CUNDALL

Greenhead Sixth Form College, Kirklees

Environmental Strategy Report

Galliford Try

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A	25 March 2021	Issued for Information
B	26 March 2021	Daylighting Results table updated
C	29 March 2021	Updated to incorporate GT comments
D	24 September 2021	Contractors Proposal
E	15 October 2021	Contractors Proposal - Updated to incorporate GT comments

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18/10/2021

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Signed by: Chatwin, Paul

Contents

4.0

School Environment

4.0 School Environment

The project brief clearly states five main requirements for the college design:

1. To put the long-term need of the college users at the centre of all decisions.
2. To be future proofed against the risks of climate change as defined by UK adaptation policy.
3. To achieve Net Zero Carbon in operation as defined by the standards within the Net Zero Carbon Buildings: a Framework Definition UK Green Building Council (UK GBC) recognising a development of targets over a timeline.
4. To report on Embodied Carbon in Construction (Stage 4 and 6), as defined by the standards within the Net Zero Carbon Buildings: A Framework Definition UK Green Building Council (UK GBC) using EN1597. Recognising a development of targets over a timeline.
5. To create a healthy and productive whole school setting in response to UK's 25-year Environment Plan including biodiversity net gain.

4.1 Services and Environment Strategy

This section of the submission sets out the environmental services and energy strategy for the proposed college.

The environmental strategy report highlights how we will achieve compliance with the Output Specification (OS), and the project brief.

To achieve Net Zero Carbon in operation (NZCiO), our strategy followed our steps to net zero carbon methodology:

1. Passive Design
2. Reduce operational energy demand and consumption
3. Eliminate fossil fuel
4. Provide onsite renewable energy and storage where possible.

4.1.1 - Steps to Low Carbon

The design was tested against future scenarios, both a 2°C and a 4°C global warming scenarios above pre-industrial levels were considered.

The design strategy is outlined in this report as per following section:

- 4.2 Ventilation and Cooling Strategies
- 4.3 Environmental Controls – Mechanical
- 4.4 Acoustic Strategy
- 4.5 Environmental Controls – Electrical
- 4.6 Energy Strategy Report
- 4.7 1:50 Cross Section Drawing through a typical classroom
- 4.8 Zoning Strategy Drawings 1:200
- 4.9 Hot and Cold Water Services Strategy
- 4.10 Sustainability

4.1.A Overview of our Design Strategy

The design of the proposed development has been developed to meet the NZCiO target outlined in the project brief.

The energy strategy follows our steps to net zero carbon methodology, which aligned with the industry recognised Energy Hierarchy, as follows:

Be Lean: The design will consider the building form and fabric to provide a highly efficient envelope to drive down the energy demand from heating and cooling.

Be Clean: The building services plant and equipment that we specify will be as efficient as possible to drive down energy consumption.

Be Green: We will aim to reduce the requirement for renewables technologies as far as possible by being 'Lean' and 'Clean'. Renewable technologies are not required to pass building regulations nor are they required to satisfy any local planning requirement. They will be provided to comply with the Net Zero Carbon in Operation requirements of the Technical Annex Sustainability.

4.1.B Approach to Comfort and Façade

We understand and recognise that the façade is key to:

- Thermal performance
- Thermal comfort
- Daylight availability
- Acoustics

The façade solution must allow for effective passive ventilation while minimising unwanted solar gains, maximising daylight availability, controlling external noise and providing a secure and thermally efficient barrier to the outside. At various times of the year the façade will need to perform different functions under the dictates of the user.

The effectiveness of the design was tested against, energy, acoustic, visual, and thermal comfort targets.

As per project brief, the thermal comfort in the spaces was assessed using the methodology outlined in BB101: Ventilation, thermal comfort, and indoor air quality 2018 and against both the 2°C and 4°C global warming scenarios. Proving compliance in the first case and testing adaptability of the design in the latter.

4.1.C Approach to Energy and Thermal Performance

In line with the project brief, energy modelling was carried out throughout the design stage to assess the impact of different design measures on the building performance against the project targets.

In order to meet the NZC target in operation of 74kWh/m^2 GIA per year, which excludes unheated spaces and on-site renewable energy generation, the net zero carbon methodology previously outlined was followed.

The results of the analysis were used to produce annual energy consumption totals for the school's core operating hours in accordance with the requirements of the OS Technical Annex 2H:Energy. This analysis includes both regulated and unregulated energy.

A separate model using National Calculation Methodology (NCM) has been carried out. It is to be noted that the NCM is only used to show compliance with Part L of the Building Regulations and to produce the Energy Performance Certificates (EPC) and does not calculate real energy consumption.

4.1.D Acoustics and Ventilation Strategy Impacts

From the noise survey data, it is considered that a natural ventilation strategy is appropriate for the college. The design is for teaching spaces to be predominantly naturally ventilated with fan assisted supply and extract ventilation within each teaching space.

A summary of the current ventilation proposals are as follows:

- General teaching areas: ventilation provided by means of opening façade ventilation system / fan assisted supply and extract. During summertime periods, opening façade ventilation system / windows are acceptable for the control of overheating.
- Larger spaces including Dining, Social spaces and Main Hall are to have mechanical supply and extract.
- Centrally located land-locked rooms are to be mechanically ventilated.
- Mechanical ventilation and localised cooling to the Fitness suite.

Any mechanical ventilation within a teaching space will be designed not to exceed the noise level requirements set out within Table 1 of BB9 on the following basis:

- Windows with a view to adjacent roads can normally remain closed, with ventilation provided by fan units terminated on the facade
- Overheating mitigation via open windows for up to 200 hours per annum.

4.1.E Integration of retained buildings

- The existing blocks within the main building cluster are served from a central basement gas fired boiler plant. The boiler plant will be retained, and the existing heating circuits will be re-connected to the retained buildings via new pipework to be installed below ground following the demolition of the Laingspan Blocks.
- The existing domestic cold-water system will be extended to serve the new Courtyard Infill building.
- New security and safety systems within the New Main Teaching Block and Courtyard Infill building, including Fire Alarms, CCTV, Intruder alarms, Access Control and Assistance alarms will be interfaced with the Colleges existing systems. Refer to sections 4.5K to 4.5O for further details of these systems.

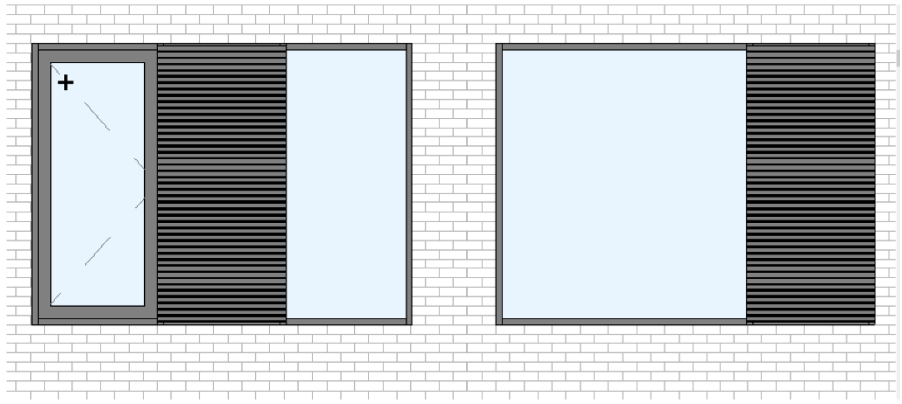
4.2 Ventilation and Cooling Strategies

4.2.A Natural Ventilation

Typically, all occupied rooms have been tailored to maximise the natural ventilation availability via opening façade ventilation systems and louvres wherever possible. This includes for 'land-locked' rooms on the upper floor which will be provided with natural light and separate roof ventilation terminals for daylighting and natural ventilation.

Some other spaces such as the lower level social spaces and the infill block social spaces will be naturally ventilated by the use of a mix of opening windows, motorised louvres, and penthouse ventilation turrets.

The buildings BEMS will be used to control the ventilation in these spaces automatically, and to suit the internal temperature and CO_2 levels. Where required weather compensation will be provided to limit ventilation openings in cold or windy weather to prevent cold draughts. Natural ventilation will be used where possible to provide a comfortable internal environment, but it cannot satisfy all the comfort criteria for the peaks of winter and summer. Therefore, a mixed mode solution and operating strategy is proposed.



4.2.1 - Typical combined louvre and window façade design (with occasional north facing opening window where necessary)

4.2.B Mixed-Mode Classroom Ventilation

The general class, science-based teaching spaces and some social study areas use a mixed mode room ventilation approach. The ventilation will be provided by high-level perimeter ventilation units in conjunction with the façade ventilation system. In some cases, openable windows are also provided to enhance the passive ventilation rates where required.

The ventilation units will be used in occupied areas to supply adequate fresh air for staff and students throughout the year. The units will provide thermally comfortable conditions throughout the year. They mitigate against cold down draughts in winter and assist with maintaining comfort during warmer summer periods by providing additional air movement.

The ventilation units are barely audible in operation. The ventilation units also have a very low specific fan power (SFP) ensuring that they are very energy efficient. The fans will only operate for parts of the year when ventilation is required.

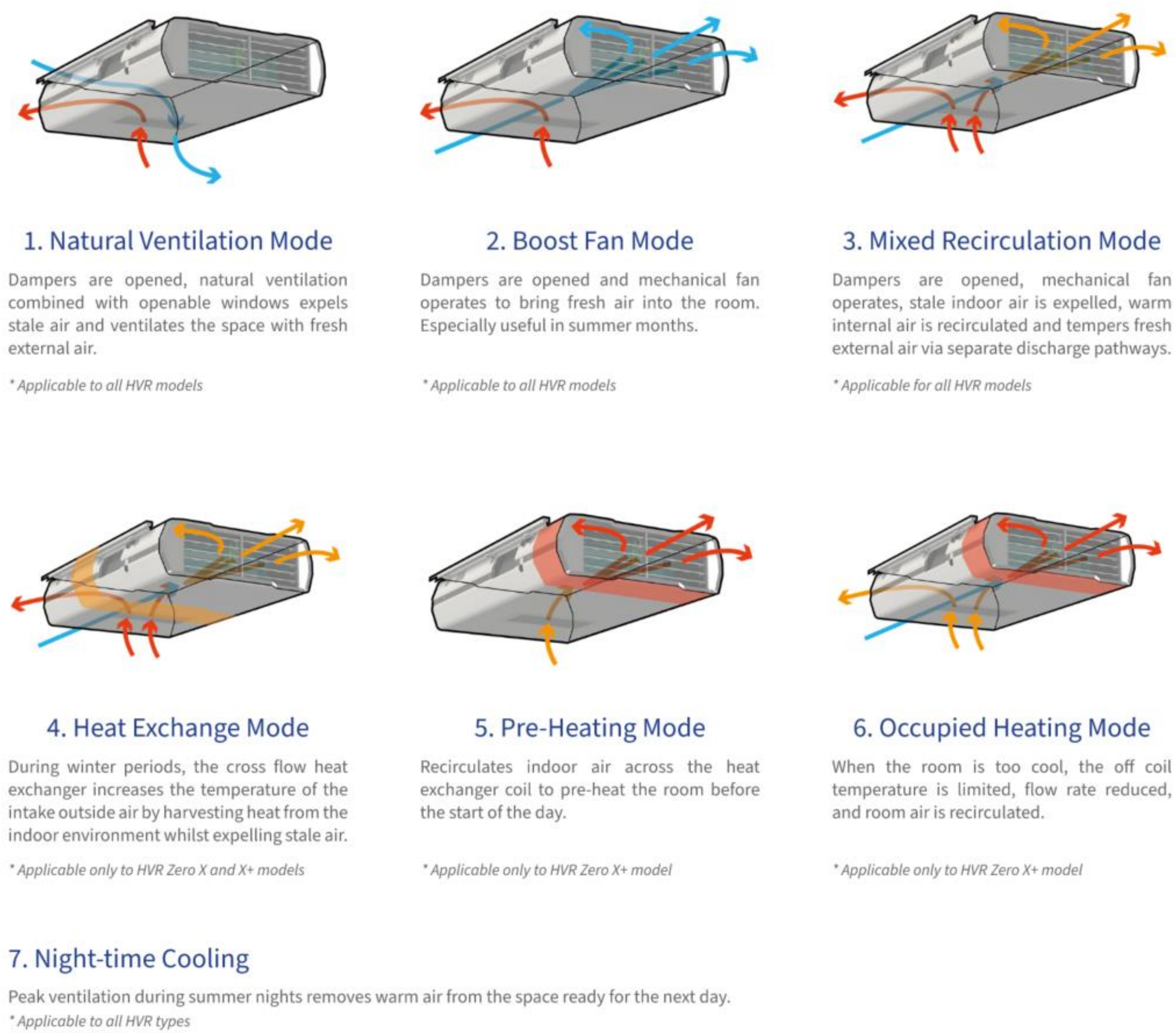
4.2.2 – Ventilation Unit (HVR Zero by Monodraught)

4.2.3 - Typical façade ventilation system (Ventsair by Mondraught)

The ventilation unit has been developed for teaching spaces. This unit allows deeper plan spaces to be naturally ventilated while also delivering optimum thermally comfortable conditions.

The units are installed at high level and typically require a 900mm (W) by 300mm (H) weather louvre on the façade. Each unit typically provides a minimum daytime fresh air ventilation rate of 130 l/s and is suitable for supplying 16 occupants in a school environment. There will typically be two units installed in each general teaching space and ensuring that sufficient fresh air will be supplied for all 32 occupants. Science based classrooms require 'boost' ventilation to 450 l/s (5 l/s/m^2) in accordance with Technical Annex 2F:Mechanical Services and Public Health Engineering, which will typically be provided by three units in each laboratory space, each able to provide 180l/s in daytime boost mode.

In winter mode, the fresh external air enters the ventilation unit at the façade. The unit is fitted with both heat recovery device and two low energy fans which mix the warm room air with the incoming cold air. In doing so, the unit supplies tempered fresh air into the space at a comfortable temperature.



4.2.4 - Ventilation unit operating modes

The ventilation unit is also designed to enable the air in the space to naturally exhaust through the body of the unit to the outside. This means that no other ventilation openings are required during cold external conditions, mitigating any cold draughts issues.

During warm periods, one of the ventilation unit's low energy fans runs to draw in external air to the rear of the space to boost the ventilation rate when internal conditions are very warm or there are high carbon dioxide levels in the occupied space. The summer boost can also be used at night to provide night cooling of the space to ensure that the thermal mass is effectively cooled.

Each room will be automatically controlled via a wall mounted controller using a combined wall mounted temperature / CO_2 sensor located in each room. The controller will enable occupant to control their unit.

These controllers optimise comfort and air quality through combined use of temperature / CO_2 sensors in each room and an external temperature sensor. A local override switch will also be provided to enable occupant control of the unit.

The seven operating modes of the typical classroom ventilation unit is illustrated. Typically, the operating modes include (note set points are adjustable to allow changes based on the building performance management activities):

This operating strategy relies on passive ventilation to control the temperatures and CO_2 levels in the classrooms. These units operate in conjunction with the façade ventilation system, reducing the requirement for the occupants to intervene.

To maintain comfort the units, include a night-time cooling (night purge) mode:

- Night purge will operate the extract fan for up to 1 hour after the end of the day and for up to 2 hours before the start of the next day. This will happen when the room temperature is >22ºC and where the external temperature is less than the room temperature.

4.2.C Air handling plant

Where rooms are required to be mechanically ventilated then a very high efficiency integral air-source heat pump air handling units (AHU), will be used. An AHU located in the Ground Floor plantroom will serve the large spaces on the Ground Floor (Main Hall, Dining and Social Space), and the central “landlocked” areas on the First, Second and Third Floors.

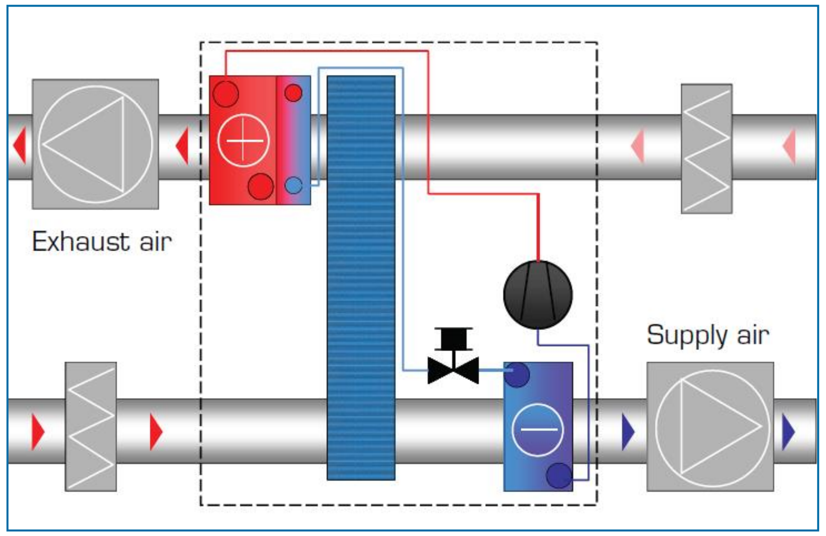
All WC’s on the Ground, First, Second and Third Floors will be ventilated via the central AHU, enabling the recovery of heat from the WC areas

Corridors and circulation areas will be mechanically ventilated via the central AHU, to prevent overheating in accordance with the OS.

A separate supply only AHU, located externally at roof level will serve the Kitchen and separate dedicated extract will be provided to the Kitchen, discharging exhaust air at roof level. The Kitchen supply AHU will include LTHW heating coils, served from the central ASHP’s.

Individual room and zone controls will be provided in the form of VAV and CAV type motorised damper assemblies located within downstream ductwork. The variable volume operation of the central AHU suits the varied occupancy of internal spaces, and the movement of pupils around different parts of the college during the school day. Centralised AHU’s allows the maximum possible advantages to be taken for diversified occupancy profiles across the whole of the new block. It is anticipated that the diversified air volume flow rate will allow for a reduction in AHU sizing of some 15-20%, which has benefits for capital cost, maintenance, and reduced energy consumption.

For the integral air-source heat pump AHU, all heat from the exhaust air is recovered from the building, by a plate heat exchanger before the heat pumps temper the supply air to the building, extracting any remaining heat (or coolth) from the exhaust air-stream. The heat pumps typically operate at seasonal energy efficiency ratios of up to 5:1 in cooling operation and 6:1 in heating operation. The peak lopping cooling provided in summer months ensures that mechanically ventilated spaces meet the thermal comfort criteria, with air supply temperature in the region of 18-20°C.



4.2.5 - Integral ASHP AHU with heat recovery

The exception is the main cooking kitchen, which will be provided with its own dedicated supply and extract ventilation system, due to greases in the exhaust air-stream not being suitable for heat recovery without expensive filtration equipment.

4.2.D Specialist ventilation

In spaces such as the, server rooms, hub rooms and kitchens, additional ventilation will be provided to remove fumes and heat from equipment in accordance with the OS.

4.2.E Local Exhaust Ventilation (LEV) systems

Local Exhaust Ventilation (LEV) systems will be provided in science laboratories.

Fixed fume cupboards will be provided where required to prep rooms and science labs in accordance with the OS and School Specific Brief.

Alternatively, for some labs, mobile re-circulatory fume cupboards could be provided, which would offer greater flexibility for their use in different rooms.

In rooms where gas taps are provided, ventilation at an increased rate will be provided by local extract fans whenever the fume cupboards or Bunsen burners are in use, in accordance with the OS requirements. Gas supplies to such spaces will be interlocked to the rooms ventilation system, typically for operation and management by the teaching staff.

4.2.6 - Typical fume cupboard exhaust air roof fans

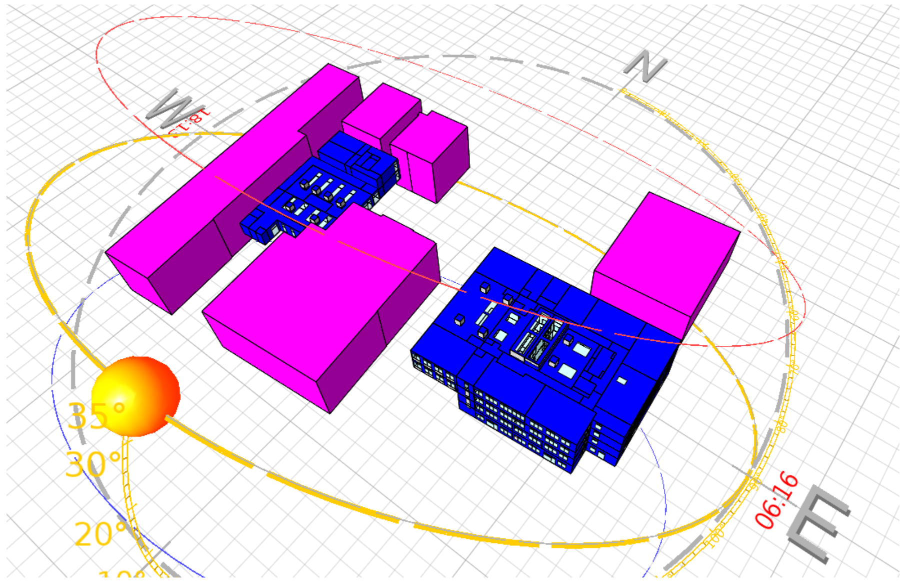
4.2.F Adaptive Thermal Comfort Calculations

This section demonstrates that the thermal modelling undertaken at this stage to inform the natural ventilation design strategy by assessing adaptive thermal comfort criteria is as required by the DFE Output specification Technical Annex 2F: Mechanical Services and Public Health Engineering.

The proposed college has been modelled using IES (Integrated Environment Solutions) software to assess its design for overheating using the CIBSE Birmingham Design Summer Year weather file for the following scenarios:

- DSY1 - 2020 High emissions, 50th percentile scenario
- DSY1 - 2080 Low emissions, 50th percentile scenario
- DSY1 - 2080 High emissions, 50th percentile scenario

Façade ventilation units, windows and the ventilation units operating in either night-purge or daytime boost will be installed in occupied spaces to provide ventilation as necessary during summertime.



4.2.7 – IES ORA Model

Adaptive Thermal Comfort Methodology

The Overheating Risk Assessment (ORA) for these sample rooms has been carried out for the school in accordance with the new CIBSE Overheating Adaptive Thermal Comfort model, as detailed in CIBSE Technical Memorandum 52 and in accordance with the European Standard EN 15251 for determining if a building is likely to overheat.

