

Highgate School RMC

Part L 2021 report

Project number: 60580302

26 August 2022

Quality information

Prepared by	Checked by	Verified by	Approved by
Anna Holding Associate Director	Elizabeth Ward Associate Director		

Revision History

Revision	Revision date	Details	Authorized	Name	Position

Distribution List

# Hard Copies	PDF Required	Association / Company Name

Prepared for:

Highgate School

Prepared by:

Anna Holding
Associate Director

AECOM Limited
Aldgate Tower
2 Leman Street
London E1 8FA
United Kingdom

aecom.com

© 2022 AECOM Limited. All Rights Reserved.

This document has been prepared by AECOM Limited ("AECOM") for sole use of our client (the "Client") in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client. Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.

Table of Contents

1.	Introduction.....	6
1.1	Part L 2021 methodology.....	6
1.2	GLA Energy assessment guidance (June 2022)	6
2.	Model inputs	7
2.1	Model geometry	7
2.2	Building fabric and air infiltration.....	9
2.3	NCM activities and HVAC systems and application.....	9
2.4	HVAC system efficiencies.....	10
2.5	Domestic hot water system.....	10
2.6	Lighting efficiencies and controls.....	11
2.7	Power factor correction.....	12
2.8	Green strategy	12
3.	Results	13
	Appendix A Extract from BRUKL for RMC	14

Figures

Figure 1.	View of model from the North.....	7
Figure 2.	View of model from the South	8

Tables

Table 1.	Architectural drawings used to create the thermal model	7
Table 2.	Building fabric	9
Table 3.	NCM activities and systems.....	9
Table 4.	HVAC efficiencies	10
Table 5.	POU DHW system efficiencies	10
Table 6.	Heat pump DHW system efficiencies	11
Table 7.	Lighting inputs and controls.....	11
Table 8.	PV array	12
Table 9.	Carbon dioxide emissions after each stage of the Energy Hierarchy	13
Table 10.	Part L 2021 results for RMC	13

Executive Summary

This document details the results of Part L 2021 modelling undertaken during RIBA Stage 2 for RMC, as required by the GLA Energy Planning Guidance. This analysis uses the Part L 2021 methodology, as this came into force on 15th June 2022.

1. Introduction

This document details the Part L 2021 modelling undertaken for the RMC RIBA Stage 2 design. RMC is a secondary school building comprised of comprising teaching spaces, a drama theatre, showers for the use of the adjacent sports pitches and staff areas.

The proposed building was modelled using IES VE version 2022.1.1.0.

1.1 Part L 2021 methodology

Compliance with Part L 2021 for new non-domestic buildings requires that the following requirements are met:

- The building emissions rate (BER) and building primary energy rate (BPER) must be less than the target emissions rate (TER) and target primary energy rate (TPER), respectively.
- Meet limiting standards for design.
- Limit the effects of solar gains in summer.
- Quality of construction and commissioning.
- Providing information.

To carry out Part L 2A assessments, AECOM use the industry standard <Virtual Environment> software from Integrated Environmental Solutions Ltd. The building fabric properties and lighting power densities were added for each zone. All other thermal template settings, such as occupied hours, heating set-points, occupancy densities and small power loads are dictated by the National Calculation Method (NCM). NCM templates must be used for Part L 2 analysis.

A notional building is automatically derived from the actual building by the calculation software, according to rules laid down in the NCM. The notional building standards of construction and system efficiencies are also given by the NCM. The location and geometry of the notional building (with the exception of glazing and door area) are copied from those of the proposed building. Rooms in the notional building are assigned the same NCM activities as their counterparts in the actual building, so that the occupancy, internal gains (apart from lighting power density) and the operating hours in each room conform to the appropriate NCM activity.

If the CO₂ emissions and primary energy rate from the actual building (Building Emissions Rate (BER) and Building Primary Energy Rate (BPER)) are less than or equal to the CO₂ emissions and primary energy rate from the notional building (Target Emissions Rate (TER) and Target Primary Energy Rate (TPER)) then the building meets the CO₂ and primary energy requirements of Part L 2 2021.

