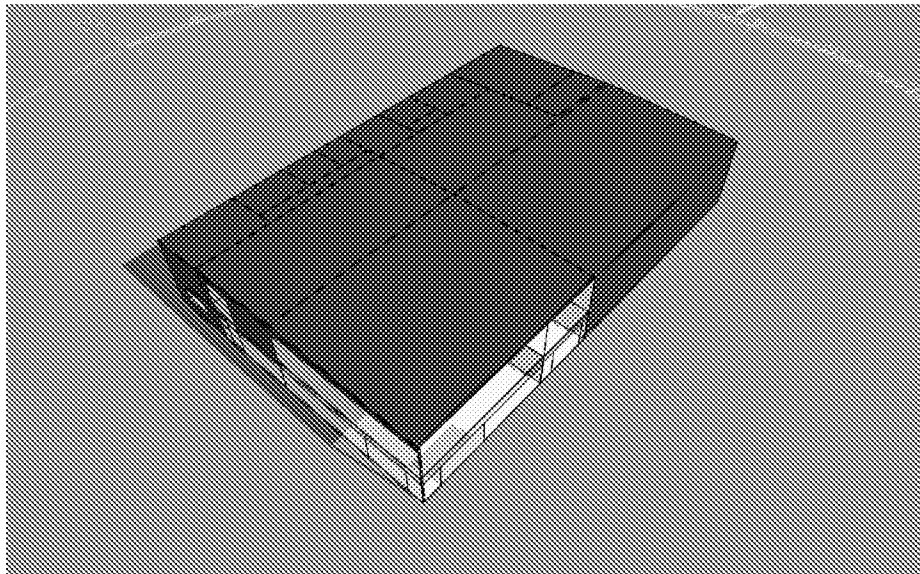
Roof: U-value 0.16

Internal Partition: U-value 0.40

Doors: U-value 2.2

Air permeability has been set as 3 m³/hr.m²

A 3D model of the building has been created as can be seen in the visualisations and that has been set up with all the factors that would affect occupant comfort such as building fabric insulation and internal gains for occupants/lighting/equipment.



This has been based on a review of the available project documentation, which is summarised below:

Internal Gains:

Lighting: 115 lm/W for the FoH area which includes the showrooms and offices

Lighting: 70 lm/W for the BoH area which includes the workshop and storages areas.

Lighting Control: Light sensors have been set as follows:

Toilets:	PIR sensors Automatic On/Off
Stores	PIR sensors Automatic On/Off
Offices:	Manual turned on and automatic shutoff
Canteen:	Manual turned on and automatic shutoff
Parts Drop:	Manual turned on and automatic shutoff
Parts Store:	Manual turned on and automatic shutoff
Equipment Store:	Manual turned on and automatic shutoff
Showroom:	Time clock control with manual override
Workshop:	Local switching via contactors

Lighting control (Dimming profiles were not considered and a constant lighting gain has been modelled for the occupied hours)

Equipment: default NCM template equipment load

Occupancy: default NCM occupant density

Occupancy gains per person- Varies according to NCM template for activity type.

(Occupancy profile varies according to the activity of the space, default NCM Occupancy profile has been considered)

Mechanical Supply and extract have been modelled for the following spaces as follows:

<u>Space Name</u> <u>(Actual)</u>	<u>Mechanical</u> <u>Supply?</u> <u>(Actual)</u>	<u>Supply</u> <u>Specific</u> <u>Fan</u> <u>Power</u> <u>(W/(l/s))</u> <u>(Actual)</u>	<u>Mechanical</u> <u>Exhaust?</u> <u>(Actual)</u>	<u>Extract</u> <u>Flow</u> <u>Rate</u> <u>(ac/hr)</u> <u>(Actual)</u>	<u>Exhaust</u> <u>Specific</u> <u>Fan</u> <u>Power</u> <u>(W/(l/s))</u> <u>(Actual)</u>	<u>Heat</u> <u>Recovery</u> <u>Seasonal</u> <u>Efficiency</u> <u>(Actual)</u>
Show Room	Yes	0.3	Yes	10	0.4	65%
Show Room	Yes	0.3	Yes	10	0.4	65%
Canteen	Yes	0.3	Yes	12	0.4	65%
Canteen	Yes	0.3	Yes	12	0.4	65%
Show Room	Yes	0.3	Yes	10	0.4	65%
Kitchen	No	0.3	Yes	40	0.4	-
Sales Base	Yes	0.3	Yes	10	0.4	65%
Sales & Bus. Man.	Yes	0.3	Yes	10	0.4	65%
Sales Admin	Yes	0.3	Yes	10	0.4	65%
Head of Business	Yes	0.3	Yes	10	0.4	65%
Service Manager	Yes	0.3	Yes	10	0.4	65%
Service Support	Yes	0.3	Yes	10	0.4	65%
Consultation Room	Yes	0.3	Yes	10	0.4	65%
Show Room	Yes	0.3	Yes	10	0.4	65%
Common Space	Yes	0.3	Yes	10	0.4	65%
Show Room	Yes	0.3	Yes	10	0.4	65%
WC	No	0.3	Yes	10	0.4	-
WC	No	0.3	Yes	10	0.4	-
Dis WC	No	0.3	Yes	10	0.4	-
Female WC's	No	0.3	Yes	10	0.4	-
Male WC's	No	0.3	Yes	10	0.4	-
Tech W/C	No	0.3	Yes	10	0.4	-

Space conditioning is done through split units for the FoH areas, radiant heaters for the workshop and electric heating in the BoH areas. This can be seen in more detail in the following table:

Space Name (Actual)	System (Actual)	Aux. Vent System (Actual)
Show Room	Splits	Splits
Show Room	Splits	Splits
Canteen	Splits	Splits
Canteen	Splits	Splits
Show Room	Splits	Splits
Kitchen	Splits	Splits
Sales Base	Splits	Splits
Sales & Bus. Man.	Splits	Splits
Sales Admin	Splits	Splits
Head of Business	Splits	Splits
Service Manager	Splits	Splits
Service Support	Splits	Splits
Consultation Room	Splits	Splits
Show Room	Splits	Splits
Common Space	Splits	Splits
Show Room	Splits	Splits
Comms	Splits	Splits
Equipment Store	Radiant Heaters	Radiant Heaters
Tyre Equipment	Radiant Heaters	Radiant Heaters
Archive	Radiant Heaters	Radiant Heaters
Parts Store	Radiant Heaters	Radiant Heaters
Parts Delivery	Radiant Heaters	Radiant Heaters
Workshop	Radiant Heaters	Radiant Heaters
Parts Store	Radiant Heaters	Radiant Heaters
Circulation	None	None
Circulation	None	None
CI ST	None	None
Stairs	None	None
Circulation	None	None
Stairs	None	None
Oil Tanks	None	None
Switch Room	None	None
Plant Room	None	None
WC	Electric Heating	Electric Heating
WC	Electric Heating	Electric Heating
Dis WC	Electric Heating	Electric Heating
Female WC's	Electric Heating	Electric Heating
Male WC's	Electric Heating	Electric Heating
Tech W/C	Electric Heating	Electric Heating

4. Results (CO2 Emissions) Part L2A-2013 without renewables

The model has been set out as per the design stage information. The results show that the building passes the building regulations 2013 mainly due to using LED lighting throughout and a good efficiency on the VRF/VRV heat pump system, the calculation shows an overall BER (building emission Rate) of 36.1 kg/CO₂/m²/year over the building regulations building TER (target emission rate) of 37.6 giving an overall pass rate of 20%. The results BRUKL report is shown below:

BRUKL Output Document **HM Government**
 Compliance with England Building Regulations Part L 2013

Project name

Volvo Angmering
As designed

Date: Sun Dec 12 18:01:46 2021

Administrative information

Building Details
 Address: Palatine Rd, Goring-by-Sea, Worthing, BN12 6AH

Certification tool
 Calculation engine: SBEM
 Calculation engine version: v5.6.b.0
 Interface to calculation engine: Virtual Environment
 Interface to calculation engine version: v7.0.15
 BRUKL compliance check version: v5.6.b.0