The IES model accounted for occupancy patterns, predicted heat loads and the adaptive behaviour of the building occupants. The dynamic thermal modelling software was used to calculate the Operative Temperature, T_{op} and Running Mean Temperature, T_{rm}. The ORA was carried out based on the type of space, in line with the OS guidance:

Type of Space or Activity	New Build	Suggested acceptable range ºK
Teaching and learning, drama, dance, exams, multi-purpose halls	II	+3 / -4 ºC
Practical activities such as cooking	N/A	-
Working areas, e.g. kitchens	N/A	
Offices	II	+3 / -4 ºC
Atria, circulation, reception and corridors - not continuously occupied	III	+4 / -5 ºC

4.2.8 - Space categories and acceptable temperature range

For the school to meet the Adaptive Thermal Comfort criteria, the following conditions must be met:

$T_{comf} = 0.33T_{rm} + 18.8$ and $T_{max} = T_{comf} +$ (acceptable range ºK)

For a Type II space (as defined in BS EN 15251:2007), the acceptable range is 3K and for a Type III, the acceptable range is 4K: $T_{max} = 0.33Trm + 21.8$

The three criteria for overheating are all defined in terms of ΔT, the difference between the actual operative temperature in the room at any time, (Top) and T_{max} the limiting maximum acceptable temperature. ΔT is calculated as:

$$\Delta T = Top – T_{max} \text{ (K)}$$

ΔT is rounded to the nearest degree (i.e. for ΔT between 0.5 and 1.5 the value used is 1K, for 1.5 to 2.5 the value used is 2K and so on).

According to OS requirements, a school is deemed to fail the overheating risk assessment if criteria 1 is exceeded. TM52 Criteria 2 and 3 must be reported but it is not mandatory to comply with them.

Criteria 1 – Hours of Exceedance (He):

For schools, the number of hours (He) that ΔT is greater than or equal to one degree (K) during the five summer months (May to September) shall not be more than 40 hours.

Criteria 2 – Daily Weighted Exceedance (We):

To allow for the severity of overheating the weighted exceedance (We) shall be less than or equal to 6 in any one day.

Where $We = \sum He \times wf = (he^1 \times 1) + (he^2 \times 2) + (he^3 \times 3)$

Where the weighting factor wf = 0 if $\Delta T \leq 0$, otherwise wf = ΔT, and he = time in hours when wf = y

Generally, a value of 6 is considered an acceptable limit of overheating on any single day (as per CIBSE TM 52).

Criteria 3 – Upper Limit Temperature (T_{upp}):

To set an absolute maximum value for the indoor operative temperature the value of ΔT shall not exceed 4K.

Modelling Inputs:

The operation patterns which have been used in the dynamic thermal model for the purpose of assessing summertime overheating are, as follows:

- Occupancy 09:00-16:00 (Monday – Friday), Social spaces, study areas and staff workrooms have unique occupancy templates based on predicated occupancies from the college
- 32 occupants @ 70W Sensible and 55W Latent
- Lighting Gain: 7.2 W/m^2 in all spaces
- Small Power:
  - 15 W/m^2 in general classrooms, study areas (sixth form), offices, staff workrooms, science laboratories
  - 25 W/m^2 in dedicated ICT rooms, study area,
  - 5 W/m² social areas and dining areas
- Occupancy, lighting, and small power set to zero during lunch hour (12:00 – 13:00) in all teaching areas.

Reprographics and fitness studio have mechanical cooling to 24°C

Construction:

Floor U value: 0.12W/m" K

Wall U-Value: 0.15W/m" K

Roof U value: 0.12W/m" K (exposed thermal mass)

Internal/Ceiling U-Value: 1.5 W/m" K (exposed thermal mass)

Window U-Value: 1.20W/m" K

Window G-Value:0.4

Ventilation assumptions:

- For perimeter spaces if the space temperature is 20°C perimeter openings gradually open to be fully open at a temperature of 23°C if the outside temperature is less than internal temperature;
- During summer, the mixed mode ventilation supplies a maximum daytime ventilation rate of 360 l/s in classrooms and 540l/s in science labs. When the space reaches 23°C perimeter the units switch on gradually open to increasing to maximum flowrate at 26°C if the outside temperature is less than internal temperature;
- Spaces with no access to natural ventilation are mechanically ventilated based on 8l/s/person supplied at a temperature of 20°C, operated 9am-4pm controlled on the same control profile as the mixed mode ventilation above;
- Night purge (pre-conditioning) will operate the perimeter openings to open when the room temperature is >18°C and where the external temperature is less than the room temperature.

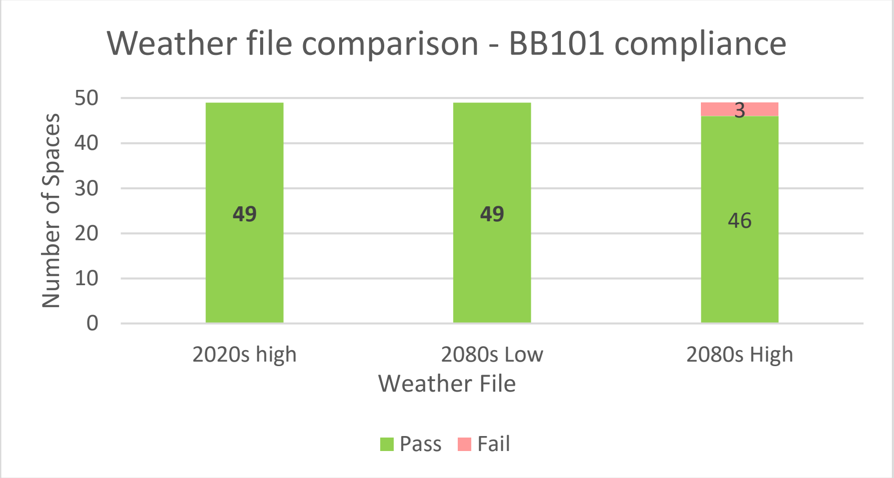
Passive measures, such as night purge, have been investigated in perimeter rooms with mixed mode ventilation, and have proven to be effective in reducing overheating in these high heat gain areas. The façade ventilation units with louvre screens provide an excellent means for the college to take advantage of night purge in a safe and secure manner.

The lower level social spaces and dining areas have a mix of opening ventilation windows and mechanical ventilation. The ventilation openings will all be automatically controlled for temperature and CO_2 and fitted with electric actuators.

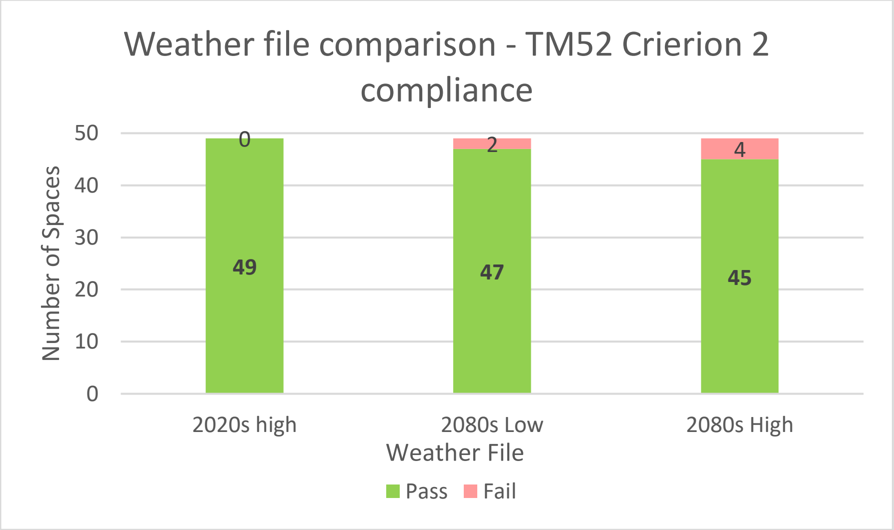
The main hall also benefits from natural ventilation at the roof level via louvres and dampers, operating in conjunction with the mechanical ventilation system.

4.2.G Adaptive Thermal Comfort Calculation Results

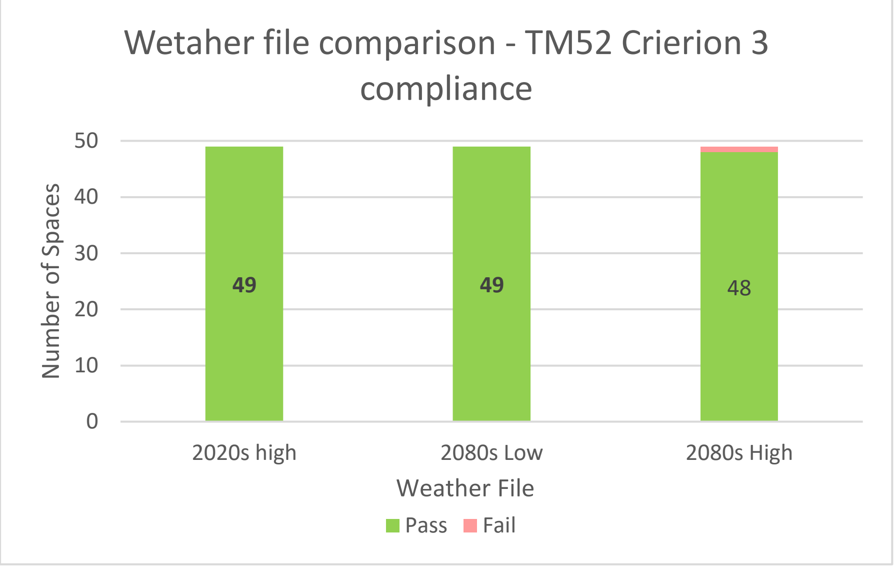
Results from the thermal modelling for each occupied room on each floor of the building are shown in the following plots and tables. The results show that all occupied areas comfortably meet the adaptive thermal comfort criteria for the different categories (pass criterion 1).



4.2.9 – Thermal Comfort Criterion 1 Compliance



4.2.10– Thermal Comfort Criterion 2 Compliance



4.2.11– Thermal Comfort Criterion 3 Compliance

4.2.H Adaptive Thermal Comfort Calculation Results

The columns coloured in yellow fail the criteria.

2020s High				BB101 / DfE [40hrs Max]	Pass / Fail	Criterion 2 [6 Max]	Criterion 3 [4 Max]	TM52 Pass / Fail
Name	**Level**	**Orientation**	**Type**	**Criterion 1**	**BB101**	**Criteria 2**	**Criteria 3**	**TM52**
East Building								
00_Atrium	L00	South, West and North	Social	0	Pass	0	0	Pass
00_Dining_area_1_2002a	L00	North	Dining	0	Pass	0	0	Pass
00_Main_Hall	L00	Rooflight	Main Hall	0	Pass	0	0	Pass
00_Reception_4005	L00	South	Office	0	Pass	0	0	Pass
00_Repographics_1_4004	L00	North	Office	0	Pass	0	0	Pass
00_Social_and_Sandwich_Area_2007	L00	South and East	Social	17	Pass	2	1	Pass
00_Study_Area_(Sixth Form)_3001	L00	SE	Study Area	4	Pass	1	1	Pass
01_General_Classroom_1_1001	L01	North	Classroom	0	Pass	0	0	Pass
01_General_Classroom_2_1002	L01	North	Classroom	0	Pass	0	0	Pass
01_General_Classroom_3_1003	L01	North	Classroom	0	Pass	0	0	Pass
01_General_Classroom_4_1004	L01	North and east	Classroom	0	Pass	0	0	Pass
01_General_Classroom_5_1005	L01	East	Classroom	3	Pass	1	1	Pass
01_General_Classroom_6_1006	L01	East	Classroom	4	Pass	1	1	Pass
01_General_Classroom_7_1007	L01	South and East	Classroom	7	Pass	1	1	Pass
01_General_Classroom_8_1008	L01	South	Classroom	8	Pass	2	1	Pass
01_Office/Meeting_(2P)_2_4008	L01	East	Office	0	Pass	0	0	Pass
01_Staff_Wk_Room_(ws)_1_4001	L01	Internal	Staff Room	0	Pass	0	0	Pass
01_Study_Area_Sixth_Form_2_3002	L01	Internal	Study Area	3	Pass	1	1	Pass
M1_Social_Space_Sixth_Form_2003b&c	LM1	South, West and North	Social	0	Pass	0	0	Pass
02_office/mtg_2P_1_4007	L02	Internal	Office	0	Pass	0	0	Pass
02_Science_Prep 1&2_5005&5006	L02	Rooflight	Science Prep	0	Pass	0	0	Pass
02_Social_Space_2_(Sixth_Form)_2004	L02	NW	Social	3	Pass	1	1	Pass
02_Specialist_Lab_8_(Biology)_1108	L02	North and West	Science Lab	0	Pass	0	0	Pass
02_Specialist_Laboratory_10_(Biology)_1110	L02	North	Science Lab	0	Pass	0	0	Pass
02_Specialist_Laboratory_11_(Biology)_1111	L02	North and East	Science Lab	0	Pass	0	0	Pass
02_Specialist_Laboratory_12_(Biology)_1112	L02	East	Science Lab	0	Pass	0	0	Pass
02_Specialist_Laboratory_13_(Biology)_1113	L02	South and East	Science Lab	0	Pass	0	0	Pass
02_Specialist_Laboratory_14_(Biology)_1114	L02	South	Science Lab	0	Pass	0	0	Pass
02_Specialist_Laboratory_15_(Medicinal)_1115	L02	South and West	Science Lab	0	Pass	0	0	Pass
02_Specialist_Laboratory_9_(Biology)_1109	L02	North	Science Lab	0	Pass	0	0	Pass
02_Specialist_Laboratory_9_(Biology)_1109	L03	North	Science Lab	0	Pass	0	0	Pass
02_Staff_Wk_Room_(ws)_2_4002	L02	Internal	Staff Room	0	Pass	0	0	Pass
02_Study_Area_1_3003	L02	NE	Study Area	11	Pass	3	2	Pass
03_General_Classroom_9_1009	L03	South and East	Classroom	3	Pass	1	1	Pass
03_Office/Mtg_(1P)_1_4006	L03	East	Office	0	Pass	0	0	Pass
03_Science_Prep_1_5003	L03	Internal	Science Prep	0	Pass	0	0	Pass
03_Social_Space_3_(Sixthform)_2005	L03	West	Classroom	1	Pass	1	1	Pass
03_Specialist_Lab_1_(Chemistry)_1101	L03	North and West	Science Lab	0	Pass	0	0	Pass
03_Specialist_Laboratory_2_(Chemistry)_1102	L03	North	Science Lab	0	Pass	0	0	Pass
03_Specialist_Laboratory_3_(Chemistry)_1103	L03	North	Science Lab	0	Pass	0	0	Pass
03_Specialist_Laboratory_4_(Chemistry)_1104	L03	North and East	Science Lab	0	Pass	0	0	Pass
03_Specialist_Laboratory_5_(Chemistry)_1105	L03	South and East	Science Lab	0	Pass	0	0	Pass
03_Specialist_Laboratory_6_(Biology)_1106	L03	South	Science Lab	2	Pass	1	1	Pass
03_Specialist_Laboratory_7_(Chemistry)_1107	L03	South and West	Science Lab	0	Pass	0	0	Pass
03_Staff_Wk_Room_(Ws3)_4003	L03	East	Staff Room	0	Pass	0	0	Pass
03_Study_Area_2_3004	L03	NE	Study Area	22	Pass	4	3	Pass
Infill Building								
0X_Dining_Area_2_2002b	L00	East and Rooflight	Dining	1	Pass	1	1	Pass
0X_Fitness/Excercise_Studio_1_1116	L00	East and Rooflight	Fitness Studio	0	Pass	0	0	Pass
0X_Social_Space_(Sixth Form)_2006	L00	South and Rooflight	Social	10	Pass	4	2	Pass

4.2.12– Thermal Comfort 2020s High Results

2080s Low				BB101 / DfE [40hrs Max]	Pass / Fail	Criterion 2 [6 Max]	Criterion 3 [4 Max]	TM52 Pass / Fail
Name	**level**	**Orientation**	**Type**	**Criterion 1**	**BB101**	**Criteria 2**	**Criteria 3**	**TM52**
East Building								
00_Atrium	L00	South, West and North	Social	1	Pass	1	1	Pass
00_Dining_area_1_2002a	L00	North	Dining	0	Pass	0	0	Pass
00_Main_Hall	L00	Rooflight	Main Hall	0	Pass	0	0	Pass
00_Reception_4005	L00	South	Office	0	Pass	0	0	Pass
00_Repographics_1_4004	L00	North	Office	0	Pass	0	0	Pass
00_Social_and_Sandwich_Area_2007	L00	South and East	Social	19	Pass	2	1	Pass
00_Study_Area_(Sixth Form)_3001	L00	SE	Study Area	16	Pass	3	2	Pass
01_General_Classroom_1_1001	L01	North	Classroom	4	Pass	1	1	Pass
01_General_Classroom_2_1002	L01	North	Classroom	7	Pass	2	1	Pass
01_General_Classroom_3_1003	L01	North	Classroom	7	Pass	2	1	Pass
01_General_Classroom_4_1004	L01	North and east	Classroom	7	Pass	2	1	Pass
01_General_Classroom_5_1005	L01	East	Classroom	16	Pass	3	2	Pass
01_General_Classroom_6_1006	L01	East	Classroom	18	Pass	3	2	Pass
01_General_Classroom_7_1007	L01	South and East	Classroom	22	Pass	3	2	Pass
01_General_Classroom_8_1008	L01	South	Classroom	27	Pass	5	3	Pass
01_Office/Meeting_(2P)_2_4008	L01	East	Office	0	Pass	0	0	Pass
01_Staff_Wk_Room_(ws)_1_4001	L01	Internal	Staff Room	0	Pass	0	0	Pass
01_Study_Area_Sixth_Form_2_3002	L01	Internal	Study Area	11	Pass	3	2	Pass
M1_Social_Space_Sixth_Form_2003b&c	LM1	South, West and North	Social	1	Pass	1	1	Pass
02_office/mtg_2P_1_4007	L02	Internal	Office	0	Pass	0	0	Pass
02_Science_Prep 1&2_5005&5006	L02	Rooflight	Science Prep	0	Pass	0	0	Pass
02_Social_Space_2_(Sixth_Form)_2004	L02	NW	Social	8	Pass	3	3	Pass
02_Specialist_Lab_8_(Biology)_1108	L02	North and West	Science Lab	3	Pass	1	1	Pass
02_Specialist_Laboratory_10_(Biology)_1110	L02	North	Science Lab	3	Pass	1	1	Pass
02_Specialist_Laboratory_11_(Biology)_1111	L02	North and East	Science Lab	3	Pass	1	1	Pass
02_Specialist_Laboratory_12_(Biology)_1112	L02	East	Science Lab	4	Pass	1	1	Pass
02_Specialist_Laboratory_13_(Biology)_1113	L02	South and East	Science Lab	9	Pass	2	1	Pass
02_Specialist_Laboratory_14_(Biology)_1114	L02	South	Science Lab	11	Pass	3	2	Pass
02_Specialist_Laboratory_15_(Medicinal)_1115	L02	South and West	Science Lab	5	Pass	1	1	Pass
02_Specialist_Laboratory_9_(Biology)_1109	L02	North	Science Lab	3	Pass	1	1	Pass
02_Specialist_Laboratory_9_(Biology)_1109	L03	North	Science Lab	3	Pass	1	1	Pass
02_Staff_Wk_Room_(ws)_2_4002	L02	Internal	Staff Room	0	Pass	0	0	Pass
02_Study_Area_1_3003	L02	NE	Study Area	29	Pass	6	3	Pass
03_General_Classroom_9_1009	L03	South and East	Classroom	14	Pass	3	2	Pass
03_Office/Mtg_(1P)_1_4006	L03	East	Office	0	Pass	0	0	Pass
03_Science_Prep_1_5003	L03	Internal	Science Prep	3	Pass	1	1	Pass
03_Social_Space_3_(Sixthform)_2005	L03	West	Classroom	6	Pass	2	2	Pass
03_Specialist_Lab_1_(Chemistry)_1101	L03	North and West	Science Lab	3	Pass	1	1	Pass
03_Specialist_Laboratory_2_(Chemistry)_1102	L03	North	Science Lab	12	Pass	3	2	Pass
03_Specialist_Laboratory_3_(Chemistry)_1103	L03	North	Science Lab	3	Pass	1	1	Pass
03_Specialist_Laboratory_4_(Chemistry)_1104	L03	North and East	Science Lab	4	Pass	1	1	Pass
03_Specialist_Laboratory_5_(Chemistry)_1105	L03	South and East	Science Lab	7	Pass	2	1	Pass
03_Specialist_Laboratory_6_(Biology)_1106	L03	South	Science Lab	12	Pass	3	2	Pass
03_Specialist_Laboratory_7_(Chemistry)_1107	L03	South and West	Science Lab	7	Pass	3	2	Pass
03_Staff_Wk_Room_(Ws3)_4003	L03	East	Staff Room	0	Pass	0	0	Pass
03_Study_Area_2_3004	L03	NE	Study Area	40	Pass	7	4	Fail
Infill Building								
0X_Dining_Area_2_2002b	L00	East and Rooflight	Dining	17	Pass	4	2	Pass
0X_Fitness/Excercise_Studio_1_1116	L00	East and Rooflight	Fitness Studio	0	Pass	0	0	Pass
0X_Social_Space_(Sixth Form)_2006	L00	South and Rooflight	Social	33	Pass	9	3	Fail

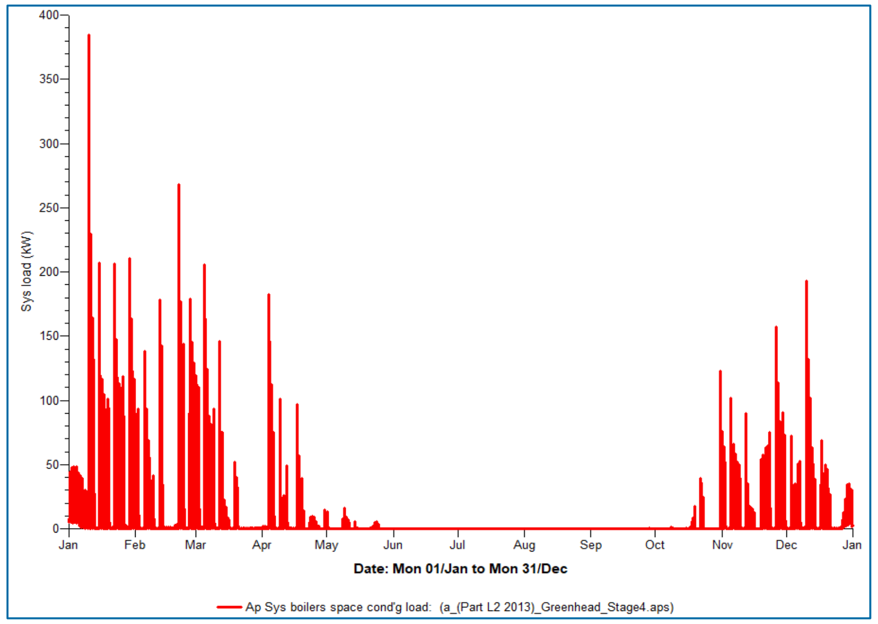
4.2.13– Thermal Comfort 2080s Low Results