1.2 GLA Energy assessment guidance (June 2022)

The proposed building will use a Ground Source Heat Pump (GSHP) to serve the space heating demand, with direct electric point of use domestic hot water heaters.

In order to fulfil the GLA requirements as described in the Energy Assessment Guidance, dated June 2022, baseline and lean options were also created as follows:

- Baseline: the baseline is the TER from the final proposed building specification (i.e. the TER from the “Be Green” stage of the energy hierarchy).
- Be Lean: this model includes the notional building system type and performance values as determined by the final proposed building specification for space heating and hot water. Where there are no “be clean” or “be green” technologies the system type and performance values of the final proposal are used in the Be Lean case.

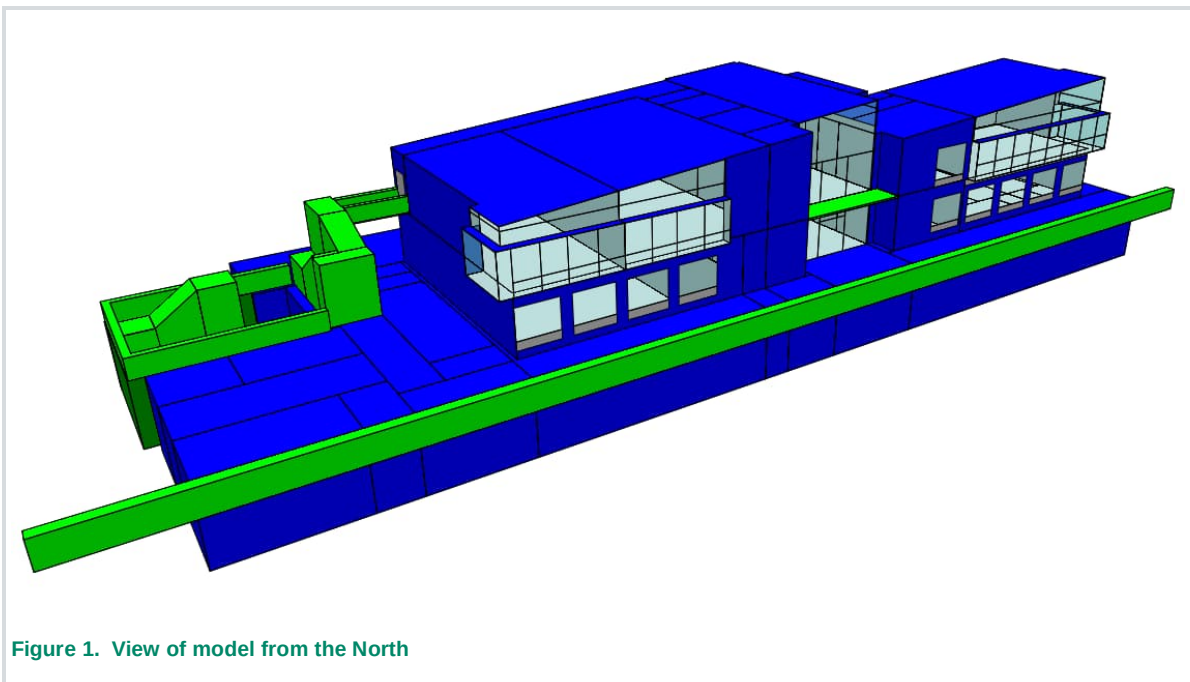
2. Model inputs

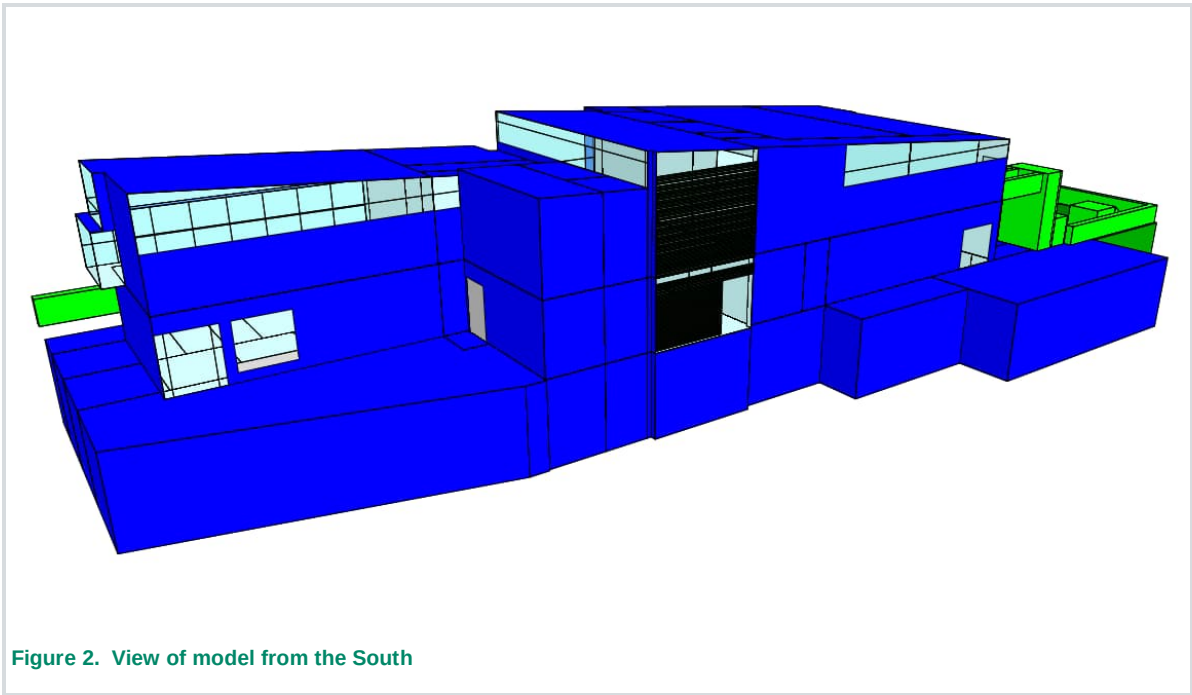
2.1 Model geometry

The model geometry was created based on the following drawings provided by Hopkins Architects Limited.

Table 1. Architectural drawings used to create the thermal model

Drawing number	Description	Revision
A/HS-RMC2 2300	Proposed site plan	C (30.06.2018)
A/HS-RMC2 2310	Proposed GA basement plan	H (11.04.2018)
A/HS-RMC2 2311	Proposed GA ground floor plan	H (11.04.2018)
A/HS-RMC2 2312	Proposed GA first floor plan	H (11.04.2018)