Certifier details
 Name: Steven Molean
 Telephone number: +447981811728
 Address: 1 Blochington Road, Hove, BN3 3YP

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² annum	37.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	37.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	36.1
Are emissions from the building less than or equal to the target?	BER <= TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _{element}	U _{total}	U _{case}	Surface where the maximum value occurs*
Wall**	0.35	0.25	0.38	"B.000003 W-1 AG"
Floor	0.25	0.23	0.34	"SH000000 F AS"
Roof	0.25	0.17	0.34	"B.000005 C A1"
Windows***, roof windows, and rooflights	2.2	1.3	1.3	"B.000004 W-1 DG"
Personnel doors	2.2	2.2	2.2	"SH000000 W-1 CG"
Vehicle access & similar large doors	1.8	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"
U _{total} = Linking area-weighted average U-values [W/m ² K]				
U _{case} = Calculated area-weighted average U-values [W/m ² K]				U _{case} = Calculated maximum individual element U-values [W/m ² K]

* There might be more than one surface where the maximum U-value occurs.
 ** Automatic U-value check by the tool does not apply to certain walls whose linking standard is similar to that for windows.
 *** Double windows and similar glazing are excluded from the U-value check.
 N.B.: Flat roof ventilators (i.e. solar ventilators) are not permitted and are not checked against the linking standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /h.m ² at 50 Pa	10	3

5. Results (CO2 Emissions) Part L2A-2013 with Photovoltaic Panels

Criteria 1 (Co2 Emissions)- Part L2A-2013

The model has been set out as per the design stage information with an addition of 14 kWp of photovoltaic panels (approx. 84 m²). The PV panels would produce sufficient electricity to reduce the BER of the building from the original 36.1 kg/CO₂/m²/year to 32.4 kg/CO₂/m²/year which is equivalent to a 10 % reduction.

BRUKL Output Document HM Government Compliance with England Building Regulations Part L 2013

Project name

Volvo Angmering

As designed

Date: Sun Dec 12 21:30:07 2021

Administrative information

Building Details

Address: Poldene Rd, Goring-by-Sea, Worthing, BN12 6JH

Certification tool

Calculation engine: BREEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.15

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Steven Molean

Telephone number: +447881811728

Address: 1 Blatchington Road, Hove, BN3 2YP

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² annum	37.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	37.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	32.4
Are emissions from the building less than or equal to the target?	BER <= TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _{value}	U _{limit}	U _{calc}	Surface where the maximum value occurs*
Wall**	0.35	0.25	0.35	"S_000003_W-1_A0"
Floor	0.25	0.23	0.34	"SH000000_F_A0"
Roof	0.25	0.17	0.34	"S_000003_C_A0"
Windows***, roof windows, and rooflights	2.2	1.1	1.1	"S_000004_W-1_D0"
Personnel doors	2.2	2.2	2.2	"SH000000_W-1_C0"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	2.5	-	-	"No external high usage entrance doors"
U _{calc} = Limiting area-weighted average U-values [W/(m ² K)]				
U _{calc} = Calculated area-weighted average U-values [W/(m ² K)]				U _{calc} = Calculated maximum individual element U-values [W/(m ² K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls where limiting standard is similar to that for windows.

*** Double windows and similar glazing are excluded from the U-value check.

N.B.: Heatier roof ventilators (i.e. on-site vents) for swimming pool basins are installed or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	3

6. Conclusion

Comparing the BRUKL Reports with and without PV panels in Appendix B and A respectively shows the following reduction in carbon/energy demand would achieve:

BER no PV	36.1
BER with PV	32.4
= 11.4% reduction	

Energy consumption no PV	69.47 kWh/m ²
Predicted PV energy production	7.12 kWh/m ²

Therefore, the energy consumption of the building would reduce by 10.2% as a result of the incorporation of PV panels.

To comply with the Arun District Council Plan Policy ECC SP2 the building must **include at least 14kWp of Photovoltaic panels** to reduce the energy consumption by 10% over the non-renewable partL2013 building emission rate.