2080s High				BB101 / DfE [40hrs Max]	BB101 / DfE Pass / Fail	Criterion 2 [6 Max]	Criterion 3 [4 Max]	TM52 Pass / Fail
Name	**Level**	**Orientation**	**Type**	**Criterion 1**	**BB101**	**Criteria 2**	**Criteria 3**	**TM52**
East Building								
00_Atrium	L00	South, West and North	Social	3	Pass	1	1	Pass
00_Dining_area_1_2002a	L00	North	Dining	0	Pass	0	0	Pass
00_Main_Hall	L00	Rooflight	Main Hall	0	Pass	0	0	Pass
00_Reception_4005	L00	South	Office	1	Pass	1	1	Pass
00_Repographics_1_4004	L00	North	Office	0	Pass	0	0	Pass
00_Social_and_Sandwich_Area_2007	L00	South and East	Social	19	Pass	2	1	Pass
00_Study_Area_(Sixth Form)_3001	L00	SE	Study Area	22	Pass	5	3	Pass
01_General_Classroom_1_1001	L01	North	Classroom	13	Pass	3	2	Pass
01_General_Classroom_2_1002	L01	North	Classroom	14	Pass	3	2	Pass
01_General_Classroom_3_1003	L01	North	Classroom	14	Pass	3	2	Pass
01_General_Classroom_4_1004	L01	North and east	Classroom	14	Pass	3	2	Pass
01_General_Classroom_5_1005	L01	East	Classroom	23	Pass	5	2	Pass
01_General_Classroom_6_1006	L01	East	Classroom	26	Pass	6	3	Pass
01_General_Classroom_7_1007	L01	South and East	Classroom	36	Pass	6	3	Pass
01_General_Classroom_8_1008	L01	South	Classroom	42	Fail	6	3	Pass
01_Office/Meeting_(2P)_2_4008	L01	East	Office	0	Pass	0	0	Pass
01_Staff_Wk_Room_(ws)_1_4001	L01	Internal	Staff Room	0	Pass	0	0	Pass
01_Study_Area_Sixth_Form_2_3002	L01	Internal	Study Area	17	Pass	4	3	Pass
M1_Social_Space_Sixth_Form_2003b&c	LM1	South, West and North	Social	4	Pass	2	2	Pass
02_office/mtg_2P_1_4007	L02	Internal	Office	0	Pass	0	0	Pass
02_Science_Prep 1&2_5005&5006	L02	Rooflight	Science Prep	0	Pass	0	0	Pass
02_Social_Space_2_(Sixth_Form)_2004	L02	NW	Social	11	Pass	3	3	Pass
02_Specialist_Lab_8_(Biology)_1108	L02	North and West	Science Lab	9	Pass	3	2	Pass
02_Specialist_Laboratory_10_(Biology)_1110	L02	North	Science Lab	7	Pass	3	2	Pass
02_Specialist_Laboratory_11_(Biology)_1111	L02	North and East	Science Lab	7	Pass	3	2	Pass
02_Specialist_Laboratory_12_(Biology)_1112	L02	East	Science Lab	10	Pass	3	2	Pass
02_Specialist_Laboratory_13_(Biology)_1113	L02	South and East	Science Lab	16	Pass	3	2	Pass
02_Specialist_Laboratory_14_(Biology)_1114	L02	South	Science Lab	17	Pass	3	2	Pass
02_Specialist_Laboratory_15_(Medicinal)_1115	L02	South and West	Science Lab	14	Pass	3	2	Pass
02_Specialist_Laboratory_9_(Biology)_1109	L02	North	Science Lab	7	Pass	3	2	Pass
02_Specialist_Laboratory_9_(Biology)_1109	L03	North	Science Lab	7	Pass	3	2	Pass
02_Staff_Wk_Room_(ws)_2_4002	L02	Internal	Staff Room	0	Pass	0	0	Pass
02_Study_Area_1_3003	L02	NE	Study Area	39	Pass	7	4	Fail
03_General_Classroom_9_1009	L03	South and East	Classroom	20	Pass	4	3	Pass
03_Office/Mtg_(1P)_1_4006	L03	East	Office	3	Pass	1	1	Pass
03_Science_Prep_1_5003	L03	Internal	Science Prep	6	Pass	3	2	Pass
03_Social_Space_3_(Sixthform)_2005	L03	West	Classroom	10	Pass	3	3	Pass
03_Specialist_Lab_1_(Chemistry)_1101	L03	North and West	Science Lab	10	Pass	3	2	Pass
03_Specialist_Laboratory_2_(Chemistry)_1102	L03	North	Science Lab	17	Pass	3	2	Pass
03_Specialist_Laboratory_3_(Chemistry)_1103	L03	North	Science Lab	11	Pass	3	2	Pass
03_Specialist_Laboratory_4_(Chemistry)_1104	L03	North and East	Science Lab	9	Pass	3	2	Pass
03_Specialist_Laboratory_5_(Chemistry)_1105	L03	South and East	Science Lab	13	Pass	3	2	Pass
03_Specialist_Laboratory_6_(Biology)_1106	L03	South	Science Lab	20	Pass	5	3	Pass
03_Specialist_Laboratory_7_(Chemistry)_1107	L03	South and West	Science Lab	17	Pass	3	2	Pass
03_Staff_Wk_Room_(Ws3)_4003	L03	East	Staff Room	3	Pass	1	1	Pass
03_Study_Area_2_3004	L03	NE	Study Area	49	Fail	10	5	Fail
Infill Building								
0X_Dining_Area_2_2002b	L00	East and Rooflight	Dining	30	Pass	8	3	Fail
0X_Fitness/Excercise_Studio_1_1116	L00	East and Rooflight	Fitness Studio	0	Pass	0	0	Pass
0X_Social_Space_(Sixth Form)_2006	L00	South and Rooflight	Social	48	Fail	10	4	Fail

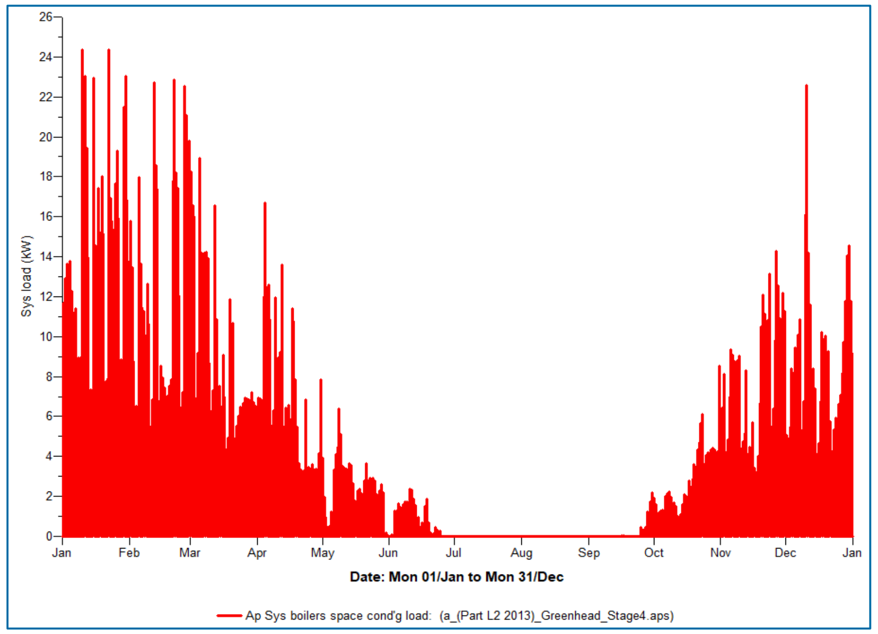
4.2.14– Thermal Comfort 2080s High Results

4.2.I Heating Calculations

The IES model output for one year's hourly heat demand for the school is illustrated. The peak building fabric steady state heat losses have been calculated, for a -4°C winter design condition, as **144** kW and **28** kW for the East and Infill building respectively. The graphs below show the Part L estimated annual heating loads for the building.



4.2.15 – Predicted Annual Heat Load Profile for the New Block from local weather file (LeedsTRY05.fwt)



4.2.16– Predicted Annual Heat Load Profile for the Infill Building from local weather file (LeedsTRY05.fwt)

Heating plant selections will consider pre-heat factors for ventilation unit heating selections, fresh air heating loads, air handling unit heating loads, and heating loads for entrance warm air curtains. As well as this a surplus plant capacity of 25% is proposed for resilience should a single heat-pump unit fail.

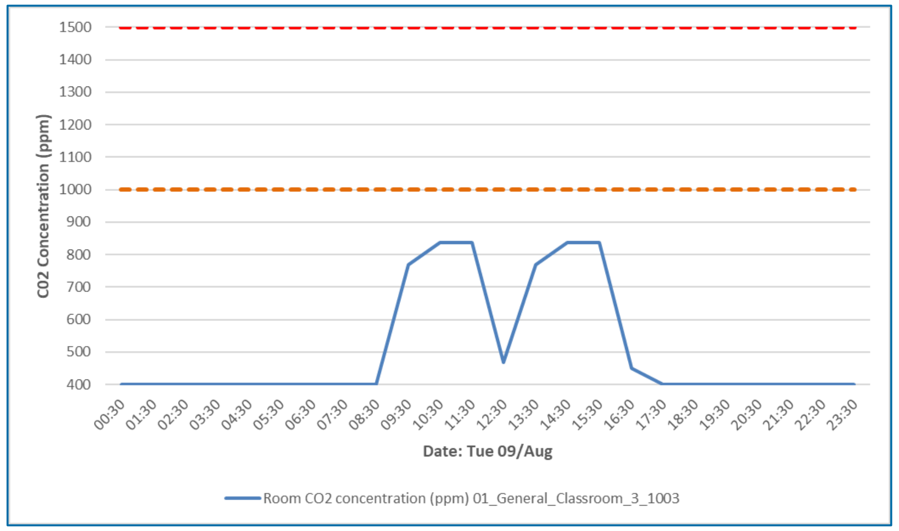
The heat-pumps will be fully modulating type and will therefore match the load exactly. The flow and return water temperatures will vary to suit the season. This optimises the efficiency of the heat-pumps. The run load will be a sum of the hours of operation and heat demand multiplied by the seasonal efficiency which is a total of **120,889 kWh**. Separate heat pumps will provide hot water.

Ventilation Calculations

The Output Specification specifies that where mechanical ventilation is used, enough fresh air must be provided to achieve a daily average concentration of carbon dioxide during occupied core hours of less than 1,000ppm and so that the maximum concentration does not exceed 1,500ppm for more than 20 minutes each day.

Furthermore, where natural ventilation is used, the system can provide enough fresh air so that the average concentration of carbon dioxide during occupied core hours is in the range of 1,000 to 1,500 ppm and so that the maximum concentration does not exceed 2,000 ppm for more than 20 minutes each day.

As part of the thermal modelling undertaken, we have also utilised the software to test for CO_2 concentrations. The graph below demonstrate that good air quality and CO_2 levels will be maintained throughout an occupied school day for a typical classroom space. All areas have been checked for compliance.



4.2.17 - Typical Classroom Daily Profile for CO_2 Concentration

4.2.J Prevention of Cold Draughts

The new block level 00 and 01 has double height areas for social spaces. To three sides automatic windows will be provided to allow ventilation during periods of warm weather. In periods of cold weather, the central and local mechanical ventilation systems will operate to prevent cold draughts.

The main hall has a full void to roof level. The roof level includes automated dampers. In periods of cold weather, the central and local mechanical ventilation systems will operate to prevent cold draughts.

All classrooms have the ventilation units provided to prevent cold draughts.

4.3 Environmental Controls - Mechanical

The majority of environmental services and mechanical services controls philosophies are described in preceding or following sections of this report, and this section should be read in conjunction with such descriptions. Section 4.8 in particular includes further descriptions and strategy drawings for the various mechanical services.

The heating, ventilation, and domestic water services schematics should also be referred to and these outline the overarching distribution and design philosophies of the various mechanical services.

4.3.A End User Controls

All controls accessible to the pupils and staff will be provided for in accordance with the OS and its technical annexes. They will be designed from the outset to be intuitive and simple to use and will aim to be kept consistent across the school even where environmental strategies or HVAC systems are fundamentally different.

Environmental controls in teaching spaces, Study Rooms and the smaller Social Spaces will consist of integrated controllers, providing display of room temperature, CO2 level, set point. Mode and fault indication. The controllers will provide control of the Ventsair natural ventilation louvres and room Hybrid ventilation units.

All lighting controls will consistent and simple to use with the ability to override automated switching functions where required.

4.3.B Building and Energy Management systems and building services controls

The college will be provided with a building management system, designed to deliver an effective energy management system and will be fully OS compliant. The BMS will provide the infrastructure for an intelligent building. This will incorporate a distributed intelligence system operating using open protocol over the IT network. Full energy management, monitoring, recording, and reporting facilities will be provided in accordance with ESFA's generic design brief and technical annexes.

The system will automatically control and monitor all of the main engineering services within the school in order to optimise energy efficiency while maintaining their required comfort conditions.

A BMS head end PC with full graphical interface package will be provided within the main building, within a suitable staff area or office. All graphics pages will be clear, intuitive to use, and laid out on top of the building floor plans for ease of navigation. In addition, a touch screen interface will be provided at the main building ground floor plantroom control panel to allow the college's FM staff to fully interrogate the BMS, review alarms, adjust time-clocks, adjust set-point, and adjust other user-defined controls parameters.

The BMS system will include for a site wide network via the college's own IT network, in order to communicate with remote BMS outstations located within existing retained buildings where required.

All main air-handling units shall incorporate fully packaged control panels, factory fitted and tested, and provided with BMS system compatible out-stations, suitable for sitting on the BMS LAN.

The BMS system will be utilised as follows:

- As a day-to-day operational tool to control the building to drive down energy consumption and identify avoidable wastage
- Be operated by experienced operators and matched to departmental operational schedules and updated regularly to match occupancy profiles
- Time/control schedules will be logged and all changes noted and reviewed on a regular basis
- Ensuring the correct level of alarm monitoring and reporting
- Full control of all HVAC plant including any small stand-alone plant i.e. air-conditioning split units
- Optimised start-stop for space heating controls to maximise free heat periods
- Automatic change over between duty/standby heat-pumps and pump sets
- Heat-pump sequence control (manual and automatic) including operation periods
- Direct weather compensation of flow and return temperatures
- Weather compensation for automated natural ventilation systems
- Alarm handling with low level, medium and high/critical fault levels
- Meters/monitors utilities and key environmental parameters
- Remote monitoring of systems where required

The BMS/EMS system shall incorporate multiple energy metering devices to provide sufficient information for monitoring and targeting of gas, electricity, and water supplies, including for:

- Enhanced metering and sub metering to that required by Part L 2013 building regulations for monitoring and targeting purposes will be as standard. Sub-metering to allow areas of the building used for out of hour's activities to be metered and charged
- Metering and sub-metering will be incorporated, with Sub-metering to separate teaching zones, kitchens, IT servers and external lighting will be employed to monitor usage
- Sub-metering to lighting/small power distribution panels to each area.
- A metering data collection system utilising the BEMS to ensure quality real time data is available to the proposed monitoring and targeting system

The building management system will have the following monitoring/alarm capabilities:

- Zoned control of distribution systems to match the various buildings occupancy profiles
- Controls including alarm mode to maximise energy performance arrangements including
    - DHWS and LTHW flow and return temperature including alarm mode
    - Plant status information including failure mode alarm
    - Cold and hot water storage temperature including alarm mode
    - Lift alarms
    - External temperature including alarm mode including weather compensated control
- Ability of system to send phone, pager or email message if in alarm mode
- Ability to have remote monitoring capability for off-site interrogation
- Ability to provide record and data history of monitoring regime including alarm modes

Monitoring and targeting (M&T) reporting facilities shall be provided that will provide precise information on levels and patterns of use and running costs. These reporting facilities will be graphically presented, easy to use and understand, for the general college staff. It will include for a simple graphically based 'dashboard' front page to provide all summary energy and metering data, with more detailed user pages for each individual service. The overall M&T system shall enable the user to:

- Monitor core hours usage and out of hours usage separately, and provide internal billing reporting for each third-party client usage,
- Display period by period data over a user selected date ranges for each different building zone and service,
- Identify peak demand levels to provide early warning of potential overuse or out of normal range values, and provide analysis of usage to highlight inefficient practices
- Show consumption trends over user selected date ranges and for core hours vs. out of hours use,
- Analyse real usage against target levels through graphical based M&T,
- Determine potential supply capacity and power factor problems,
- Identify the need for maintenance due to increased levels of energy use through M&T,
- Automatic energy/service usage data collection, including for automated upload to a portal independent of the college's IT system. We shall liaise with the energy data collection provider to establish and agree the data collection requirements and methodologies, include for archiving and back-up of all received data for a minimum of 36 months
- calculate heating degree day values based upon local weather data
- Align the M&T reporting with CIBSE TM54 protocols,
- Retain all current collected data values
- Produce automated weekly, monthly, and annual energy/service usage reports,
- Identify and report peak demands against utility provider constraints

4.4 Acoustics Strategy

Refer to Apex acoustics report (doc ref. NE8659-APX-ZZ-ZZ-RP-YA-002, dated 14th September 2021).

4.5 Environmental Controls - Electrical

The majority of electrical and lighting services controls philosophies are described in preceding or following sections of this report, and this section should be read in conjunction with such descriptions. Section 4.8 in particular includes for further descriptions and strategy drawings for the various electrical and lighting services.

The electrical schematic drawings should also be referred to and outlines the overarching electrical distribution strategy.

4.5.A Main Electrical Distribution

A new 650kVA LV supply is required and will be derived from the HV/LV substation located onsite, this will need be upgraded (to be confirmed during next stage of design) by NPG to supply the new college building with the required maximum capacity.

Within the new Teaching Block building and Courtyard Building a main low voltage switchboards will be located in the ground floor LV switch rooms, and will be form 4 type 2 and will use moulded case circuit breakers (MCCBs). This will feed local distribution boards located within service risers / cupboards / storerooms / classrooms / practical rooms, and large items of electrical equipment. Particularly large loads such as lift supplies, mechanical plant supplies, etc. will be fed directly from the main LV panel. Distribution boards that are local to the LV switch room and distribution boards serving Server/Hub rooms will be directly fed off the main LV switchboard.

Each main LV switchboard is to be provided with a check meter on the incoming mains, plus meters on the majority of the outgoing sub mains (no meter to be provided on the fire alarm supplies), to meet Building Regulations Part L. Surge protection will be provided at the main LV panel within the new building as well as local surge protection to the server and hub rooms.

Separate energy sub meters are to be provided to meet the requirements of Part L of the building regulations, and to meet the ESFA OS.

The following will typically be provided with kWHr MODBUS output meters:-

- All outgoing ways of the main LV switch panel (excluding fire alarm supplies and split metered lighting and power distribution boards).

The following will be provided with multifunction MODBUS meters:-

- Main incoming supply to the main LV switchboard.(within the new Teaching Block)
- The following meters will be networked onto the BMS:-
- All outgoing ways of the main LV section board (excluding fire alarm supplies).
- Main incoming supply to the main LV switch board.(within Courtyard Infill)

All meters shall be MODBUS type to interface with an open protocol BMS front-end.

General purpose distribution boards will serve the general lighting and power throughout the college. These are to be housed in service risers / cupboards / store rooms in areas generally non-accessible to pupils.

For safety, in classrooms containing machinery or other sources of danger e.g. science labs. Power within the rooms will be contactor controlled off a local emergency stop circuit within the room, to provide a ready means of isolation in an emergency. Emergency Power Off ('EPO', or 'knock-off') buttons will be provided in these rooms, re-setting of the emergency stop circuit will be from a single key switch. This system will be integrated into a safety system for the class room to shut off the gas in those areas also.

4.5.B Electrical Vehicle charging points

The local authority requires 10% of on-site parking spaces to be provided with EV charging points. The details of these will be determined at the next stage as part of the Planning submission.

We will be exploring load management of the EV charging systems.

The EV charging system is to be fed from a local feeder pillar supplied from the Courtyard infill building.

4.5.C Feeder Pillar

Feeder Pillars are to be provided to serve external services, which include but are not limited to, external lighting, illuminated signage, EVC, automated gates, intercom positions and access control positions. Note this list is not exhaustive and is to be developed at detailed design.

4.5.D Electrical Distribution, Cables and Containment

Refer also to strategy drawings within section 4.8 of this report.

Cable containment management will be provided from the main LV switchgear to the point of utilisation.

Sub-main cables feeding distribution boards and large items of plant will be installed on galvanised heavy-duty steel cable tray or heavy duty cable basket. Final circuit containment will generally consist galvanised heavy-duty steel cable tray routed through ceiling voids/above lighting rafts (as applicable).

Containment for fire alarm services will generally be provided via cable tray/basket within the ceiling voids of the circulation spaces. Containment for ICT services will generally be provided via cable baskets within the ceiling voids of the circulation spaces.

The cable management system will be segregated to provide individual containment for final distribution cables, sub-mains cabling, fire alarm, ELV systems (i.e. security, BEMS) and data systems. The segregation of services will comply with BS 7671 and CIBSE AM 7 for IT cable installations. A reserve will be provided in all containment systems and service voids for future expansion.

Sub-distribution board feeder cables will be of the XLPE/LSF/SWA and the final circuit cables will be of the copper LSF type.

The electrical distribution design will incorporate the following:

- 25% spare ways in distribution boards where practicable
- Surge protection fitted to the main switch panel.
- Sub metering provided to the main switch panel and distribution boards as shown on the distribution schematic wiring diagram.
- Space for future Power Factor correction equipment located at the main switchboard.

4.5.E Renewable Electrical Energy Systems

A new Photo-voltaic (PV) array will be provided to the roof of the main building. This array will be sized to meet the requirements for the Sustainability TA requirements. The total NZCiO requirement is ~60.5kWp.