A/HS-RMC2 2313	Proposed GA roof plan	H (11.04.2018)
A/HS-RMC2 2410	Proposed GA elevations – north and south	H (11.04.2018)
A/HS-RMC2 2411	Proposed GA elevations – east and west	H (11.04.2018)
A/HS-RMC2 2510	Proposed GA long section through foyer	H (11.04.2018)
A/HS-RMC2 2511	Proposed GA long section through stairs and sunken garden	C (24.07.2018)
A/HS-RMC2 2512	Proposed GA cross section through foyer	H (24.07.2018)
A/HS-RMC2 2513	Proposed GA cross section through theatre	C (24.07.2018)
A/HS-RMC2 2514	Proposed GA cross section through offices/pitch connection stair	C (24.07.2018)





2.2 Building fabric and air infiltration

The building fabric was assumed to have the following properties, as agreed with Hopkins Architects Ltd.

Table 2. Building fabric

Element	U-value (W/m ² K)	g-value (EN ISO 410)	Visible light transmittance
Roof	0.13	N/A	N/A
Exposed walls	0.15	N/A	N/A
Basement walls	0.15	N/A	N/A
Exposed floors and ground floors	0.13	N/A	N/A
Windows and glazed doors	1.20	0.29	0.60
Louvred glazing	1.20	0.29	0.60
Opaque pedestrian doors and high usage entrance doors	2.20	N/A	N/A

An air tightness result of 3m³/m².hr at 50Pa is being targeted for the building.

2.3 NCM activities and HVAC systems and application

The zones in the model have been grouped by activity type and thermal templates applied by these types. The most appropriate NCM activity has been chosen for each template type.