Notional building TER (kgCO2/m2/year)	Actual Building BER (kgCO2/m2/year)	Actual Building BER with 14 kWp of PV panels (kgCO2/m2/year)
37.6	36.1	32.4

Appendix A BRUKL report

BRUKL Output Document

Compliance with England Building Regulations Part L 2013



Project name

Volvo Angmering

As designed

Date: Sun Dec 12 18:01:46 2021

Administrative information

Building Details

Address: Palatine Rd, Goring-by-Sea, Worthing, BN12 6JH

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Steven Molean

Telephone number: +447881811728

Address: 1 Blatchington Road, Hove, BN3 3YP

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	37.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	37.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	38.1
Are emissions from the building less than or equal to the target?	BER >= TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _{actual}	U _{calc}	U _{limit}	Surface where the maximum value occurs*
Wall**	0.35	0.25	0.38	"0.000009_W-1_A0"
Floor	0.25	0.23	0.34	"SH000000_F_A0"
Roof	0.25	0.17	0.34	"0.000008_C_A1"
Windows***, roof windows, and rooflights	2.2	1.1	1.1	"0.000004_W-1_O0"
Personnel doors	2.2	2.2	2.2	"SH000000_W-1_O0"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"
U _{limit} = Limiting area-weighted average U-values [W/(m ² K)]				U _{calc} = Calculated maximum individual element U-values [W/(m ² K)]
U _{calc} = Calculated area-weighted average U-values [W/(m ² K)]				

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Spills

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	3	-	-	-
Standard value	2.5*	2.6	N/A	N/A	N/A

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system

NO

* Standard shown is for all types > 12 kW output, except absorption and gas engine heat pumps. For types <= 12 kW output, refer to EN 14825 for limiting standards.

2- Radiant Heaters

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.66	-	0.66	-	-
Standard value	N/A	N/A	N/A	N/A	N/A

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system

NO

3- Electric Heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	-	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system

NO

1- SYST0002-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0.524
Standard value	N/A	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
Sales Base	0.4	-	-	0.3	-	-	-	-	-	0		N/A
Sales & Bus. Man.	0.4	-	-	0.3	-	-	-	-	-	0		N/A
Sales Admin	0.4	-	-	0.3	-	-	-	-	-	0		N/A
Head of Business	0.4	-	-	0.3	-	-	-	-	-	0		N/A

General lighting and display lighting		Luminous efficacy (lm/W)			General lighting [W]
Zone name	Standard value	Luminaire	Lamp	Display lamp	
WorkShop	70	-	-	-	2724
Parts Store	70	-	-	-	488
Archive	70	-	-	-	21
Tech W/C	-	70	-	-	44
WC	-	115	-	-	17
WC	-	115	-	-	24
Dis WC	-	115	-	-	24
Female WC's	-	115	-	-	47
Male WC's	-	115	-	-	60
Switch Room	70	-	-	-	45
Stairs	-	70	-	-	53
Circulation	-	115	-	-	20
CI ST	115	-	-	-	5
Oil Tanks	70	-	-	-	37
Circulation	-	70	-	-	30
Plant Room	70	-	-	-	144
Stairs	-	70	-	-	60
Circulation	-	115	-	-	42

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Sales Base	NO (-84.2%)	NO
Sales & Bus. Man.	N/A	N/A
Sales Admin	N/A	N/A
Head of Business	N/A	N/A
Service Manager	N/A	N/A
Canteen	N/A	N/A
Service Support	N/A	N/A
Kitchen	N/A	N/A
Canteen	N/A	N/A
Comms	N/A	N/A
Show Room	N/A	N/A
Show Room	N/A	N/A
Show Room	YES (+24.3%)	NO
Show Room	N/A	N/A
Consultation Room	N/A	N/A
Common Space	N/A	N/A
Show Room	YES (+78.9%)	NO
Parts Store	N/A	N/A
Parts Delivery	N/A	N/A
WorkShop	N/A	N/A
Parts Store	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