4.5.F Lighting Systems

For each area type the design average maintained illuminance will be as detailed on the layout drawings and all in accordance with relevant SLL and CIBSE guidance and the ADS's.

LED lighting will be used throughout, including for circulation spaces, WC's, offices, rooms with suspended ceilings, and other ancillary spaces as a minimum. To ensure that part L is met it is important that the luminaires used are efficient and need to meet the requirements below as a minimum.

LED light fittings with a minimum efficacy of 110 Lumens/circuit Watt will be used throughout the scheme

Lamps will generally be white 4000K. Enhanced colour lamps will be considered in particular areas such as art and textiles where colour rendering is critical.

Artificial lighting designs will be developed to complement the natural lighting strategy, which makes use of the natural lighting entering the building, and to enable users to take control over the lighting in the space. Luminaires adjacent to windows in all Classrooms will be dimmable to exploit the available natural daylight.

Within each general classroom having significant natural daylight, there will be a local control system in the room. The control elements are:

- Presence detection (automatic) – Lighting is to be automatically switched on when an occupant enters the space and is to be automatically switch off following a pre-determined period of inactivity. Note: for the purposes of commissioning this is to be 15 minutes unless advised otherwise.

- Absence detection (semi-automatic) – Lighting is to be manually switched on or off by retractive switch. In addition, the lighting is to be automatically switch off following a pre-determined period of inactivity within the space. Note: for the purposes of commissioning this is to be 15 minutes, unless advised otherwise.
- Daylight dimming – Lighting is to be automatically dimmed by photocell in areas expected to achieve an ambient daylight level of more than 100 Lux. Luminaire output is to be modulated in order to maintain the correct average illuminance level.
- Scene setting – Lighting is to be manually switched by a control panel within the space to the recall a selection of pre-programmed lighting scenes. Note: all scene select panels are to be clearly labelled to indicate purpose of each scene.
- Manual Switching – Single or multi-gang switches are to be used for the manual operation of lighting. Note: this arrangement offers no automatic lighting control.

The control philosophies outlined above are to be employed as indicated on the accompanying strategy drawings and room data sheets.

All luminaires within teaching spaces are to be provided with an integral smart sensor which facilitates daylight harvesting, maintained illuminance, presence/absence detection and scene setting, as applicable. The system is to also be capable of group presence communication, which ensures luminaires are switched in groups and with individual control and all luminaires are to be programmed using an infra-red remote control.

In conjunction with the above, separate lighting control zones will be provided as follows:

- Teaching/demonstration areas
- Whiteboards/display screens
- Office zones of no more than 4no. workspaces within each area

Potential dangers from lighting controls have been considered, automatic lighting controls will not be provided within Laboratories, plant and Server/Hub rooms due to the dangers of inadvertent switching off.

Corridor lighting will be switched via ceiling mounted microwave mains operated presence detectors with a time adjustable stay on facility (linked into open class room areas and stairwells where required). Daylight linking switching will be provided where daylighting is provided.

WC, changing area and store room lighting will be switched via ceiling mounted presence detectors.

Office lighting will be controlled via absence detection and also switched locally via manual wall mounted switches.

The main hall will be controlled by a simple DALI network to enable dimming of the luminaires from 100% to 0%.

Rooms containing machinery, including classrooms, kitchens and plant rooms will have local wall mounted light switches to control the lighting within those areas.

The reception desk and front reception area lighting will be switched locally via manual wall mounted switches.

Specialist lighting for displays within the general corridor areas, notably the reception area will be switched locally via manual wall mounted switches.

The lighting controls will be controlled on a standalone basis generally with lighting control modules installed within corridors adjacent classrooms and open areas.

4.5.G Emergency Lighting

Emergency lighting will be provided within the college to allow for the safe egress of occupants in the event of a mains power or lighting failure. Full coverage will be provided to all corridors, stairwells, circulation spaces, and areas deemed necessary within the BS5266. Emergency lighting will be provided to classrooms that are to be used for community use and form a means of escape. Classrooms not being used for community use do not require emergency lighting unless over 60m².

Emergency lighting will be provided via separate LED luminaires. The LED lighting will have optics suitable for the environment installed e.g. corridors. The system will provide 3 hours backup in the event of mains failure. These will be supplemented with non-maintained illuminated emergency LED exit signage.

Emergency lighting will be incorporated into all external wall mounted light fittings (see also next sub-section) to provide safe and secure egress from and around the building perimeter in the event of a power failure. All final exits will have external perimeter lighting provided via the wall mounted amenity lighting to provide a complete system to the point of assembly.

Testing of the emergency lighting will be provided by centralised key switches located at the local distribution boards.

4.5.H Specialist Lighting

Performance lighting to the main hall will be provided in the form of containment and lighting rigging bars, for fitment of theatrical lighting by others. The specialist lighting and control shall be provided by the school and installed by their contractor. Suitable containment for any lighting control cabling shall be included back to the lighting control room desk position.

4.5.I Site External Lighting

The car parks, roads and footpaths will utilize column mounted luminaires, with wall mounted luminaires provided to the building façade to supplement the column mounted luminaires. External lighting will be time controlled via the BEMS time clock with override facility and wall mounted photocell, mounted on a north facing wall.

Additional lighting as per the external services drawings in section 4.6 will be provided for the MUGA.

The designs for external lighting systems will support CCTV coverage, providing illuminance to the areas covered by the CCTV system.

The external lighting for road and walkways shall be LED with improved asymmetric optics selected to suit the area to be lit. This will assist in reduction of energy use.

Refer to the drawings for types of luminaires proposed.

Where building mounted luminaires are installed these will be fitted with suitable anti-glare screens illuminating access routes for safety.

Access roads, car park areas and service access routes – to be minimum 6m high metal lighting columns with LED asymmetric lighting.

All external lighting must be designed to reduce light spill and light pollution in accordance with planning conditions. External lighting adjacent to residences will require appropriate snoods and shrouds to be fitted to control light spill.

4.5.J Fire Alarm Installation

An analogue addressable fire alarm system will be provided in both the Teaching Block and Courtyard buildings with automatic detection coverage to achieve an L2 classification.

The system will incorporate analogue technology devices and field devices will comprise of multi-criteria detectors, break glass call points, sounders, visual alarms (flashing beacons), and interface units. In addition, radio pagers will be provided for use by the hard of hearing. Any ceiling voids over 800mm will be provided with void detection and will visual indication below the ceiling.

Activation of any one break glass sets the fire alarm into full evacuation. On activation of the fire alarm into full evacuation an auto dial out facility is available for a central monitoring station to manage the incident (to be confirmed by Fire Strategy).

All Internal circulation/corridor fire doors will be detained (open) by electro-magnetic retainers.

Generally multi-criteria detectors will be installed to avoid false alarms. Visual strobe alerts in the form of Xenon beacons will be provided throughout for the hard of hearing in the form of flashing beacons.

The system will operate on a double knock (coincidence detection) strategy (to be confirmed by Fire Strategy):

Detection of one smoke/heat detector will sound an alarm at the main panel and in the main reception. The College has a predetermined time to investigate the activation before the fire alarm goes into full evacuation and calls out the fire brigade. The College has the facility to cancel the alarm if required. Detection of a second smoke/heat detector sets the fire alarm into full evacuation.

The fire alarms are to link to various building services, to take authoritative action upon the detection of fire. Interface the fire alarm system with the following as a minimum:

- Door retaining units (détentes), to release upon alarm.
- Mechanical Control Panel in the external plant area.
- Lifts - the lifts to return to ground floor level, open their doors.
- Access controlled doors in the new Courtyard and Teaching Block buildings shall release on Fire Alarm. (Note, subject to agreement with

Building Control), the external doors will be kept closed to maintain security of the building – emergency exit will be via a push release or green break glass.
- Disabled refuge point to hold the device off any and only energise in fire conditions.
- Gas Shut off.
- Kitchen Fire Shutters

The fire alarm system will also be networked to the existing fire alarm system located in the existing building (details to be developed during next stage). New ductwork will be provided between the new and existing building to facilitate this.

4.5.K CCTV

An internal CCTV system will be allowed for, with a single camera provided at the main entrance. Containment provision for internal cameras to all circulation and stairs is to be provided in the scheme for fit-out and use by the school in the future.

New external CCTV will be provided to prevent, detect, deter and help investigate crime to the external areas of the premises and the system will be suitable for identification and providing evidence. External column or building mounted CCTV cameras will be provided as indicated on the strategy drawings.

The CCTV system as a whole must be suitable to support future internal and external cameras and meet all other requirements of the ESFA's generic design brief.

New Ethernet ICT infrastructure will be provided to support both new and future internal and external cameras. The CCTV system to be suitable for offsite monitoring.

The CCTV system will also be networked to the existing CCTV system located in the existing building (details to be developed during next stage).

New ductwork will be provided between the new and existing building to facilitate this.

4.5.L Intruder Alarms

An intruder alarm system will be installed which comprises two distinct systems which create a "double knock" and will include a facility to be linked to a remote monitoring centre for compliance with DD243 via a dedicated Redcare line.

The Intruder Alarm system will also be networked to the existing Intruder Alarm system located in the existing building (details to be developed during next stage).

New ductwork will be provided between the new and existing building to facilitate this.

4.5.M Access Control

An access control system will be provided to selected areas within the building to manage and control the entry and egress of people throughout the school. The strategy for restricting access into and through the building will be developed in conjunction with the overall security and operational strategies for the building during design development. As indicated on the strategy drawings.

The access control system will also be networked to the existing access control system located in the existing building (details to be developed during next stage). New ductwork will be provided between the new and existing building to facilitate this.

4.5.N Assistance Alarm System

Equity of access and use of the new college is an important factor of the development. The electrical services will include a range of provisions, including DDA WC alarms, hearing loops, refuge alarms and automatic doors. Other provisions for lighting levels, switching heights and colour contrast are described in other sections.

DDA WC alarms are to be installed in each disabled toilet including the disabled cubicles in changing rooms. Each alarm will also sound locally, plus will be linked to a main alarm indication panel in the main school reception. Provision and arrangements of alarms will be in accordance with Building Regulations Approved Document M.

Disabled refuges will be provided in the stairwells above ground floor level. Each refuge will require a two-way communication system to a fire supervisory position at the Reception. Provision and arrangements of refuge alarms will be in accordance with Building Regulations Approved Document M.

4.5.O Induction Loops

A combination of portable infra-red, fixed infra-red, portable induction loop and fixed induction loop assisted hearing systems are to be provided to serve the following areas:

- The reception desk – fixed counter induction loop
- Main Hall – perimeter or low loss induction loop
- Dining Hall - perimeter or low loss induction loop

In addition, three (3) portable induction loops will be provided for the College's use in meeting and interview rooms, including senior staff offices.

Sound field systems are excluded and would be provided in classrooms by others when and where required. Should these prove insufficient to communicate with a particular student, then the intent is that portable induction loops could also support this.

4.5.P Intercom System

An intercom system is to be provided to enable two-way audio / video communication between the main entrance lobby and reception.

Please refer to the accompanying strategy drawings and room data sheets for details.

4.5.Q Daylight Design Strategy

A wide range of daylight design solutions have been tested throughout the development of the ISP stage, to find the most efficient, cost effective and practical solution that meets with the OS requirements, whilst providing flexible control over the visual environment to ensure visual comfort for the occupants.

The main new building is orientated with the facades facing almost true north, east, south and west.

The infill block being almost surrounded by the existing building though benefits from daylight from both windows and roof lights.

The analysis completed for the college has focused on two main areas. The area and specification of glass for the north facing façade which is also close to the existing Rostron building. And the remaining east, south and west facing facades.

At the outset the floor to ceiling raft height for all floors was agreed to be 3,000mm with floor to soffit being ~3,350mm. This provides a good opportunity to distribute light to the rear of the room.

With this floor to ceiling height typically the OS daylight criteria can be met with classrooms up to 7,500mm deep. This is based on the following reflectance's being achieved with the developed design, ceiling/wall/floor achieving 80% / 60% / 20%.

Each room has daylight performance criteria given by its area type and an ADS code as follows:

- **L1** – Basic Teaching area, space requires primary performance criteria of 80%
- **L2** – Hall, Dining and PE spaces; and libraries, space requires primary performance criteria of 75%
- **L3** – Group rooms and study area; staff area, space requires primary performance criteria of 60%
- **L4** – Circulation kitchen preparation area; changing rooms, stairwells and wherever possible, space requires primary performance criteria of daylight access required
- **L5** – Store rooms; toilets. No performance requirements

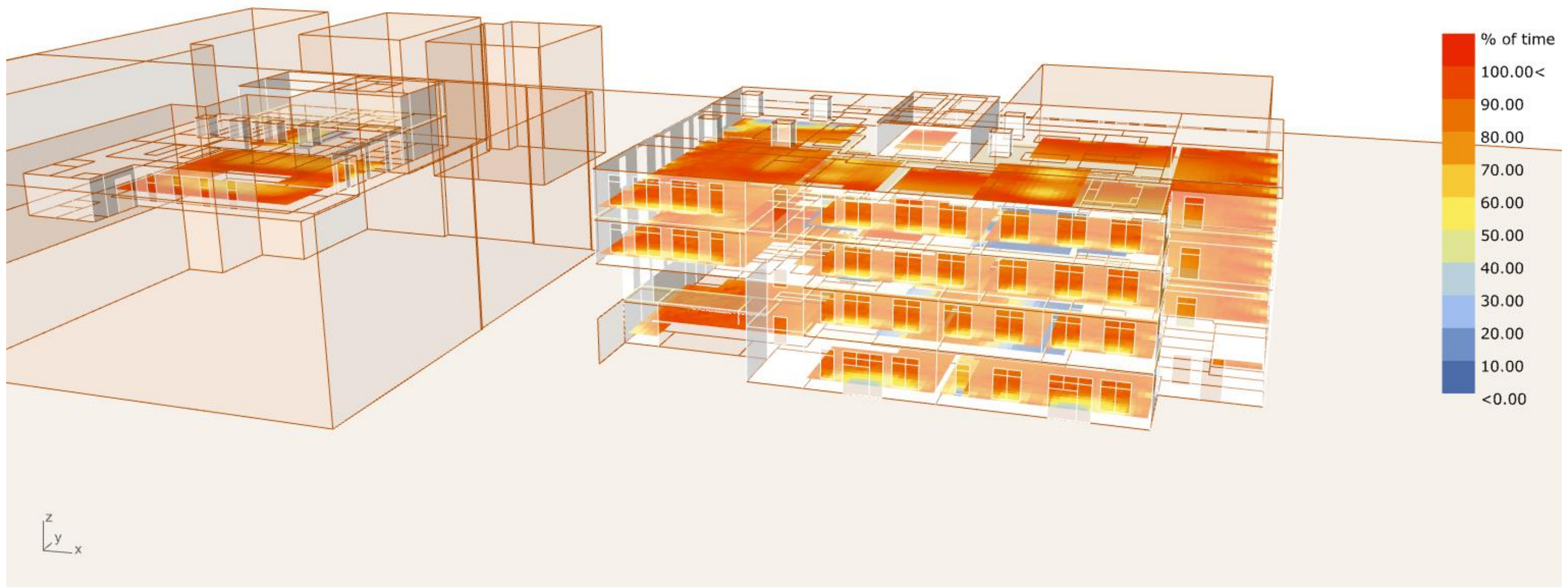
<u>Daylighting Modelling Methodology</u>

In order to inform preliminary glazing design, a parametric daylight study has been undertaken using climate-based daylighting modelling (CBDM). This study looks at a single typical classroom, running numerous analyses to determine the relative impact of different parameters. The following performance parameters should be achieved for L1 spaces:

- The spatial daylight autonomy ($sDA_{300/50\%}$) should be ≥50%
- The useful daylight index ($UDI\text{-}a_{100\text{–}3000\ Lux}$) should be ≥80%

The model was constructed in Rhinoceros with the analysis undertaken using the Grasshopper, Honeybee and Ladybug plug-ins and applied the following parameters:

- Weather file: Finningley.033600_IWEC energy plus.
- Glazing visible Light Transmission (VLT) North: 73%
- Glazing visible Light Transmission (VLT) East/South/West: 69%
- Glazing visible Light Transmission (VLT) Rooflight: 69%
- Wall Reflectance: 60%
- Ceiling Reflectance: 80%
- Floor Reflectance: 20%
- Working plane: 0.7m
- Grid spacing: 0.5m
- Ambient bounces: 4



4.5.1 – Daylight Model of Both Buildings

4.5.R Results

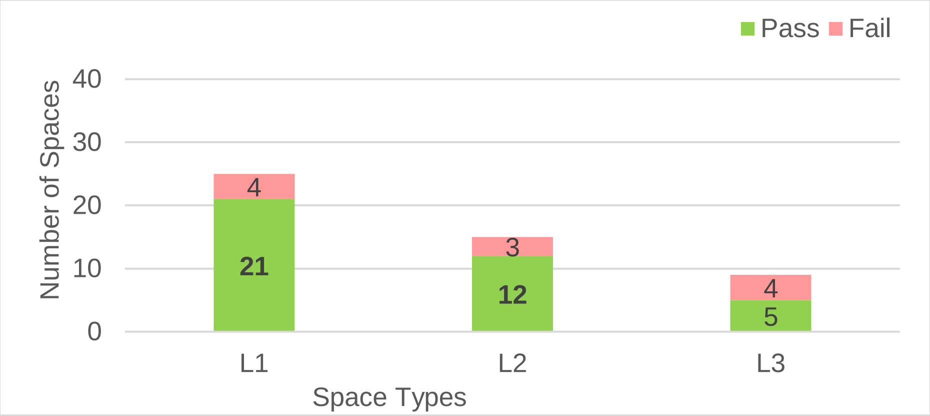
The results from the CBDM concludes the required number of L1, L2 and L3 achieve compliance.

The CBDM model doesn't account for blind usage, however the results within the table, suggest UDI in the south, east and west orientated L1 spaces is not achieved due to over illumination, thus it's proposed blinds are introduced into these spaces to achieve compliance that when blinds are introduced into these spaces for daylight control.

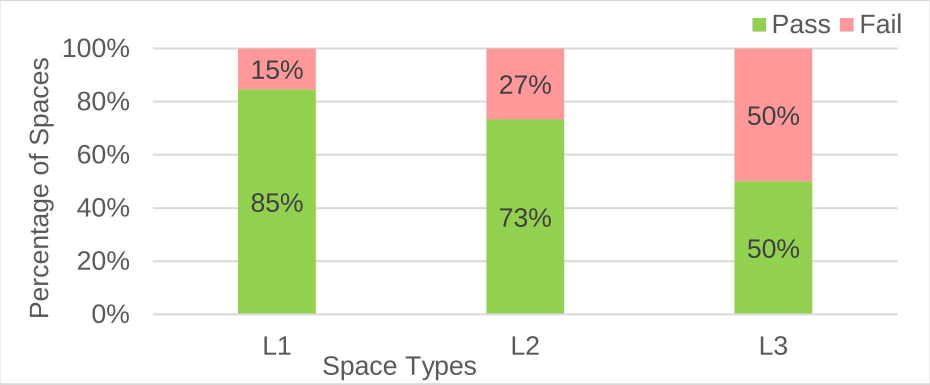
Despite a higher glazing ratio on the north façade, and increased VLT, spaces on the ground and first floor are under illuminated, this is due to the Rostrum building overshadowing these floors as compliance is achieved from north facing spaces on level 2 and 3.

Roof lights are introduced for landlocked rooms on level 3 and are effective at achieving compliance, lightwells are introduced to penetrate light into the main hall, prep rooms and study areas, analysis shows although this introduces light it is not enough to achieve compliance. However, corridors are lit by adjacency to this lightwell, thus achieving L4 compliance. A roof light is proposed to be introduced to the level 3 office to increase daylight and achieve compliance.

The kitchen office has been located on the perimeter; this has resulted with substantial daylight into the space (71.9 sDA300).