Table 3. NCM activities and systems

Thermal template	NCM Activity (Actual)	HVAC system applied
Armoury	NCM Office: Cupboard	LTHW radiators NV
AV dimmer room	NCM D1EduS: Office (SecSchl: IT)	DX no vent
Changing	NCM D1EduS: Changing facilities (SecSchl)	LTHW radiators AHU
Circulation	NCM D1EduS: Circulation area (SecSchl)	LTHW radiators NV
Control room	NCM D1EduS: High density IT work space	DX no vent
Drama classroom	NCM D1EduS: Teaching areas (SecSchl)	LTHW radiators MVHR
Drama foyer	NCM D1EduS: Circulation area (SecSchl)	LTHW radiators NV
Drama office	NCM D1EduS: Office (SecSchl: Open)	LTHW radiators MVHR
Green room	NCM D1EduS: Office (SecSchl: Meeting)	LTHW radiators MVHR
IT patch panel room	NCM Misc24Hr: Server room	DX no vent
Plant room	NCM Office: Light plant room	LTHW radiators NV
Showers	NCM D1EduS: Changing facilities (SecSchl)	LTHW radiators AHU
SpEx manager's office	NCM D1EduS: Office (SecSchl: Cellular)	LTHW radiators MVHR
SpEx office	NCM D1EduS: Office (SecSchl: Open)	LTHW radiators MVHR
Staff breakout/kitchenette	NCM D1EduS: Office (SecSchl: Common)	LTHW radiators MVHR
Stairs	NCM D1EduS: Circulation area (SecSchl)	LTHW radiators NV
Storage	NCM Office: Cupboard	LTHW radiators NV
Technician	NCM D1EduS: Workshop - small scale	LTHW radiators MVHR
Theatre	NCM D1EduS: Hall/lecture theatre/assembly area	Displacement ventilation
Viewing area	NCM D1EduS: Circulation area (SecSchl)	LTHW radiators NV

Thermal template	NCM Activity (Actual)	HVAC system applied
Voids	Internal void	None
WCs	NCM D1EduS: Toilet (SecSchl)	LTHW radiators AHU
Workshop	NCM D1EduS: Workshop - small scale	LTHW radiators MVHR

2.4 HVAC system efficiencies

Table 4. HVAC efficiencies

Item	Value
Ground Source Heat Pump seasonal efficiency	3.5
Heating delivery efficiency	95%
Ventilation heat recovery efficiency	76% from AHU 89% from MVHR
Cooling system SEER (including heat rejection)	5.0 from GSHP 3.5 for DX
Cooling delivery efficiency	90%
Cooling SSEER	4.5
AHU SFP	1.40 W/l/s
MVHR SFP	0.75 W/l/s
FCU terminal unit SFP	0.20 W/l/s
Extract fan SFP	0.4W/l/s (fan remote from zone)
Room level extract flow rate	Plant rooms and stores: 2 ach ⁻¹
Auxiliary pump type	Variable speed multiple pressure sensors
Ductwork leakage classification	CEN Class A
AHU leakage classification	CEN Class L2
HVAC system metering	Yes – with “out of range” warnings
Demand control ventilation	Yes Ventilation from AHU has damper control based on gas sensor Ventilation from MVHR has speed control based on gas sensor

2.5 Domestic hot water system

An electric point of use (POU) DHW system is in use in most areas of the building, with the shower and changing area getting DHW from a heat pump. These systems are modelled as described in the following tables.

Table 5. POU DHW system efficiencies

Item	Value
System fuel	Electricity
DHW generator seasonal efficiency	100%
DHW delivery efficiency	95%

Table 6. Heat pump DHW system efficiencies

Item	Value
System fuel	Electricity
DHW generator seasonal efficiency	286%
DHW delivery efficiency	80%

2.6 Lighting efficiencies and controls

All lights are assumed to achieve a luminaire efficacy of 95 luminaire lumens per circuit Watt, with lux levels applied in accordance with the relevant NCM template type.

PIR controls are included throughout the building, and those areas that benefit from external windows are modelled with photoelectric controls that automatically dim the light when natural daylight levels are sufficient.

The parasitic power for controls has been set as 0.06W/m², based on previous project experience. This is assumed to operate continuously.

Lighting is separately metered, with no 'out of range' warnings.