<i>Were alternative energy systems considered and analysed as part of the design process?</i>	<i>NO</i>
<i>Is evidence of such assessment available as a separate submission?</i>	<i>NO</i>
<i>Are any such measures included in the proposed design?</i>	<i>NO</i>

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	S. Area	Building Type
Area [m ²]	1370.9	1370.9	44	A1/A2 Retail/Financial and Professional services
External area [m ²]	3496.3	3496.3		A3/A4/A5 Restaurants and Cafes/Drinking In/Takeaways
Weather	SOU	SOU	56	B1 Offices and Workshop businesses
Infiltration [m ³ /hm ² @ 50Pa]	3	5		B2 to B7 General Industrial and Special Industrial Groups
Average conductance [W/K]	1016.21	1216.08		B8 Storage or Distribution
Average U-value [W/m ² K]	0.29	0.35		C1 Hotels
Alpha values* [%]	14.01	16.15		C2 Residential institutions: Hospitals and Care Homes
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging				C2 Residential institutions: Residential schools
				C2 Residential institutions: Universities and colleges
				C2A Secure Residential institutions
				Residential spaces
				D1 Non-residential institutions: Community/Day Centre
				D1 Non-residential institutions: Libraries, Museums, and Galleries
				D1 Non-residential institutions: Education
				D1 Non-residential institutions: Primary Health Care building
				D1 Non-residential institutions: Crown and Courts Courts
				D2 General Assembly and Lecture, Night Clubs, and Theatres
				Others: Passenger terminals
				Others: Emergency services
				Others: Miscellaneous other activities
				Others: Car Parks 24 hrs
				Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	17.6	16.28
Cooling	6.26	7.62
Auxiliary	9.43	9.98
Lighting	17.84	37.45
Hot water	16.33	13.43
Equipment*	28.65	28.65
TOTAL**	69.47	84.76

* Energy used by equipment does not count towards the total for consumption or calculating emissions.

** Total is net of any electrical energy displaced by CHP generation, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	152.81	190
Primary energy* [kWh/m ²]	213.27	199.71
Total emissions [kg/m ²]	36.1	37.6

* Primary energy is net of any electrical energy displaced by CHP generation, if applicable.

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	72.2	152.2	7.2	19.8	21.4	2.8	2.13	3	3
Notional	34.9	237.4	2.8	19.3	32.7	2.43	3.6	---	---
[ST] Unflued radiant heater, [HS] Unflued radiant heater, [HFT] Electricity, [CFT] Electricity									
Actual	81	11.8	28	0	0	0.8	0	0.86	0
Notional	89.3	49.3	29.3	0	0	0.82	0	---	---
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	181.4	18.7	56	0	18.9	0.8	0	1	0
Notional	156.5	54.8	53.1	0	15.9	0.82	0	---	---
[ST] No Heating or Cooling									
Actual	109.5	7	0	0	0	0	0	0	0
Notional	25.8	16.6	0	0	0	0	0	---	---

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U _{typ}	U _{min}	Surface where the minimum value occurs*
Wall	0.23	0.15	"0_000004_W-1"
Floor	0.2	0.23	"0_000004_F"
Roof	0.15	0.15	"0_000000_C"
Windows, roof windows, and rooflights	1.5	1.1	"0_000004_W-1_O0"
Personnel doors	1.5	??	"0_000000_W-1_O0"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{typ} = Typical individual element U-values [W/m ² K]		U _{min} = Minimum individual element U-values [W/m ² K]	
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m ³ /(h.m ²) at 50 Pa	5	3

Appendix B BRUKL report with Photovoltaic panels

BRUKL Output Document



Compliance with England Building Regulations Part L 2013

Project name

Volvo Angmering

As designed

Date: Sun Dec 12 21:30:07 2021

Administrative information

Building Details

Address: Palestine Rd, Goring-by-Sea, Worthing, BN12 6JH

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Steven Molean

Telephone number: +447661811728

Address: 1 Blatchington Road, Hove, BN3 3YP

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² annum	37.8
Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	37.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	32.4
Are emissions from the building less than or equal to the target?	BER <= TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _{element}	U _{calc}	U _{max}	Surface where the maximum value occurs*
Wall**	0.35	0.25	0.35	"G_000009_W-1_A0"
Floor	0.25	0.23	0.34	"SH000000_F_A5"
Roof	0.25	0.17	0.34	"G_000008_C_A1"
Windows***, roof windows, and rooflights	2.2	1.1	1.1	"G_000004_W-1_O0"
Personnel doors	2.2	2.2	2.2	"SH000000_W-1_O0"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"
U _{limit} = Limiting area-weighted average U-values [W/m ² K]				U _{max} = Calculated maximum individual element U-values [W/m ² K]