4.5.3 – CBDM Results for L1, L2 and L3 spaces



4.5.4 – CBDM Results for L1,L2 and L3 spaces

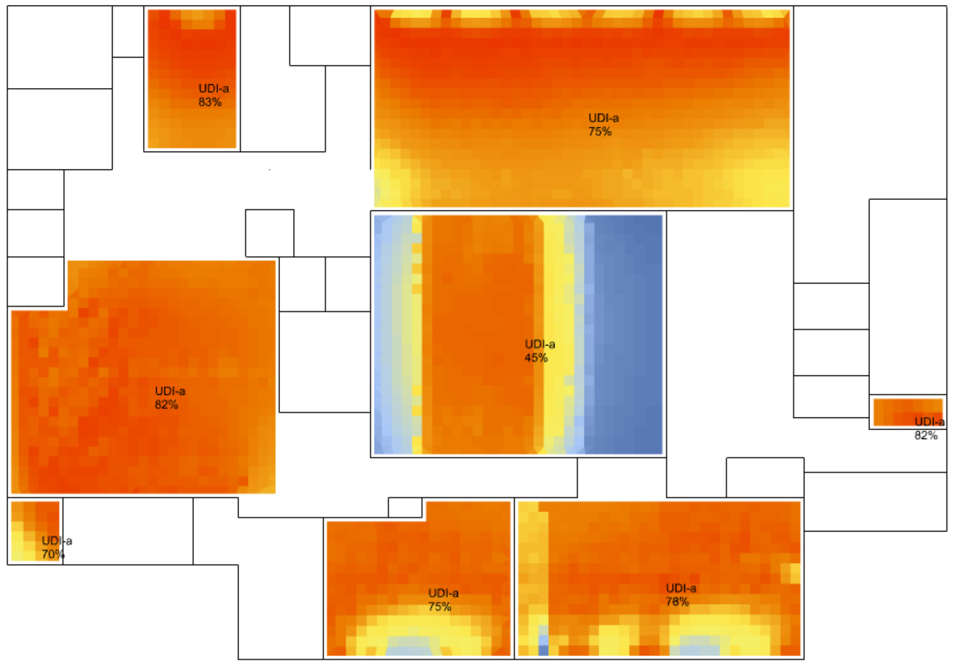
4.5.5 – CBDM Table of Results – L1, L2 & L3

L1 - Space	sDA	UDIa	Pass /Fail
01_General_Classroom_1_1001	46	77	No
01_General_Classroom_2_1002	41	69	No
01_General_Classroom_3_1003	45	70	No
01_General_Classroom_4_1004	63	80	Yes
01_General_Classroom_5_1005	61	80	Yes
01_General_Classroom_6_1006	58	80	Yes
01_General_Classroom_7_1007	75	80	Yes
01_General_Classroom_8_1008	68	80	Yes
02_Science_Prep 1&2_5005&5006	2	6	No
02_Specialist_Lab_8_(Biology)_1108	63	85	Yes
02_Specialist_Laboratory_10_(Biology)_1110	58	82	Yes
02_Specialist_Laboratory_11_(Biology)_1111	66	82	Yes
02_Specialist_Laboratory_12_(Biology)_1112	61	80	Yes
02_Specialist_Laboratory_13_(Biology)_1113	74	80	Yes
02_Specialist_Laboratory_14_(Biology)_1114	73	80	Yes
02_Specialist_Laboratory_15_(Medicinal)_1115	74	80	Yes
02_Specialist_Laboratory_9_(Biology)_1109	58	83	Yes
03_Science_Prep_1_5003	85	80	Yes
03_Specialist_Lab_1_(Chemistry)_1101	65	80	Yes
03_Specialist_Laboratory_2_(Chemistry)_1102	74	80	Yes
03_Specialist_Laboratory_3_(Chemistry)_1103	66	86	Yes
03_Specialist_Laboratory_4_(Chemistry)_1104	67	83	Yes
03_Specialist_Laboratory_5_(Chemistry)_1105	74	83	Yes
03_Specialist_Laboratory_6_(Biology)_1106	73	80	Yes
03_Specialist_Laboratory_7_(Chemistry)_1107	74	80	Yes

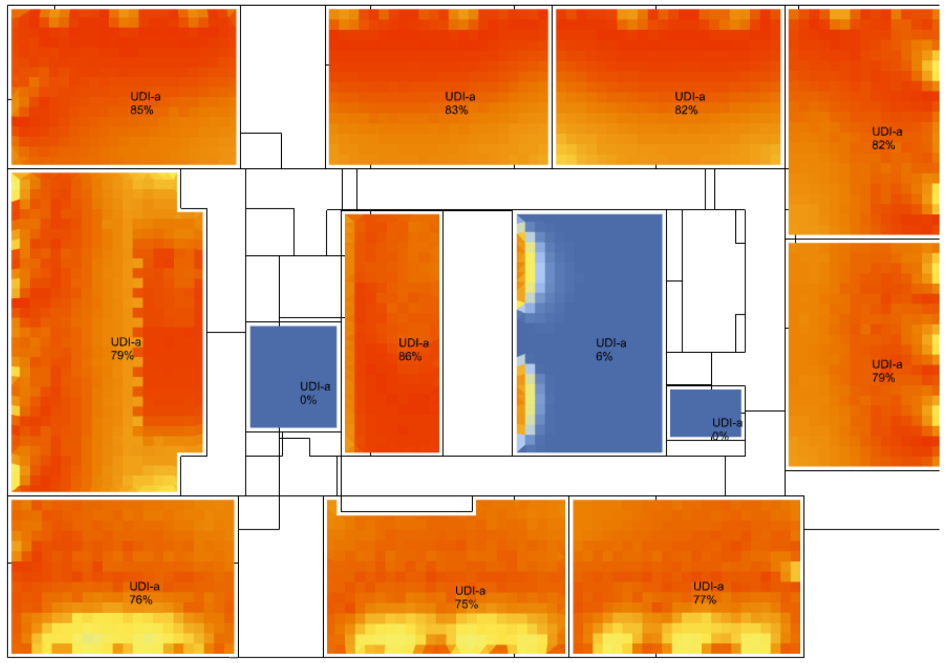
L2 Spaces	UDIa	Pass /Fail
00_Atrium	82.3	Yes
00_Dining_area_1_2002a	75.1	No
00_Main_Hall	45.2	No
00_Social_and_Sandwich_Area_2007	80.0	Yes
00_Study_Area_(Sixth Form)_3001	80.0	Yes
01_Study_Area_Sixth_Form_2_3002	80.0	Yes
02_Social_Space_2_(Sixth_Form)_2004	80.0	Yes
02_Study_Area_1_3003	85.6	Yes
00_Social_and_Sandwich_Area_2007	80.0	Yes
03_Social_Space_3_(Sixthform)_2005	83.0	Yes
03_Study_Area_2_3004	80.0	Yes
0X_Dining_Area_2_2002b	82.2	Yes
0X_Fitness/Excercise_Studio_1_1116	55.1	No
0X_Social_Space_(Sixth Form)_2006	79.0	Yes
M1_Social_Space_Sixth_Form_2003b&c	82.4	Yes

L3 Spaces	UDIa	Pass /Fail
00_kitchen_Office_6002	82.4	Yes
00_Reception_4005	80.0	Yes
00_Repographics_1_4004	83.0	Yes
01_Staff_Wk_Room_(ws)_1_4001	0.0	No
02_office/mtg_2P_1_4007	0.0	No
02_Staff_Wk_Room_(ws)_2_4002	0.0	No
03_Office/Mtg_(1P)_1_4006	80.0	Yes
03_Staff_Wk_Room_(Ws3)_4003	86.1	Yes
01_Office/Meeting_(2P)_2_4008	18.4	No

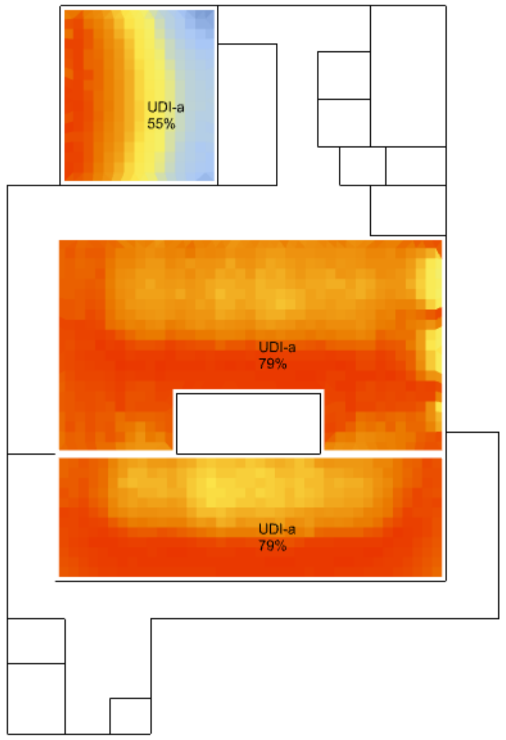
4.5.6 – CBDM Results for East Building Level 0

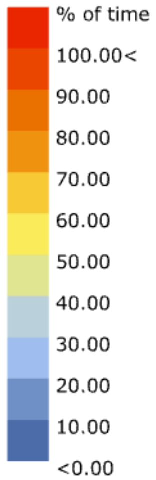


4.5.8 – CBDM Results for East Building Level 2 -

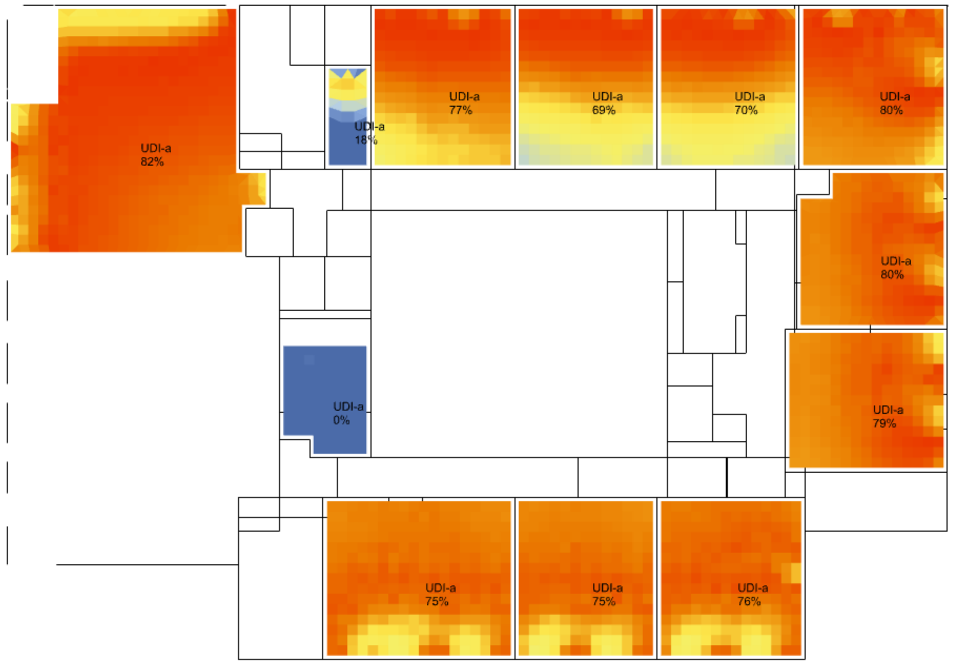


4.5.10 – CBDM Results for Infil Building – Level 0

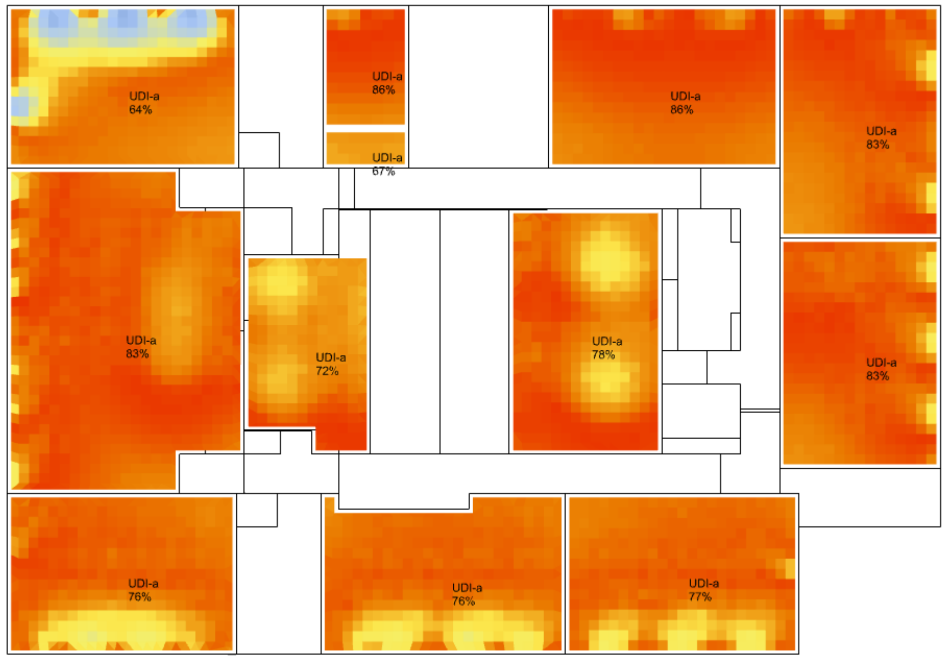




4.5.7 – CBDM Results for East Building Level 1 -



4.5.9 – CBDM Results for East Building Level 3 -



4.6 Energy Strategy Report

This energy strategy report demonstrates that thorough consideration has been given to the energy use of the college.

4.6.A Introduction to the Project

The School-Specific Brief provides the school's strategic brief and stipulates the educational needs, whereas the ESFA OS identifies the funded requirements. Both must be fully considered.

For this introduction, the outline requirements for the project include:

- College age range - 16-19
- Current Published Admission Number (PAN) – 1,255 per year group
- Current Number on Role (NOR) in 2020 – 2,505
- Proposed PAN for Project Brief – 2,450

4.6.B Assessment of local planning requirements

The local planning policy for Greenhead College is relatively generic with no specific energy or sustainability related targets. The closest related policy is Policy LP24 part d. This states:

> **Policy LP24**
>
> **Design**
>
> Good design should be at the core of all proposals in the district and should be considered at the outset of the development process, ensuring that design forms part of pre-application consultation of a proposal. Development briefs, design codes and masterplans should be used to secure high quality, green, accessible, inclusive and safe design, where applicable. Where appropriate and in agreement with the developer schemes will be submitted for design review.
>
> Proposals should promote good design by ensuring:
>
> a. the form, scale, layout and details of all development respects and enhances the character of the townscape, heritage assets and landscape;
> b. they provide a high standard of amenity for future and neighbouring occupiers; including maintaining appropriate distances between buildings and the creation of development-free buffer zones between housing and employment uses incorporating means of screening where necessary;
> c. extensions are subservient to the original building, are in keeping with the existing buildings in terms of scale, materials and details and minimise impact on residential amenity of future and neighbouring occupiers;
> d. high levels of sustainability, to a degree proportionate to the proposal, through:
>
> i. The re-use and adaptation of existing buildings, where practicable;
> ii. design that promotes behavioural change, promoting walkable neighbourhoods and making walking and cycling more attractive;
> iii. considering the use of innovative construction materials and techniques, including reclaimed and recycled materials;
> iv. where practicable, minimising resource use in the building by orientating buildings to utilise passive solar design. This includes encouraging the incorporation of vegetation and tree planting to assist heating and cooling and considering the use of renewable energy;
> v. providing charging points to encourage the use of electric and low emission vehicles;
> vi. incorporating adequate facilities to allow occupiers to separate and store waste for recycling and recovery that are well designed and visually unobtrusive and allows for the convenient collection of waste;
> vii. designing buildings that are resilient and resistant to flood risk, where such buildings are acceptable in accordance with flood risk policies and through incorporation of multi-functional green infrastructure where appropriate;
> viii. designing places that are adaptable and able to respond to change, with consideration given to accommodating services and infrastructure, access to high quality public transport facilities and offer flexibility to meet changing requirements of the resident / user.

All of the above points in part d will be provided.

4.6.C Approach to Optimising Energy Use (Be Lean, Clean & Green)

The design of the proposed development has been developed to meet the NZC in operation target outlined in the project brief.

The energy strategy follows our steps to net zero carbon methodology, which aligned with the industry recognised Energy Hierarchy, as follows:

- Be Lean: energy reduction through passive design measures and energy efficient systems.
- Be Clean: potential to connect to a district heating network or host a combined heat and power unit.
- Be Green: the inclusion of low and zero carbon technologies in the scheme.

As part of the energy strategy an energy assessment has been carried out to benchmark the proposed energy strategy and evaluate its performance against the relevant Policies. The energy strategy will cover passive design elements, energy efficiency measures and low and zero carbon energy delivery systems and how they have been incorporated into the project.

4.6.D Be Lean – Passive and Active considerations

Approximately 30% of the proposed reduction in energy demand for the new build elements of the scheme will be achieved by enhancing the passive building elements. This 'Be Lean' section provides details where we have optimised key elements of our design to reduce energy consumption.

Passive considerations relate to the fabric of the building. The active relate to the services. These include:

- Building orientation
- Air permeability
- Building envelope
- Natural ventilation windows and louvres
- Glazing
- Exposed thermal mass
- Thermal bridges
- Exploiting heat gains
- Reducing heat loss through doors
- Efficient lighting and lighting controls
- Efficient services and services controls

4.6.E Building Orientation

The new college buildings have limited opportunity to be re-orientated on the site when compared to the control option. At the initial stage of the design various locations were considered.

The orientation of the proposed building has main elevations facing almost true north, east, south and west.

To the east and south a high degree of vegetation and mature trees as well as the sloping ground provides good passive design principles. To the west the proximity of the existing main building will also provide a degree of passive shading to the lower two levels of the building.

These features improve comfort through the proposed building orientation.

4.6.F Air Permeability

Education buildings which we have designed for other Schools Building Programme with similar construction techniques have achieved air permeability in the range of ~2 $m^3/h/m^2$.

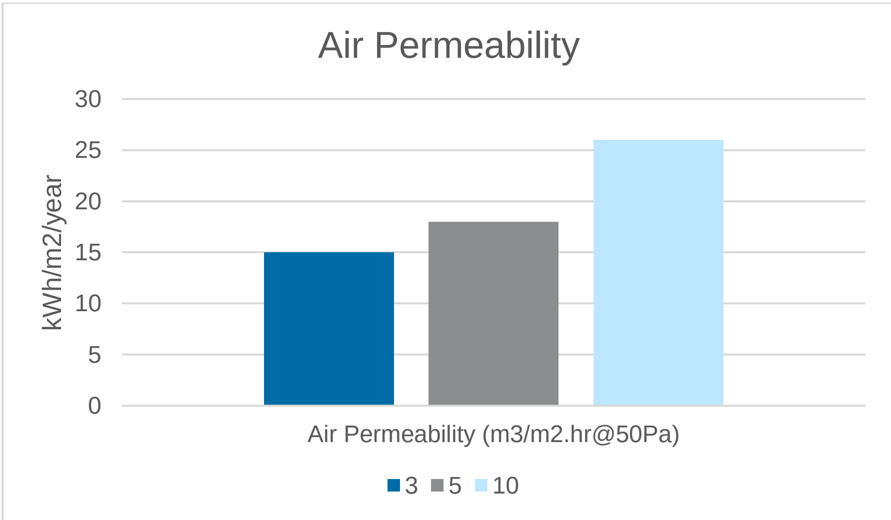
High air leakage rates increase the wastage of heat during the winter months. A high leakage rate tends to mean that the building itself is poorly constructed.

We are confident in achieving a low air permeability value and therefore the heat loss air infiltration parameters will meet the TA Sustainability requirements of 3 $m^3/h/m^2$.

As air leakage accounts for a significant proportion of the overall energy loss, robust detailing of the building fabric and identifying the surfaces within the building that will form the air barrier are key to keeping the building lean.

A more complex building with an awkward envelope will introduce more detailing problems, so designing for air tightness is fundamental to keeping energy usage down.

The best practice figure of 3 $m^3/h/m^2$ at 50 Pascals will be targeted by using approved and tested construction details.



4.6.1 - Comparison of air permeability and impact on heating energy

4.6.G Building Envelope

The thermal insulation levels will be improved significantly beyond the minimum Building Regulation standards, thereby limiting the heat loss though the building's fabric. Both air permeability and the specification for the external walls, roof, and glazing will have an impact. These are provided in accordance with the Sustainability TA as tabled below, apart from glazing which is to be determined and a range is provided:

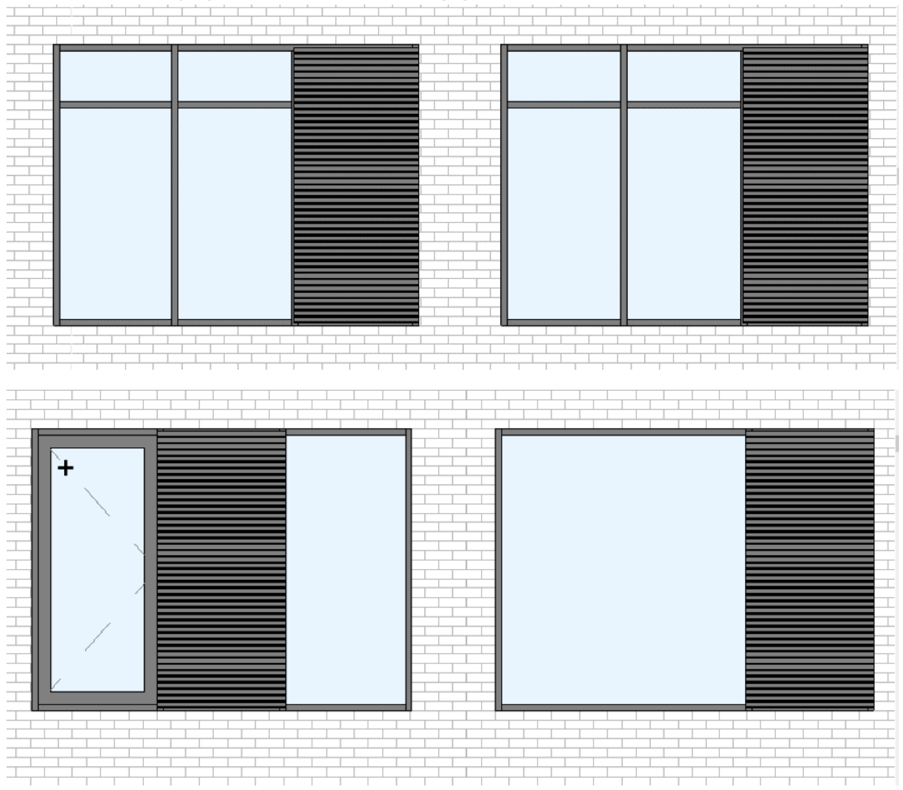
Element	Design	% Improvement over Part L (minimum)
Floor (U-Value)	0.12 W/m²K	52%
External Wall (U-Value)	0.15 W/m²K	57%
Roof (U-Value)	0.12 W/m²K	52%
Windows (U-Value)	1.1 – 1.3 W/m²K	~45%
Glazing solar transmission (G-value)	<40%	-
Rooflights - Glazing solar transmission (G-value)	30%	-
North glazing visible light transmission (VLT)	73%	-
South, east and west glazing visible light transmission (VLT)	69%	-
Air permeability @ 50 Pascals	3 m³/h/m²	70%

4.6.2 - Building Fabric Values

4.6.H Natural Ventilation Windows and Louvres

Most teaching spaces can be ventilated naturally using opaque ventilation louvres. This is in addition to the supplementary, draught free, temperature and carbon dioxide controlled, mechanical ventilation units. The louvres will be integrated with dampers to form part of the façade design. The dampers will regulate air flow as determined by the controls.

In some areas on the North façade there will be a mixture of ventilation via louvres and windows. The windows are inroduced to the North façade in order to maximise daylight whilst maintiaining good venitlation:



4.6.3 - Typical combined louvre and window façade design

Louvered openings are a very efficient way of providing natural ventilation to occupied spaces, offering many benefits over the more traditional method of using openable glazed windows for natural ventilation.

Firstly, fixed windows allow much more daylight into a space providing a much brighter, more pleasant, and visually comfortable environment for occupants. This is because, for a window to be openable, a frame is required for both the structural opening and for the inner sections that open. In contrast, for a fixed window, only a structural frame is required. This means that the frame for our proposal takes up a less percentage area of the overall window design.

In addition, louvres provide an effective free area for air movement into and out of the occupied space without any health and safety risks associated with openable windows.

Typically for schemes which use openable windows, ~130mm restrictors are frequently fitted. These are to prevent people accidentally falling out of the windows or walking into the windows when located at ground level. The external louvre proposal protects a wide-open window offering secure natural ventilation. Furthermore, as the louvres are opaque, they do not give rise to the increased solar gain which is often an issue with glazed windows.