Table 7. Lighting inputs and controls

Thermal template	Illuminance level (lux)	Local manual switching?	Occupancy sensing	Daylight controls (rooms with external windows)
Armoury	100	Yes	Man-On-Auto-Off	None
AV dimmer room	300	Yes	Man-On-Auto-Off	None
Changing	100	None	Auto-On-Off	None
Circulation	100	None	Auto-On-Off	Dimmable
Control room	300	Yes	Man-On-Auto-Off	None
Drama classroom	300	Yes	Man-On-Auto-Off	Dimmable
Drama foyer	100	None	Auto-On-Off	Dimmable
Drama office	300	Yes	Man-On-Auto-Off	Dimmable
Green room	300	Yes	Man-On-Auto-Off	Dimmable
IT patch panel room	100	Yes	Man-On-Auto-Off	None
Plant room	200	Yes	Man-On-Auto-Off	None
Showers	100	None	Auto-On-Off	None
SpEx manager's office	300	Yes	Man-On-Auto-Off	Dimmable
SpEx office	300	Yes	Man-On-Auto-Off	Dimmable
Staff breakout/kitchenette	300	Yes	Man-On-Auto-Off	Dimmable
Stairs	100	None	Auto-On-Off	None
Storage	100	Yes	Man-On-Auto-Off	None
Technician	500	Yes	Man-On-Auto-Off	Dimmable
Theatre	300	Yes	Auto-On-Off	Dimmable
Viewing area	100	None	Auto-On-Off	Dimmable
Voids	-	-	-	-
WCs	100	None	Auto-On-Off	None
Workshop	100	Yes	Man-On-Auto-Off	None

2.7 Power factor correction

The whole building power factor correction was set to >0.95.

2.8 Green strategy

In addition to the GSHP serving space heating demands, it is proposed to include a roof mounted PV array. This has the following assumed performance.

Table 8. PV array

Item	Value
PV module nominal efficiency (%)	21
Nominal cell temperature (NOCT) (°C)	45
Reference irradiance for NOCT (W/m ²)	800
Temperature coefficient for module efficiency (1/κ)	0.004
Electrical conversion efficiency	0.97
Area of panels (m ²)	136
Azimuth (° clockwise from north)	270
Inclination (° from horizontal)	5

3. Results

The modelling described above has demonstrated the following performance.

Table 9. Carbon dioxide emissions after each stage of the Energy Hierarchy

	Carbon Dioxide Emissions for non-residential buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	5.4	7.9
After energy demand reduction (be lean)	5.4	7.9
After heat network connection (be clean)	5.4	7.9
After renewable energy (be green)	2.2	7.9

For compliance with Building Regulations, RMC achieves the following.

Table 10. Part L 2021 results for RMC

	Emission rate (kgCO ₂ /m ² .yr)	Primary energy rate (kWh/m ² .yr)
Actual building	1.26	11.86
Notional building	3.04	32.36
Results	Pass (58.6%)	Pass (63.3%)

Appendix A Extract from BRUKL for RMC

BRUKL Output Document



Compliance with England Building Regulations Part L 2021

Project name

RMC base_green 2021

As designed

Date: Fri Aug 26 14:05:48 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.16

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.16

BRUKL compliance module version: v6.1.c.0

Foundation area [m²]: 658.31

The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m²·annum	3.04
Building CO ₂ emission rate (BER), kgCO ₂ /m²·annum	1.26
Target primary energy rate (TPER), kWh/m²·annum	32.36
Building primary energy rate (BPER), kWh/m²·annum	11.86
Do the building's emission and primary energy rates exceed the targets?	BER =< TER BPER =< TPER

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

Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.15	0.15	B_000000:Surf[2]
Floors	0.18	0.13	0.13	L1000004:Surf[14]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	0.13	0.13	B_000000:Surf[1]
Windows** and roof windows	1.6	1.2	1.2	BT000005:Surf[4]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors [†]	1.6	1.68	2.2	RF00000D:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]

U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]

U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* 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.

*** Values for rooflights refer to the horizontal position.

[†] For fire doors, limiting U-value is 1.8 W/(m²K)

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

aecom.com