* There might be more than one surface where the maximum U-value occurs

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Splits

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	3	-	-	-
Standard value	2.5*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

2- Radiant Heaters

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.66	-	0.66	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

3- Electric Heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

1- SYST0002-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0.024
Standard value	N/A	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
Sales Base	0.4	-	-	0.3	-	-	-	-	-	0		N/A
Sales & Bus. Man.	0.4	-	-	0.3	-	-	-	-	-	0		N/A
Sales Admin	0.4	-	-	0.3	-	-	-	-	-	0		N/A
Head of Business	0.4	-	-	0.3	-	-	-	-	-	0		N/A

Zone name	ID of system type	SFP [W/(ls)]									HR efficiency	
		A	B	C	D	E	F	G	H	I	Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.8	0.5	1.1	0.5	1		
Service Manager		0.4	-	-	0.3	-	-	-	-	-	0	N/A
Canteen		0.4	-	-	0.3	-	-	-	-	-	0	N/A
Service Support		0.4	-	-	0.3	-	-	-	-	-	0	N/A
Kitchen		0.4	-	-	-	-	-	-	-	-	-	N/A
Canteen		0.4	-	-	0.3	-	-	-	-	-	0	N/A
Show Room		0.4	-	-	0.3	-	-	-	-	-	0	N/A
Show Room		0.4	-	-	0.3	-	-	-	-	-	0	N/A
Show Room		0.4	-	-	0.3	-	-	-	-	-	0	N/A
Show Room		0.4	-	-	0.3	-	-	-	-	-	0	N/A
Consultation Room		0.4	-	-	0.3	-	-	-	-	-	0	N/A
Common Space		0.4	-	-	0.3	-	-	-	-	-	0	N/A
Show Room		0.4	-	-	0.3	-	-	-	-	-	0	N/A
Tech WC		0.4	-	-	-	-	-	-	-	-	-	N/A
WC		0.4	-	-	-	-	-	-	-	-	-	N/A
WC		0.4	-	-	-	-	-	-	-	-	-	N/A
Dis WC		0.4	-	-	-	-	-	-	-	-	-	N/A
Female WC's		0.4	-	-	-	-	-	-	-	-	-	N/A
Male WC's		0.4	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	80	80	22	
Sales Base		115	-	-	180
Sales & Bus. Man.		115	-	-	93
Sales Admin		115	-	-	93
Head of Business		115	-	-	96
Service Manager		115	-	-	93
Canteen		-	115	100	72
Service Support		115	-	-	119
Kitchen		-	115	-	64
Canteen		-	115	100	59
Commons		115	-	-	42
Show Room		-	115	100	54
Show Room		-	115	100	93
Show Room		-	115	100	162
Show Room		115	-	-	159
Consultation Room		115	-	-	68
Common Space		115	-	-	86
Show Room		-	115	100	26
Equipment Store		70	-	-	51
Parts Store		70	-	-	513
Parts Delivery		70	-	-	166
Tyre Equipment		70	-	-	19

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
WorkShop		70	-	-	2724
Parts Store		70	-	-	486
Archive		70	-	-	21
Tech W/C		-	70	-	44
WC		-	115	-	17
WC		-	115	-	24
Dis WC		-	115	-	34
Female WC's		-	115	-	47
Male WC's		-	115	-	60
Switch Room		70	-	-	45
Stairs		-	70	-	53
Circulation		-	115	-	20
CI ST		115	-	-	5
Oil Tanks		70	-	-	37
Circulation		-	70	-	30
Plant Room		70	-	-	144
Stairs		-	70	-	60
Circulation		-	115	-	42