4.6.I Glazing

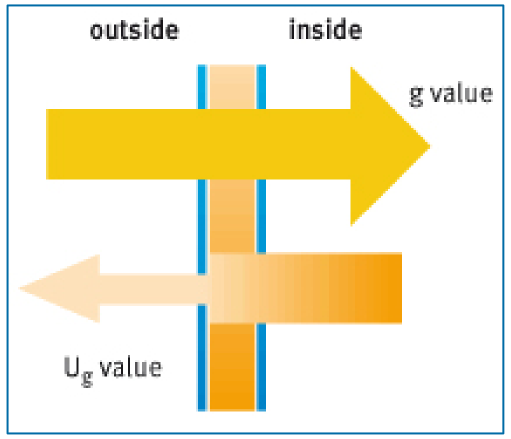
Glazing types have been carefully considered so that an optimum balance is achieved between the daylight and heating benefit of low angle sun during winter, whilst in summer limit solar gains to reduce the risk of overheating.

This has been achieved by utilising low emissivity glass. Typically, the glazing performance will include good visible light transmittance (VLT- value) with a good low solar transmission value (g- value). We are currently proposing VLT values of around 65 - 73% and g-values of ~37% The thermal comfort and daylight sections of this report provide the optimum design criteria used to achieve compliance with the OS and realise the lowest energy consuming solution for the college.

In addition to glazing, internal blinds will help limit the solar penetration into the teaching spaces in summer whilst limiting issues associated with glare.

We have considered the location of the performance glazing to provide it only where necessary. i.e. high-performance glazing is not required to general teaching rooms on the north facing façade of the building. Higher performance glazing is required on the east, south and west facing glazing.

In addition, we are proposing glazing with an argon cavity fill to reduce heat loss during the winter months.



4.6.4 - U-value and g value illustration for optimum performance

4.6.J Exposed thermal mass

The school will be provided with thermal mass as part of the structural design. Thermal comfort will be improved and heating energy consumption reduced by utilising the benefit of the thermal mass within the ceiling void.

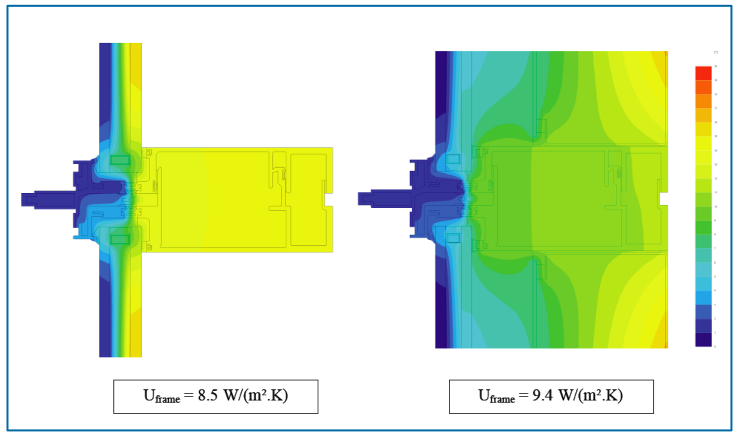
Thermal mass, in conjunction with improved air tightness and a natural ventilation / mixed mode ventilation system, reduces the heating energy requirement over the year. Buildings which utilise thermal mass typically have a slower dynamic thermal response to changes in ambient conditions with the ability to reduce peak temperatures. This is particularly beneficial in periods of warm weather when the exposed mass absorbs internal heat gains during the day and helps to limit the peak temperature.

4.6.K Thermal bridges

A target of 0.04 W/m will be targeted with the detailed design at the next stage.

This is to focus on issues concerning insulation continuity and airtightness and suggest a common approach to design, construction and testing methodology, and general improvements of the process.

By using improved thermal bridging details over and above the building regulations minimum values, typically a 10–20% reduction in heat losses due to thermal bridging is achieved. Through using improved thermal bridging details, we will reduce the overall annual heating demand for the building by approximately 5-10%.



4.6.5 - Thermal bridging calculation

4.6.L Exploiting heat gains

Once the college becomes fully occupied the heat provided by the occupants can be significant. This heat energy is considered low grade energy due to its relative low temperature i.e. low-grade heat cannot be used to heat up cold water for domestic hot water usage. However, in periods of cold weather this heat energy is useful to reduce the heating demand and will be considered when calculating the heating demand for the overall heating system.

The heating system will use electrically driven heat pump. The system design is driven towards a fossil fuel free site. Heat will be distributed around the building by a single set of heating flow and return pipes with variable speed pumping. Downstream heating devices will include for two-port control valves, and zone shut off valves, so that heating is only distributed to the areas of the building that require it.

4.6.M Reducing heat losses through doors

The design for the college will employ various methods to reduce heat losses through doors. These include for the use of lobbies for main access / egress with air curtains and sheltering of main access areas from facing the prevailing wind condition during winter. All main access and egress doors have lobbies including air curtain heaters.

After the building fabric and passive elements have been optimised, the next priority will be to reduce the energy consumption associated with:

- Lighting
- Fans and pumps
- Domestic hot water

4.6.N Efficient Lighting

The selection of efficient luminaries will help reduce overall energy use. A mix of high efficiency LED lighting will be provided. LED lighting efficacies are typically >90 lamp lumens per circuit watt.

All external lighting within the development will be provided by dedicated energy efficient LED fittings. All security light fittings will be designed for energy efficiency and will be adequately controlled such that all burglar security lights have a maximum wattage of 150W, movement detecting control devices (PIR) and daylight sensors.

The use of LED lighting will further contribute to reduce internal heat gains.

4.6.O Lighting Controls

In accordance with the OS spaces such as basic teaching, staffrooms, the learning resource centre and study areas will have daylight dimming control provided. In addition, daylight off control will be provided to corridors, stairs and lobbies with proximity to windows or roof lights.

Automatic lighting controls will be provided to most spaces. Manual on absence off will be provided in teaching areas and office spaces. Presence on, absence off presence detection (PIR) control will be used in toilets and circulation areas. External lighting will be controlled via movement detecting control devices (PIR) and daylight sensors.

4.6.P Building Services Controls

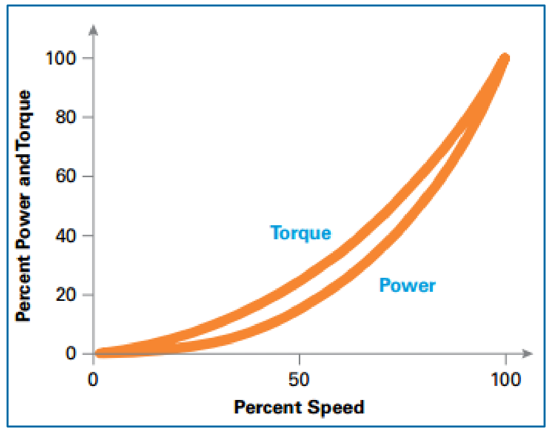
To provide the most efficient plant operation for the season simple but useful local controls will be provided. This will allow the user of building to operate and over-ride the heating, ventilation, and lighting systems as required to reduce energy consumption.

Central plant controls will include for optimum start for heating systems, and for direct weather compensation of heating flow temperature.

4.6.Q Variable speed drives (VSD)

Variable speed drives will be used on fans and pumps across the scheme to help reduce the overall power consumption. By controlling the flow and reducing the speed of the fan or pump, even by a relatively small amount will generate a large reduction in power consumption due to the associated flow/power laws (i.e. The change in power varies in proportion to the change in speed cubed). VSD's also offer other advantages such as:

- Tighter control of air volumes and temperature
- Soft starting can prolong equipment life
- Soft starting also limits electrical currents at start-up, reducing motor heating and enabling more frequent starting, whilst limiting the demand on the mains electrical supply.
- The efficiency of the electrical supply is increased (power factor)
- Greater level of feedback to building management system



4.6.6 - Variable speed drive savings

4.6.R Be Clean

Due to the proposed be lean and clean principles, the building passes the Building Regulations requirements based on Part L 2013 edition incorporating 2016 amendments by 24%

The College has one new building and an infill building, consideration has been given to district heating networks. The Be Clean energy strategy is likely to be relevant to larger schemes with a substantial heat load comprising two or more Buildings. The feasibility of a combined heat and power (CHP) network has been considered. The proposed project is located where no district heating schemes are currently operating in the district, therefore the project cannot connect to an existing district heating scheme. The efficient use of CHP typically depends on finding a use for the heat generated by the process. Issues to consider include:

- If heat is not used, then the system is effectively just an electricity generator and electricity will be greener and cheaper if sourced from the national grid.
- If excess electricity is generated on site this can be exported (sold) back to the grid whereas excess heat needs to be rejected (wasted). Exported electricity can count towards reducing the site's CO_2 emissions.
- Exported electricity will typically not be financially attractive as exports tend to coincide with low demand periods on the national grid so the cost of producing the electricity on site can be less than the prices received for the exported electricity.

The proposed college development is characterised by a low base load heat demand, hence the use of CHP is considered not viable.

4.6.S Be Green

A new solar photovoltaic (PV) array will be provided to the roof of the main building. The 69.3 kWp panel system is sized to meet the required energy figures as previously calculated as part of the NZCiO review.

The design meets Approved Document Part L conservation of fuel and power criterion 1 with the PV allocated to meet the NZC in operation requirements. The local planning policies do not require any carbon or energy proportions to be met by renewable technologies. BREEAM is not an Employer's requirement and it is also not a requirement of local planning.

4.6.T Concept Model Assumptions

The proposed new the school has been designed in accordance with the TA 2H energy benchmarks.

Analysis has been undertaken to prove the relative performance of the proposed school using a concise set of assumptions, to provide an indication of the whether the building can achieve the energy benchmarks for its core operating hours. It is important to note that the analysis was based on several assumptions for the design and operation, not least of which is weather data used to determine the likely annual cooling and heating load. We have carried out this analysis based on the best information available but can offer no guarantee that reported consumptions will be achieved in practice.

The baseline energy model has been developed to predict the energy consumption of the school. We are required to demonstrate that the building can meet the targets as set out in the OS. The operation and usage patterns which have been used within our calculations are confirmed as follows:

- Core hours 07:00-17:00 for school days
- Dining hours 12:00-14:00 for school days
- Main entrance doors assumed to be open for 30mins at the beginning and end of the operational hours and for 30mins during lunch
- Heating hours are 00:00-07:00 at 12°C setback
- Heating hours 07:00-17:00 for school days (Monday-Friday)
- School days are based on a "school" calendar (194 days per year)
- Building occupants typically based on 32 people per classroom inclusive of administration staff.

The baseline model assumes that the occupants will:

- Close ventilation louvres when not required for comfort passive cooling both during lessons as well as breaks.
- Maintain windows and daylight sensors free of obstructions.
- Operate blinds to maximise the use of daylight
- Be aware that light surfaces are required to maintain the surface reflectance values at the levels assumed within the daylight model.

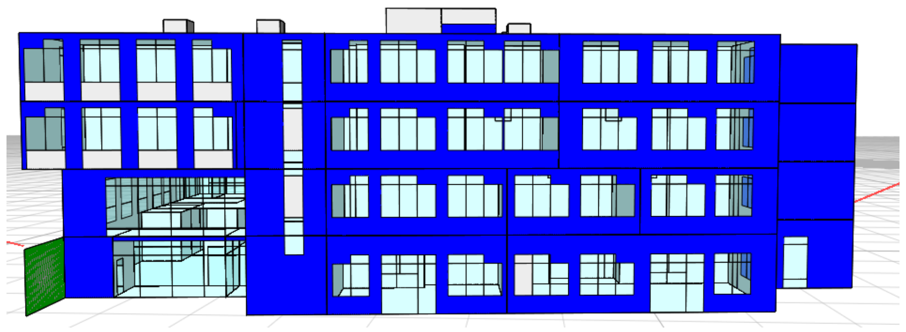
The key assumptions for the design of the systems include:

- Domestic hot water daily consumption – four litres per person (achieved through water efficient showers and wash hand basin fittings)
- Hot water secondary circulation system includes; 100W pump power; 300m loop length and insulation losses 12 W/m.
- Our heating pump sets will be variable speed pumps
- Our internal lighting design includes:
  - General lighting power consumption – 2.14 W/m²/100 lux
  - Auto on/off presence detection (PIR) in toilet areas
  - Manual on/off absence detection (PIR) in classroom, office, and meeting room areas
  - Digitally dimmable photocell lighting controls in all classrooms; office areas and circulation spaces with good daylight.
  - Lighting controls parasitic power consumption <0.01 W/m²

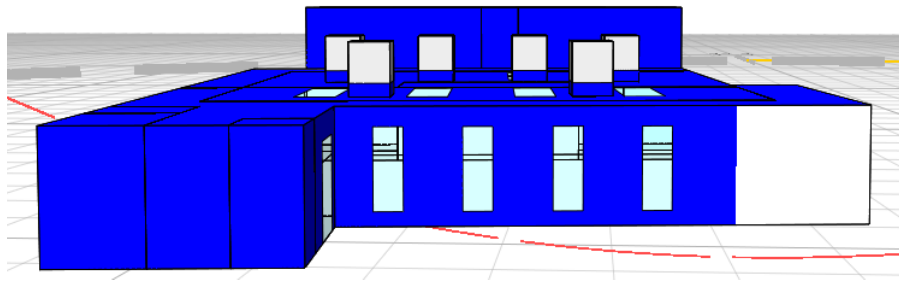
The following table provides further mechanical and electrical engineering services data used in the energy model.

Detail	Value
Heating - Heat pump seasonal efficiency (SCOP)	3.7
DHW – Heat pump seasonal efficiency (SCOP)	2.5
DHW storage volume	2000 litres
DHW storage losses	0.00475 kWh/l.day
Central AHU specific fan power	1.6 W/l/s
AHU heat recovery sensible efficiency	73%
DX cooling SEER	4.0
DX heating SCoP	3.0
Teaching areas lighting efficacy (luminaire lumens per circuit watt)	110
General lighting efficacy **(luminaire lumens per circuit watt)**	110
Parasitic power for lighting controls	0.1 W/m²
All fans and pumps will be variable speed with multiple pressure sensors	
Auto On / Off presence detection (PIR) control in toilets and circulation areas	
Manual On / Auto Off absence detection (PIR) in teaching areas and office spaces	
Daylight dimming with back half or room sensor to all perimeter spaces	

4.6.7 - Efficiency of building services systems



4.6.8 - East Building – IES model (South Façade)



4.6.9 - Infill Building – IES model (South Façade)

4.6.U Concept Model Output Data Tables

An energy assessment has been undertaken, to determine the predicted annual energy consumption of the proposed the school development.

Dynamic analysis was performed on the proposed design to predict the typical annual energy consumption rates of the fixed building services within the building, (i.e. heating, cooling, lighting, etc.). The analysis accounted for the characteristics of each space including the internal gains, type of glazing, openable areas, building fabric details, building orientation and external weather conditions.

The whole building has been modelled using IES Virtual Environment 2017. IES complies with CIBSE AM11 "Building Performance Modelling".

The results of the dynamic analysis have been used to generate predicted thermal loads for the building using hourly external weather data. The loads have then been input into full building energy model, which takes into all aspects of the building's operations, with both regulated and unregulated energy consumption considered.

In order to calculate realistic operational loads, we have prepared a calculation tool that applies real plant efficiencies to the results from the computer model as well as the effects of daylight linking on the artificial lighting load. We have made assumptions regarding the catering etc. and the inputs will need to be reviewed before we provide the final figures.

Please note that modelling has been based on these assumptions / design parameters and that any changes in these will impact on the consumption figures produced by the model. Additionally, the model is based on an external weather file based on historic data and hence any change in climate or variation from the climate norms then the consumption figures will be subject to change.

4.6.V Exclusions

The following items have been excluded from the Technical Annex 2E assessment and will be separately sub-metered:

- Catering facilities (Electricity)
- External lighting
- Server rooms (ICT)

For compliance with the Technical Annex 2J Sustainability the energy associated with the College new building and infill, the following items is considered:

- Catering facilities (Electricity) is for the whole campus
- Electrical Vehicle charging energy use is excluded
- Hot water energy for fitness / changing is for the whole campus

4.6.W Weather File

The weather data used in our modelling uses the appropriate CIBSE/Met Office Hourly Weather Data. Test Reference Years (TRYs) and Design Summer Years (DSYs) are available for 14 locations across the UK. The dynamic weather file used for our analysis is the current CIBSE Test Reference Year for Leeds, as per the recommendation of CIBSE. The Test Reference Year consists of hourly data for twelve typical months, selected from approximately 20-year data sets, and smoothed to provide a composite, but continuous, 1-year sequence of data. They enable the likely energy consumption of buildings to be assessed by simulation under typical weather conditions.

4.6.X ICT Usage

- ICT loading and heat gain under standard operating conditions
- Server Room equipment power consumption: 250 W/m^2 (including all CCTV and LAN services)
- Classroom average power density of 15 W/m^2

4.6.Y Natural Ventilation

For avoidance of overheating, the external façade ventilators / windows are assumed that they begin to open when the internal air temperature exceeds 20.0°C and are fully open when the internal temperature exceeds 24.0°C (Openings to be sized based on the adaptive thermal comfort criteria).

Between 1st May and 30th September, the ventilation units is used for night purge between 20:00 and 06:00, when the internal temperature exceeds 18°C and is greater than the external temperature.

The ventilation solution is also controlled by the CO_2 concentration between 08:30 and 17:00. They begin to operate when internal temperature exceeds 22.0°C and the CO_2 concentration exceeds 750 ppm.

4.6.Z Heating Set Points

As per room data sheets but typically

- Teaching spaces, fitness suite and office – 20ºC
- Circulation – 19ºC
- Toilets – 20ºC

4.6.AA Power Factor Correction

Equipment with poor power factors such as electric motors, and LED lighting can lead to inefficient energy use and higher energy bills. We propose to specify all such fixed building equipment with good power factor correction already built-in, and therefore are aiming for a whole building power factor of 0.95 or better, without needing to provide centralised power factor correction capacitor banks

4.6.BB Results

The results from the analysis are shown, indicating the predicted monthly energy consumption of the proposed the school development. The following table indicates the performance of the proposed school against the Technical Annex 2H: Energy benchmarks. As can be seen the development can achieve the energy benchmarks.

Measurement and verification of energy consumption will be based on computer simulation of whole building use. The initial baseline is the proposed design as defined by the previously given assumptions which is compliant with the OS Energy Input Parameters and Modelling Guide 2017. This indicates that the proposed design can meet the maximum energy consumption targets given in the OS.

4.6.CC Comparison of Energy Targets with End-Use Energy

For the college the OS Technical Annex 2E target is based on a secondary school and our modelled consumption is provided. It is noted that the direct energy saving resulting of PV is not included in the assessment.

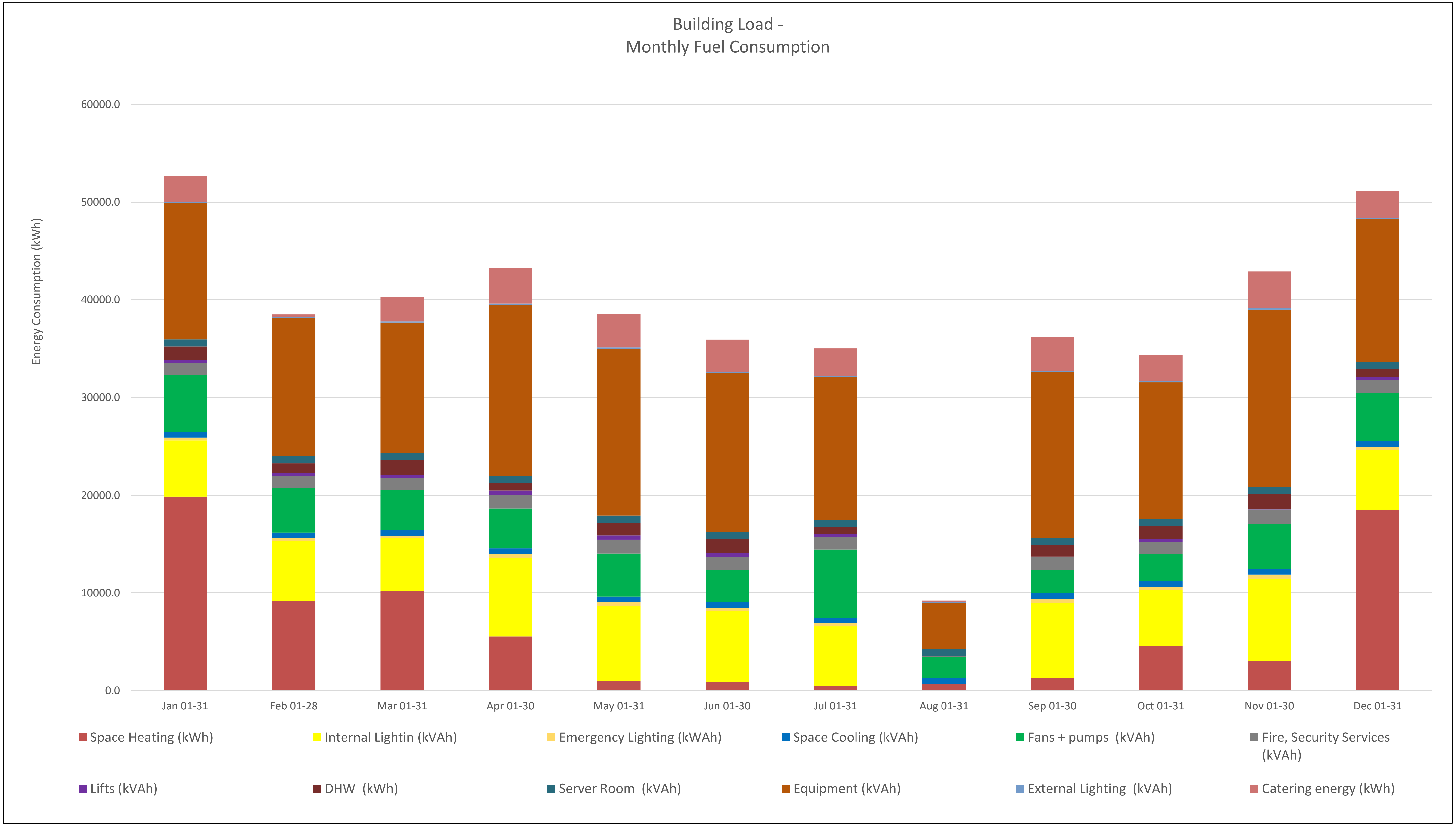
OS targets for both Annex 2E and Annex 2J Sustainability are shown.

The energy assessment is based on the New building and the infill building which has all new services provided:

	Annex 2E (kW$_e$ /m^2/yr GIA)	Annex 2J (kW/m^2/yr GIA)	Our Design (kW/m^2/yr GIA)
Heating	20	15	12.0
Hot Water	4	5	2.1*
Small Power	25	25	28.0
Server Room	-	-	1.4
Internal Lighting	13	8	12.4
External Lighting	-	6	0.2
Fans and Pumps	7	5	8.0
Cooling (Server Room & Fitness Suite)	1	0	1.1
Lifts	1	1	0.5
Building Related Services	4	2	2.3
Catering	Excluded	7	5.0*
Science Gas	-	-	1.0
Total	75	74	74.0
Result			**Pass**

**Catering and hot water is based on proportion of energy for new block based on this element serving the whole campus*

4.6.10 – Comparison of Energy Targets and our Concept Design Model



4.6.11 – Predicted Annual Energy Consumption

4.6.DD Lighting Energy Assessments – LENI

Lighting Energy Numeric Indicator (LENI) calculations have been undertaken for each space.

The LENI relies on a calculation that outputs the kilowatts per hour per metre squared (kWh/m^2). This differs from current UK legislation (Part L) which prefers to calculate efficiency of a lighting system in Lumens per Watt and / or Watts per Metre Square (W/m^2).

The fundamental difference between these methods of calculating the efficiency is that Part L is concerned with how efficient a luminaire is and how much energy the total installation uses, while LENI is concerned with how efficient the entire installation is, inclusive of lighting controls. In order to calculate the LENI number, the following equation is used:

$$LENI = \frac{W}{A}$$

Where:

W = the total energy used for lighting a room or zone in kWh/ year and

A = the total useful floor area of the building in m^2.

W is composed of two components

$$W = W_L + W_P \quad [kWh/year]$$

Where:

WL = the annual lighting energy required to provide illumination so that the building may be used.

WP = the annual parasitic energy required to provide charging energy for emergency lighting systems and standby energy for lighting control systems.

In addition to the LENI calculations, further assumptions have been made regarding the lighting strategy to calculate the annual energy consumption.

- General lighting power consumption – <10 W/m^2
- Auto on/off presence detection (PIR) in toilet areas
- Manual on/off presence detection (PIR) in classroom, office, and meeting room areas
- Digitally dimmable photocell lighting controls in all perimeter classroom and office areas
- Daylight switching of lighting in corridors, lightwells, and stairwells
- The results of the LENI calculations for each space type are given in the following table.

Space type	LENI value ($kWh/a.m^2$)
Typical Classroom	7
Circulation	7
Toilet	7
Social Space	9
Science Lab	11
Meeting Room/Staff Room	7
Office	6
Main Hall	8
Control Room	13
Changing Room	5
Dining	8
Kitchen	14
Store	5
Plant	6
Reprographics	7

4.6.12 – Results for the LENI Assessment

4.6.EE Part L and the Energy Performance Certificate

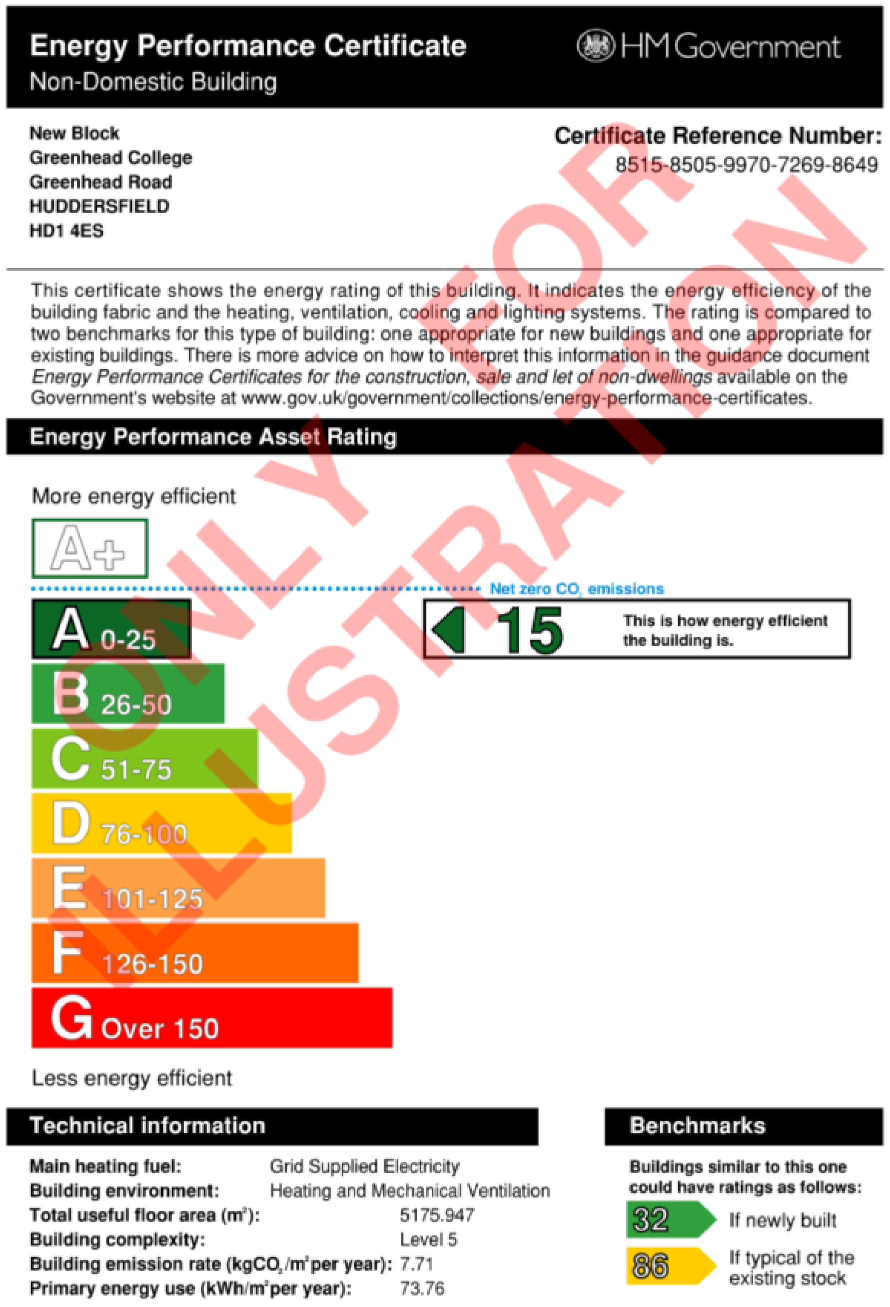
The Building has been modelled for compliance with Criterion 1 (carbon efficiency) of Part L2A 2013. The building currently passes Part L2A Criterion 1 with a 53.2% margin with the proposed photovoltaic provision.

Unfortunately, the simplistic nature of the iSBEM calculation methodology does not fully capture the benefits of a net zero carbon design.

The output results from the Part L model are shown in following table:

System	Part L2A 2013 (incorporating 2016 amendments)	
Heating	1.03	2.03
DHW	3.33	1.77
Cooling	0.17	0.09
Auxiliary	3.33	3.58
Lighting	4.61	9.00
Renewables	-4.76	0.00
Total	**7.71**	**16.48**
Improvement		**53.2%**
Part L Status (BER<TER)		**Pass**

4.6.13 - Results for the Part L Carbon Compliance



4.6.14 – Predicted Energy Performance Certificate

4.6.FF Outline of schedule of automatic meter reading and reporting headline data

The post construction energy use will be determined by using energy simulation model of the baseline, adjusted to suit the actual loads of legacy and new equipment, and the college usage patterns. The model will be calibrated using metered energy use data; this calibrated model will be referred to as the Developed Energy Model and will be used to predict the Target Building Load during Core Energy Hours and the total energy consumption. This will be compared with the actual building loads during core energy hours.

Post commissioning verification, which will be carried out in line with the OS requirements for Building Performance Evaluation Methodology, this will inform any inaccuracies or corrections because of system imbalance. Metered data will be collated and averaged into hourly data to be compatible with the hourly data produced by the simulation program.

The Developed Energy Model will predict the building load and end user loads. The Building Load on which the volume risk will be shared during Core Energy Hours comprises:

- Space heating – based on normal maintained air temperatures given in the OS. Less adjustments.
- Internal and emergency lighting - This energy end use will be separately metered. Hours of use will be adjusted for actual hours of use.
- Building related services - includes protection systems, fire alarms, sprinkler systems and intruder alarms, lifts major ventilation plant including, boiler plant and pumps and any air conditioning loads.
- The end user loads for which, in accordance with Technical Annex 2E, the college takes 100% volume risk are:
  - External sports and flood lighting – This energy end use will be separately metered.
  - External lighting security and amenity
  - Hot water consumption; domestic hot water
  - Catering electricity and water consumption
- Server and hub room loads including all ICT equipment but excluding internal lighting and heating, ventilation, and any air conditioning equipment.
- Miscellaneous power loads, in particular the electrical energy associated with small power loads in the social and study spaces are to be closely monitored to identify significant usage of energy by students charging their personal devices.

The end user loads for which, in accordance with Technical Annex 2J Sustainability also need to be considered. Therefore, in addition to the above the following sub-meters will be provided:

- Gas supply to the science labs
- Energy generation from the new photo-voltaic panels
- Energy used by electrical vehicle charging points

4.6.GG Allowable adjustments

The Developed Energy Model will be adjusted to consider any changes to the buildings, plant, equipment, weather, and hours of use. This will include:

- Lighting energy consumption due to operation of blinds
- Legacy ICT equipment
- Changes to design set points requested by the college
- Changes to equipment loads
- Additional operational days or changes to the length of the college day.

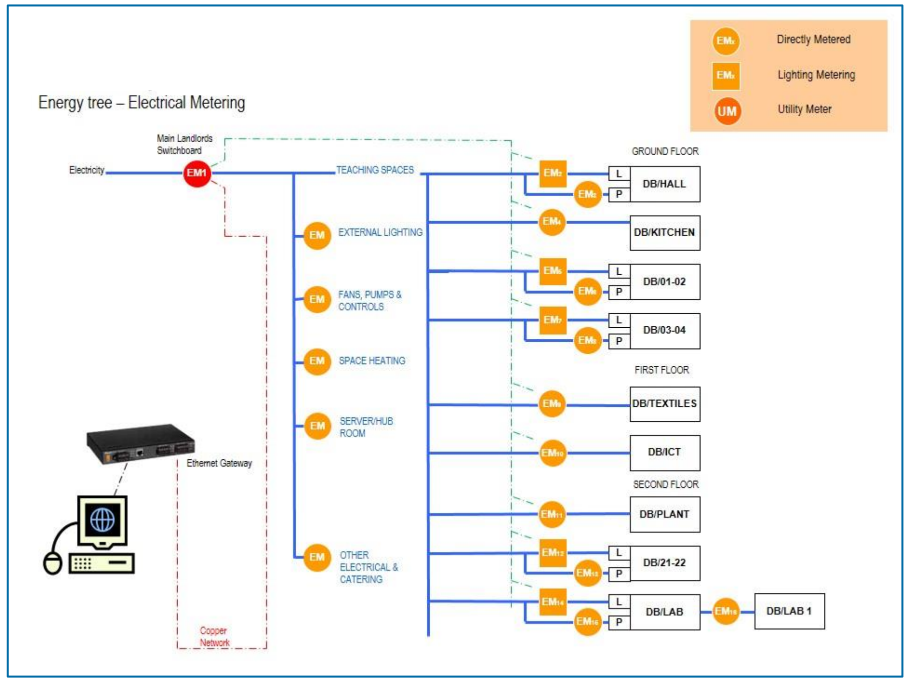
4.6.HH Verification plan

In order to record and benchmark the energy consumption, the BMS itself will provide this function via the frontend user interface. Data will either be stored on site on a suitable drive or utilise off-site cloud storage. The energy consumption will be identified in terms of gas and electricity as well as the individual end uses. This information will benchmark the college against other schools and colleges. This may identify areas where energy is being wasted and identify where savings might be made.

4.6.II Monitoring the targets

The metering schematic is provided on the relevant schematic drawings. The Building Energy Management System (BEMS), will include Automatic Meter Reading (AMR) software, in combination with the meters will distinguish energy consumption for the core and non-core hours. The BEMS will provide regular reports (at least monthly) for consumption. Initially manual checks will be carried out to ensure reports are accurate.

4.6.JJ Outline Meter and loads Schematic



4.7.14 - Detail of Typical Energy metering strategy tree

The utilities and energy metering is identified on the various services schematics within sections 4.3 and 4.5. We have highlighted notional loads for gas in Figure 4.6.10, and the estimated diversified electrical loads in figure 4.6.11. These will all be fine-tuned during the detailed design, along with the CIBSE TM54 energy assessment required for the Technical Annex 2J Sustainability. An initial total load has been calculated.

4.6.KK Incoming Services

The following sub-sections describes the site services and utilities strategies.

4.6.KK.i Gas service

The existing gas service to the college is to be extended to serve the new building science laboratory gas supplies only. As such, the existing supplies are assumed to be of adequate capacity.

There is no gas requirement to the proposed Courtyard Infill block.

4.6.KK.ii Water Service

A new incoming water supply will be provided to the new teaching block, from the external Yorkshire Water mains in Park Avenue. The new metered supply will enter the site at the corner of Greenhead Road and Park Avenue and will enter the new building in the Ground Floor Plantroom.

The existing water supply within the Main Building will be altered and extended to serve the proposed Courtyard Infill block, with a sub-meter to serve the new building.

4.6.KK.iii Electrical services Proposed New Incoming Supply

The existing College site is currently supplied from the DNO network substation “Greenhead College S.S” located to the north of the site and preliminary load estimates indicate that a supply capacity of approximately 650kVA is required to support the redevelopment.

It is anticipated the existing substation will need to be upgraded to support the proposed redevelopment, however this is still to be confirmed by Northern Power Grid.

4.6.KK.iv Electrical services Existing substation

A new 1000A MCCB Switchboard to replace the existing switchgear will be installed within the existing sub-station (client side) to facilitate the new connection to the new teaching block, a new connection to the courtyard infill block and existing retained supplies (see schematic drawings).

New MCCBs will be installed in the new switchboard and will supply low voltage (LV) via buried underground ducts, to the 630A main LV switchboard located in the ground floor electrical switchroom of the new teaching block and 630A main LV switchboard located in the ground floor electrical switchroom of the Courtyard infill

The new switchboards supply power internally via electrical cables and containment systems to all small power and fixed equipment, as described in section 4.5. Via buried underground ducts, the main LV switchboard within the courtyard infill supplies power to the proposed external feeder pillar.

4.6.KK.v Services Diversions/lowering’s

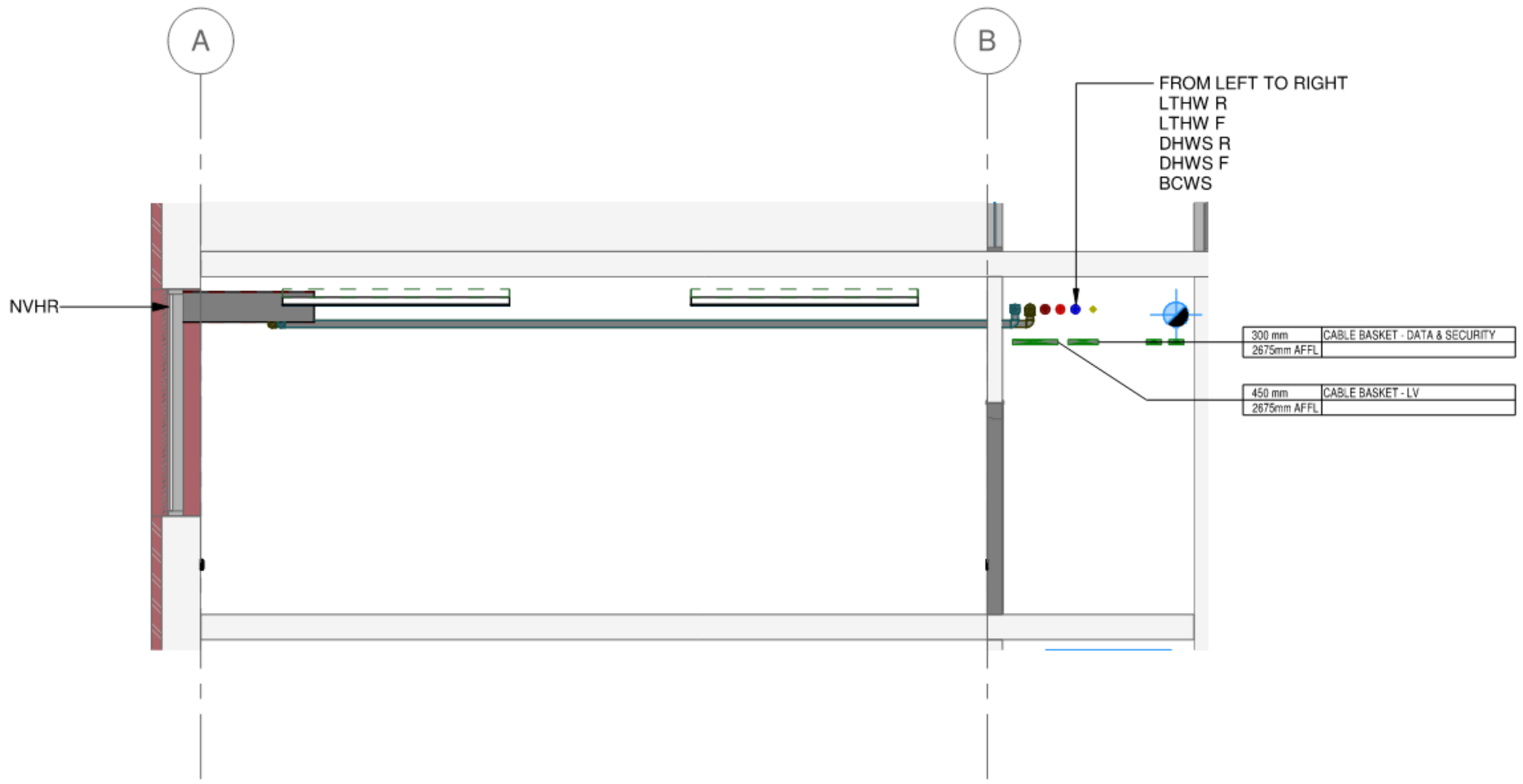
Existing electricity services are present in the carpark to the front of the existing building and to the site of the existing MUGA and external Changing Block which will require removal.

Yorkshire Water drawings also indicate a water service crossing the existing car park and running below the Rostron Building. The drawing is annotated with a note questioning whether this service remains live.

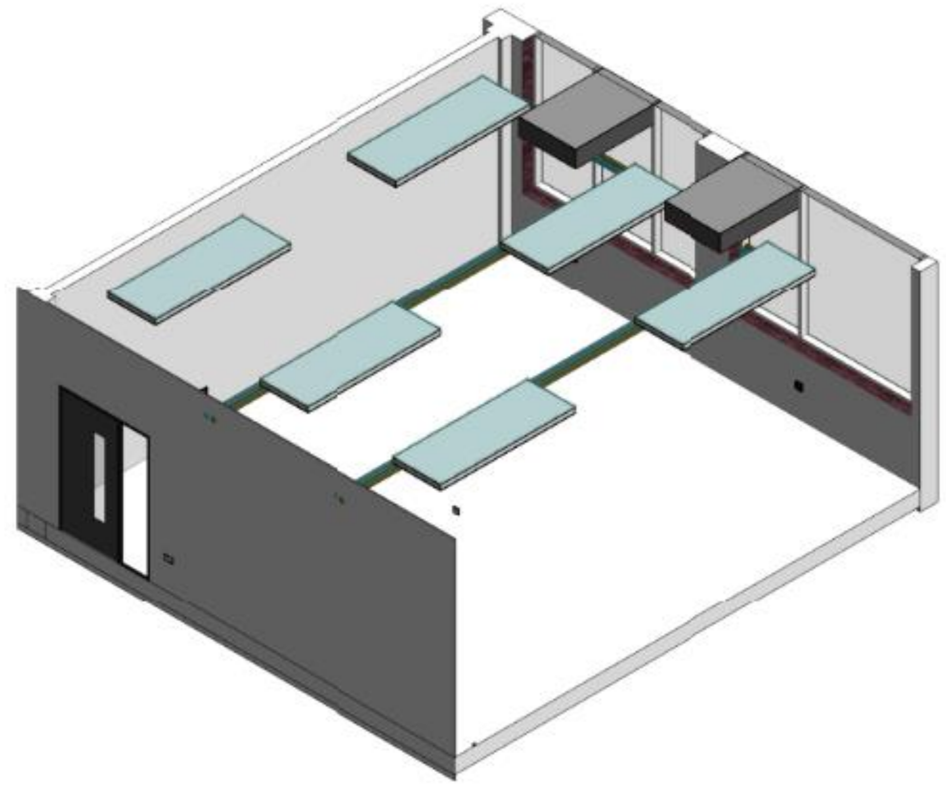
Enquiries have been made with the respective utility services to ascertain the extent of works that may be required, and their responses are awaited. Please refer the existing strategy drawings for information.

4.7 Multiservice Cross section

The following section drawing summarises the key environmental strategies employed for the proposed building.



3 TYPICAL CLASSROOM SECTION
1 : 50



2 TYPICAL CLASSROOM 3D

4.8 Zoning Strategy Drawings - 1:200

Our zoning strategy drawings for heating, cooling and ventilation services are provided to support the descriptions in this section. They are broken down into floor by floor drawings for specific services. They should all be read in conjunction with the following descriptive text sections relevant for each service, with the preceding sections on mechanical and electrical controls systems. The following sections 4.8A and 4.9 also provide details for proposed drainage and domestic water services:

4.8.A Public Health – Above ground drainage

A soil and waste system will collect the discharge from sanitary appliances and waste water producing equipment throughout the building and route it to the below ground foul water drainage system.

The system will be based on single stack principles wherever possible. All soil stacks to rise above roof level to safely vent to atmosphere.

Access points will be provided on all vertical soil stacks at each floor level and in horizontal runs at changes of direction for maintenance of the system. In Science Prep Rooms, dilution traps will be provided to laboratory sinks, and chemical resistant pipework (e.g. Vulcathene) will be used for both branch waste and vertical stacks.

All waste to kitchens and servery's to be provided with connections within 1m of final appliances for connection by catering specialist sub-contractor.

Where discharge stacks pass through classrooms, these will be acoustically insulated to prevent any noise breakout.

Biological dosing systems such as the "grease guzzler" will be provided within the main kitchen. The proposed external foul water system will discharge into the existing on-site drain runs, see separate civil engineering drawings of this installation.