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Sales Base	NO (-84.2%)	NO
Sales & Bus. Man.	N/A	N/A
Sales Admin	N/A	N/A
Head of Business	N/A	N/A
Service Manager	N/A	N/A
Canteen	N/A	N/A
Service Support	N/A	N/A
Kitchen	N/A	N/A
Canteen	N/A	N/A
Comms	N/A	N/A
Show Room	N/A	N/A
Show Room	N/A	N/A
Show Room	YES (+24.9%)	NO
Show Room	N/A	N/A
Consultation Room	N/A	N/A
Common Space	N/A	N/A
Show Room	YES (+76.8%)	NO
Parts Store	N/A	N/A
Parts Delivery	N/A	N/A
WorkShop	N/A	N/A
Parts Store	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	Area	Building type
Area [m ²]	1370.9	1370.9	44	A1&2 Retail/Financial and Professional services
External area [m ²]	3495.3	3495.3	A2&A2.5	Restaurants and Cafes/Drinking Est./Takeaways
Weather	SOU	SOU	55	B1 Offices and Workshop businesses
Infiltration [m ³ /hm ² @ 50Pa]	3	5	B2 to B7	General Industrial and Special Industrial Groups
Average conductance [W/K]	1516.21	1216.08	B8	Storage or Distribution
Average U-value [W/m ² K]	0.28	0.35	C1	Hotels
Alpha value* [%]	14.01	18.15	C2	Residential institutions: Hospitals and Care Homes
* Percentage of the building average heat transfer coefficient which is due to thermal bridging				
			C2	Residential institutions: Residential schools
			C2	Residential institutions: Universities and colleges
			C2A	Group Residential Institutions
				Residential spaces
			D1	Non-residential institutions: Community/Day Centre
			D1	Non-residential institutions: Libraries, Museums, and Galleries
			D4	Non-residential institutions: Education
			D4	Non-residential institutions: Primary Health Care Building
			D5	Non-residential institutions: Crown and County Courts
			D2	General Assembly and Leisure, Night Clubs, and Theatres
			Others	Passenger terminals
			Others	Strategic services
			Others	Manufacturing/24hr activities
			Others	Car Parks/4 hrs
			Others	Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	17.6	16.28
Cooling	8.25	7.82
Auxiliary	8.45	8.88
Lighting	17.84	37.45
Hot water	16.33	13.43
Equipment*	28.65	28.65
TOTAL**	69.47	84.78

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
 ** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	7.13	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	152.81	193
Primary energy* [kWh/m ²]	213.27	199.71
Total emissions [kg/m ²]	32.4	37.5

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance									
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	72.2	152.2	7.2	19.8	21.4	2.8	2.13	3	3
Notional	24.3	237.4	2.8	18.3	22.7	2.43	3.8	----	----
[ST] Unflued radiant heater, [HS] Unflued radiant heater, [HFT] Electricity, [CFT] Electricity									
Actual	81	11.8	28	0	0	0.8	0	0.86	0
Notional	89.3	49.3	29.3	0	0	0.82	0	----	----
[ST] Other local room heater - unflued, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	181.4	16.7	56	0	15.9	0.8	0	1	0
Notional	156.5	54.8	53.1	0	15.9	0.82	0	----	----
[ST] No Heating or Cooling									
Actual	109.5	7	0	0	0	0	0	0	0
Notional	95.8	16.6	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEEF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U _{typ}	U _{min}	Surface where the minimum value occurs*
Wall	0.23	0.15	"0_000004_W-1"
Floor	0.2	0.23	"0_000004_F"
Roof	0.15	0.18	"0_000000_C"
Windows, roof windows, and rooflights	1.5	1.1	"0_000004_W-1_O0"
Personnel doors	1.5	2.2	"SH000000_W-1_O0"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{typ} = Typical individual element U-values [W/m ² K]		U _{min} = Minimum individual element U-values [W/m ² K]	
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m ³ /(h.m ²) at 50 Pa	5	3