4.8.B Public Health – Domestic hot and cold water services

Refer to section 4.9 for descriptions and drawings

4.8.C Gas services

The incoming gas service will be extended from the existing building, will enter the new Teaching Block at the Ground Floor Plantroom, and will include for a gas cock, gas sub-meter, and gas solenoid valve, linked to local gas safety systems and interlocked with the building fire alarm system.

Each science lab and prep room shall be provided with local gas proving systems, safety knock off EPO's, and interlocks to any necessary ventilation systems. These interlocks will also shut off electrical supplies (to student sockets only) within each teaching space.

The gas mains will be distributed internally, through the ceiling voids with risers to first and second floor labs. The gas sub-meters shall be MBUS type and will be linked back to the BMS to enable the total gas usage of the new building to be measured.

All internal gas pipework routes and ceiling voids will be suitably ventilated by natural means.

All rooms served with natural gas will be designed with suitable and appropriately sized natural ventilation and/or interlocked mechanical ventilation systems in place to suit the connected kW load.

4.8.D Heating services

New Main Teaching Block

Low temperature hot water will be centrally generated using high efficiency air-source heat pumps (ASHP's) located on the roof of the new Teaching Block. The ASHP's will be set to generate LTHW at up to 50°C, but will be variable temperature, direct acting weather compensated, with flow and return temperature set-points modulated depending upon external air temperature.

Separate ASHP's, also located on the roof, generating LTHW at a higher temperature of 65°C will be provided to serve the Domestic Hot Water generator.

The entire heating plant installation will be complete with all necessary ancillary devices, including, safety valves, pressure gauges, temperature gauges, dosing pot, pressurisation unit and pumps.

The heating system will be split into distinct circuits for ease of control and zoning, and where necessary, heating circuits will be further sub-zoned as required to meet the overall proposed metering and zoning strategy for the scheme:

The ASHP heating system will generally provide low temperature hot water to serve variable temperature heating systems serving zoned fan convectors, radiator circuits, pipe-coils, air-coils, and door curtains.

Teaching spaces, offices, staff rooms, group rooms, etc, are provided with hybrid ventilation units with integral heater batteries, also providing warm air heating to the space. Circulation spaces, stairs, and corridors will be heated by radiators.

LTHW underfloor heating will be provided to the Ground Floor, double height Social Space within the New Teaching Block, and to the Dining/Social Space in the Courtyard Infill Block. Other larger and open plan spaces will be predominantly heated by the use of warm air heating from the central ventilation system, supplemented by radiators or fan convectors where appropriate.

Store rooms, where required to be heated, would be by high level exposed pipe coils. All ground main entrance or exit external doors will be provided with LTHW over-door air curtains.

LTHW pipework distribution from the plantroom will be by via a single riser serving all floors and with ceiling void distribution at each floor to all heat emitters and air handling systems.

Where required, LST radiators will be provided in any SEN room or accessible WC's, and all pipework serving such radiators will be insulated and boxed in.

Warm air curtains will be provided to the main entrance and student area entrance doors. These will be provided with manufacturers proprietary switch for fan speed and heat output control located behind the main reception desk and student reception desk. The reception desks will be provided with an electric kick space heater with local user control. Other circulation spaces, and corridor entry / exit doors will be provided with ceiling void recessed fan convector heaters.

Heating energy to the new main kitchen and its AHU will be separately heat metered and reported onto the BMS.

Courtyard Infill Block

Low temperature hot water will be centrally generated using high efficiency air-source heat pumps (ASHP's) located on the roof of the new Courtyard Infill Block. The ASHP's will be set to generate LTHW at up to 50°C, but will be variable temperature, direct acting weather compensated, with flow and return temperature set-points modulated depending upon external air temperature.

Separate ASHP's, also located on the roof, generating LTHW at a higher temperature of 65°C will be provided to serve the Domestic Hot Water generator serving the Changing Areas and WC's.

The entire heating plant installation will be complete with all necessary ancillary devices, including, safety valves, pressure gauges, temperature gauges, dosing pot, pressurisation unit and pumps.

LTHW underfloor heating will be provided to the Dining/Social Space.

The Changing Rooms will be heated via the MVHR ventilation units, which will incorporate LTHW heating coils.

WC's and circulation spaces will be provided with radiators

The Fitness Suite will be heated and cooled via a local refrigerant heat-pump unit.

Pipework insulation shall generally be foil faced mineral wool and applied to all concealed pipework, all external pipework, pipework in voids, plantrooms, and risers, and all high level (exposed or concealed) pipework above 2400mm AFFL. Pipework in plantrooms will be provided with a stucco aluminium protective finish. External pipework shall be finished in waterproof black PIB. Where pipework thermal insulation is required it shall be of a type which avoids the use of substances with an ozone depleting potential (ODP) in either manufacture or composition, and it shall be of a type that avoids the use of substances with a global warming potential (GWP) of 5 or more in either manufacture or composition.

4.8.E Ventilation services

Refer also to section 4.2

Natural/Mixed mode ventilation will be used where possible to provide a comfortable internal environment. This is achieved by a combination of opening windows, façade ventilators, cross ventilation to corner rooms and lower floor open plan spaces. Perimeter classrooms with single sided ventilation combine the façade ventilators and the hybrid HVR Zero ventilation units. Night purge will be provided to Teaching spaces, utilising exposed structure as thermal mass.

Internally located occupied rooms, and spaces where natural ventilation is impractical, and large/shared use spaces are to be provided with mechanical ventilation served from a central supply and extract AHU, incorporating heat recovery, located in the Ground Floor AHU plantroom.

Such spaces are to include for, but not limited to, the following rooms:

- Main Hall
- Dining hall
- Large open plan social study areas
- Fitness suite
- Changing rooms

The air handling plant and ductwork systems will generally be zoned by the use of CAV or VAV boxes, to each mechanically ventilated space to allow for individual control and zoning.

Smaller areas including the Fitness Room and Changing areas will be provided with mechanical supply and extract ventilation via local MVHR units.

All MVHR and air-handling units (excluding kitchen) will incorporate heat recovery devices (minimum efficiency as EcoDesign Directive). Air handling unit fans will incorporate inverter driven speed controls for energy efficiency.

Supply and extract ductwork will generally be carried out in galvanised steel with either conventional steel/aluminium terminal supply devices. Ductwork shall be insulated to appropriate thickness as follows:

- All fresh air ductwork within internal treated spaces.
- External ductwork where treated (with weatherproof insulation finish)
- Internal ductwork where heated or cooled (with vapour sealing)

Where ductwork thermal insulation is required it shall be of a type which avoids the use of substance with an ozone depleting potential (ODP) in either manufacture or composition.

Where ductwork thermal insulation is required it shall be of a type that avoids the use of substance with a global warming potential (GWP) of 5 or more in either manufacture or composition.

Duct mounted silencers and cross talk attenuators will be provided as required to meet the acoustic design requirements.

Fire dampers (fusible link type) will be provided in ductwork as required to meet the fire compartment strategy for the college. Refer also to the fire engineering reports and drawings.

4.8.E.i Toilet Ventilation

Toilets, showers, cleaners' rooms, and medical rooms are to be provided with mechanical extract ventilation.

The Ground Floor WC's in the Main Teaching Block will be provided with void mounted MVHR units, providing supply and extract ventilation incorporating heat recovery.

The WC's to the upper levels within the Main Teaching Block will be provided with supply and extract ventilation from the central AHU. Individual WC's will be provided with extract only, with make-up air from adjacent circulation space, and grouped WC's of more than 2 cubicles will be provided also with mechanical make up supply air.

The Changing rooms and WC's within the Courtyard Infill Block will be provided with void mounted MVHR units, providing supply and extract ventilation incorporating heat recovery.

4.8.E.ii Kitchen Extract Ventilation

Dedicated supply and extract ventilation will be provided to the Kitchen from a Supply AHU and Kitchen extract fan located externally at roof level. The system will serve a central Kitchen canopy, provided by the specialist catering contractor.

The main kitchen extract canopy will be designed to accommodate the planned catering equipment located in the central island and will incorporate grease filters.

The design for the main extract canopy is based upon an air handling type canopy with supply air induction terminals which are designed to entrain and trap dirty air over the cooking island and thus reduce overall supply and extract ventilation rates. The supply air to the hood is to be 80% of the extract air volume flow rate. The remaining make up air will be transferred across the servery from the dining room ventilation system.

The extract ductwork will be routed through the building to a single extract fan located externally at roof level, which will discharge the kitchen exhaust air at roof level, taking into account prevailing wind direction and relative locations of air intakes to minimise the risk of entraining exhaust air back into the building.

Kitchen extract ductwork within the building will be 2-hour fire rated where routed outside of the kitchen within the building.

Extract ventilation will also be provided to the Dishwash area.

Tempered make up air will be supplied into the kitchen via the canopy as previously described. Back of house kitchen areas such as the chef's office, food store, and staff changing areas will be provided with appropriate supply and extract ventilation derived from the main kitchen AHU plant. Air volumes will be reduced outside of 'cooking' and main dining time period, or turned off altogether, with the dining room during these times, then relying upon natural ventilation. A retractive push button switch will be provided to switch between boost and normal ventilation speeds, which will automatically set back to normal speed after a 1-hour period (adjustable).

Where ductwork thermal insulation is required it shall be of a type which avoids the use of substances with an ozone depleting potential (ODP) in either manufacture or composition, and it shall be of a type that avoids the use of substances with a global warming potential (GWP) of 5 or more in either manufacture or composition.

4.8.E.iii Fume Cupboard Ventilation

Exhaust from the fixed fume cupboards in the Science Prep Rooms and the semi mobile fume cupboards to the Science Laboratories will be provided. Separate extract ducts from each fume cupboard will be routed to a centrifugal fan located at roof level. Semi-mobile fume cupboards will have flexible ductwork final connections to allow for sufficient movement and will be provided with full services umbilicals and docking stations.

4.8.E.iv Chemical Store Extract Ventilation

Local extract ventilation will be provided to the Chemical Store and will include extract grilles at both high and low level within the store. The extract ventilation will be ducted to an extract fan at roof level. Rooms with gas services and associated extract ventilation (science labs) will have their extract fan operation interlocked with associated gas proving systems to each such room.

4.8.E.v Passive (Natural) Ventilation with ventilation unit assistance (mixed mode)

All general teaching spaces around the building perimeter are provided with mixed mode ventilation systems as previously described, with the ventilation units sized to meet minimum ventilation requirements in winter to maintain CO_2 targets.

Some spaces such as science labs, and science prep rooms all require higher ventilation rates to be achieved at times when practical activities and Bunsen burner use occurs. In such cases the make-up fresh air rate is very high and the minimum ventilation rates will be set higher as required.

Each room will be automatically controlled via a wall mounted controller using a combined wall mounted temperature / CO2 sensor located in each room and the BMS external temperature sensor to determine the operation of the system. A local override switch will also be provided to enable occupant control of the unit. The override control will comprise retractive push button switches and LED indicator for 'auto', 'off', and 'boost' operation, and which will reset automatically to auto after a pre-determined period (BMS adjustable typically 1 hour) or at the end of the occupied period. A traffic light style indicator will be employed to alert the user as to when windows should be opened. All controls will be linked to the BMS for central monitoring and adjustment of time-clock periods.

4.8.E.vi Passive (Natural) Ventilation with full mechanical ventilation assistance (mixed mode)

The Dining spaces, Main hall, and large social study spaces will all have opening high level windows and/or louvres and/or roof lights for natural ventilation. The current proposals for each space are as follows, but these are subject to change:

- Main Hall; high-level louvres opened automatically. Operates in conjunction with mechanical supply and extract air system. During very hot weather, or when the user has not reacted to high internal temperatures or CO_2 levels, the mechanical ventilation system will operate to ensure thermal comfort and to control CO_2 levels.

- Social spaces level 02 and level 03; mix of high and façade ventilator units, with high level louvres. Operates in conjunction with local mechanical ventilation units. During very hot weather, or when the user has not reacted to high internal temperatures or CO_2 levels, the mechanical ventilation system will operate to ensure thermal comfort and to control CO_2 levels.

The mechanical ventilation systems in each space will be automatically controlled via a wall mounted controller using a combined wall mounted temperature / CO_2 sensor located in each room and the BMS external temperature sensor to determine the operation of the system. A local override switch will also be provided to enable occupant control of the ventilation system. The override control will comprise retractive push button switches and LED indicator for 'auto', 'off, and 'boost' operation, and which will reset automatically to auto after a pre-determined period (BMS adjustable typically 1 hour) or at the end of the occupied period. A traffic light style indicator will be employed to alert the user as to when windows should be opened. All controls will be linked to the BMS for central monitoring and adjustment of time-clock periods.

Where ductwork thermal insulation is required it will be of a type which avoids the use of substances with an ozone depleting potential (ODP) in either manufacture or composition, and it will be of a type that avoids the use of substances with a global warming potential (GWP) of 5 or more in either manufacture or composition.

4.8.F Comfort cooling

Split air conditioning units will be provided in the IT server rooms and Fitness Suite for summertime cooling (the primary means of cooling to the server room is a ducted ventilation system from the main AHU and a dedicated extract fan with temperature led demand control). The systems will use refrigerants with low ozone depletion capacity (e.g., R134a, R404a or R407c). All external condensing units will be roof mounted.

4.8.G Sprinkler Systems

A sprinkler system is to be provided to the meet DfE requirements. The sprinkler tank and associate equipment is to be located externally. Sprinkler specification to be confirmed by specialist.

4.8.H Dry Risers

Dry Risers will be provided to each of the two Fire Fighting access stairs, which will include an externally mounted inlet breaching at Ground Floor level, and a landing valve outlet at each floor level, including ground floor.

4.8.I Smoke Ventilation

Smoke ventilation will be provided to each of the two Fire Fighting access stair lobbies. The smoke ventilation to each lobby will be via a $3m^2$ natural ventilation stack, with roof mounted ventilator, and Fire Brigade control point at the ground floor entrance to each staircase. The ventilation to the staircases will be provided by an AOV at the top of each staircase.

4.8.J Electrical Distribution

Refer to section 4.5 for descriptions and drawings

4.8.K Small Power Installations

The installations will be designed & installed in accordance with the recommendations of The 18th Edition of the IEE Wiring regulations (BS 7671).

Sockets outlets and miscellaneous small power accessories will be installed at locations throughout the School, for IT equipment, fixed equipment and general use.

Socket outlets will be provided throughout the College for cleaning purposes and other portable appliances.

In toilets and changing rooms provide suitable fused spur power supplies for hand driers including the hand driers (1no. hand drier per four WC's in communal WC's and 1No. hand drier in all single use rooms).

In laboratories, socket outlets will be mounted in perimeter dado trunking.

Socket outlets are to be generally provided as follows:

- All 13A socket outlets in general are to be protected by RCBOs within the local distribution board, generally 30mA trip. Exceptions are sockets serving essential equipment and services e.g. to fridges/freezers, or powering wireless data systems, or for the IT rack. In laboratories and food tech enhanced RCBO performance is to be provided by use of lower rated (10mA) tripping protection.
- In all areas the number of full specification PCs on a circuit will be limited, to minimise nuisance tripping. No more than 8 PCs will be served per circuit. Circuits will be sourced from the local distribution board. In ICT rich areas separate dedicated distribution boards will be provided.

Supervisory control of socket outlets:

- For safety, socket outlets and power supplies accessible to pupils in classrooms containing machinery, cooking equipment, or other sources of danger (technology workshops/classrooms, science laboratories/classrooms, food technology classrooms) will be supplied from emergency power off (EPO) systems, contactor controlling power supplies to the room emanating from the local distribution board, and where provided, combined with the classrooms gas proving panel and isolation system.
- All power outlets to the teaching wall/desk in any such rooms will be on a separate power circuit not so linked to the room EPO system.
- Any such rooms containing equipment that is to be permanently supplied, i.e. fridges/freezers will be on a separate power circuit not so linked to the room EPO system.

The mounting heights of socket outlets, switches and controls will be to accessibility requirements. All above bench mounted sockets will be coordinated with tiling, and be a minimum 150mm to bottom above any upstands.

All supplies to kitchens and servery's to be provided with power supplies/fused-spurs/isolators within 1m of final appliance for final connection by catering specialist sub-contractor.

Fixed equipment refers to all equipment supplied under this contract including lifts, cashless catering equipment, fire alarm, Intruder alarm, specialist equipment and mechanical plant.

Small power will be provided to support all items of electrical fixed equipment, both internally and externally.

4.8.L Fire Alarm

Refer to section 4.5 for descriptions and drawings.

4.8.M Security systems

Refer to section 4.5 for descriptions and drawings.

4.8.N Lighting

Refer to section 4.5 for descriptions and drawings.

4.8.O Lifts

The main building will be serviced by an 8 person 1,000 kg capacity, motor-room less lift to comply with Building Regulations Part M and EN-83. Speed 1.0 m/second or similar.

Car specification finishes include laminate to sides and rear walls, half height mirror, handrail, vinyl floor. The lift car will be illuminated by low energy lighting. We have allowed for key operation to prevent misuse. Lift landing and car doors will be brushed stainless steel side doors in brushed stainless steel frames.

4.9 Hot and Cold-Water Strategy

The schematic and layout drawings should be read in conjunction with the following descriptions, and along with the descriptions of incoming water services given in the preceding section 4.6

A new incoming water supply will be provided to serve the new main Teaching Block, and will enter the building in the ground floor plantroom.

The existing water supply in the Main Building will be altered and extended to serve the Courtyard Infill Block.

At the incomer positions there will be located a stop cock, drain cock, strainer, BMS temperature sensor, BMS sub-meter, and adjustable pressure reducing valve. Onwards pipework distribution is as shown on the supporting drawings, and as described below.

Water storage will be provided centrally in the new Teaching Block, the storage tank being located in a dedicated tank room at Ground Floor level. The tank is to be sized on the basis of 5 litre/pupil. A packaged water booster pump set shall be provided within the tank room to serve the new buildings' hot and cold water requirements.

All water services will be installed to meet the requirements of HSE ACoP and Guidance L8 on control of legionella, and Technical guidance doc ref HSG 274.

The laboratories, including supplies to fume cupboards, will be provided with a separate lab cold water service fed from a break tank and booster set (to fluid Category 5 and to comply with Water Authority regulations), both installed in the Ground Floor water tank plant room. The lab tank system shall include Kemper automatic flushing valves to maintain system temperatures during periods of low water demand. This Cat 5 system shall also serve a hose union bib tap external to the Kitchen, and a hose union bib tap on the roof for the cleaning of PV's.

Water services will be distributed to water outlets via insulated pipework. Pipework shall be concealed where practicable.

All WC cisterns will be a dual flush/low flush type. All taps to WHB's will be time controlled low water usage taps to minimise water consumption and wastage. Low flow inserts will be used. All showers will have flow restrictors to 8l/min. Ranges of showers to changing rooms will have a common thermostatic mixer valve per cubicle with mechanical timed push button flow controls, and vandal resistant shower rose. Single showers in disabled and staff changing areas generally to be domestic type with thermostatic mixing /flow control valve with sliding rail, flexible hose and shower head.

Leak detection systems will be provided to indicate potential flooding caused by water leakage outside of normal occupied hours. This will comprise of BMS alarm and audible alarm being generated if water meter usage is detected outside of normal occupancy, and if there are differential cold-water flow rates through water meters connected to the BMS.

Domestic Hot water will be generated centrally and locally to serve any lab sinks that require hot water.

Centrally, DHW will be generated by a packaged plate heat exchanger and buffer vessel arrangement, served with LTHW from the DHWS air source heat pumps.

Pumped hot water secondary return circuits will be installed, to minimise dead legs. A single circulating pump shall be fitted into the return main within the plant rooms (a standby pump shall be provided and located locally).

Separate systems will be provided within the new main Teaching Block and the Courtyard Infill building.

Ranges of showers to changing rooms will have a common thermostatic mixer valve per cubicle with mechanical timed push button flow controls, and vandal resistant shower rose. All pipework generally concealed. Single showers in disabled and staff changing areas generally to be surface mounted thermostatic mixing /flow control valve with sliding rail, flexible hose and shower head.

All other hot water requirements will be met by local point of use non-storage direct electric hot water heaters. These will be a hot-wire type heaters with outlet temperatures physically fixed to below 38°C. At this flow temperature onward blending valves are not required as scald protection is integral to the heater. All taps in student, staff and visitor toilets will be time controlled low water usage taps to minimise water consumption and wastage.

All supplies to kitchens and servery's to be provided with valved off connections within 1m of final appliance for connection by the catering specialist sub-contractor.

Pipework insulation shall generally be foil faced mineral wool and applied to all concealed pipework, all external pipework, pipework in voids, plantrooms, risers; and all high level (exposed or concealed) pipework above 2400mm AFFL. Pipework in plantrooms will be provided with a stucco aluminium protective finish below 2000mm AFFL. Thermal insulation shall be of a type which avoids the use of substances with an ozone depleting potential (ODP) in either manufacture or composition, and will avoid the use of substances with a global warming potential (GWP) of 5 or more in either manufacture or composition.

Domestic hot and cold-water use to the main Kitchen will be separately sub-metered on the BMS.

Wholesome supply of fresh palatable drinking water will be provided around the school internally to serve outlets within dining areas and fitness suite.

Internal water drinking points will be provided and located in-line with the school specific brief and are positioned to be easily accessible by all students at all times. The points will be clearly and correctly marked as drinking water. They will all be mains fed units with integrated chilling. The location of the units will be determined to avoid misuse.

4.10 Sustainability

Refer to previous sections for the building services strategies. Also please refer to the building services drawings and schematics.

Section 4.2 provided the results for the thermal comfort strategies for the new college building and infill block in relation to compliance with the future weather files.

Section 4.6 provided the results for the energy assessment for the new college building and infill block building in relation to compliance with the 74kWh/m^2 per year energy use intensity target.

4.10.A Net Zero Carbon in Operation (NZCiO)

To meet the NZCiO target has been assessed based on the DfE clarification for the carbon emission to be based on:

- BEiS 2050 emission factor in the Treasury Guide of 0.027 $kgCO_2$/kWh.
- The energy demand target of 74kWh/m^2 must be met before the application of renewable technology
- Off-site renewable technology will not be accepted.
- Offset payment schemes will not be accepted

Therefore, to meet the compliance criteria above for the NZCiO, we proposed the following, noting that at the next stage a CIBSE TM54 assessment will be carried out of the proposed systems and fabric based on detailed design development:

- Total New Build Area ~6,300m^2
- 74kWh/m^2 = 466,200 kWh per year energy consumption
- Using the 2050 emission factor = 12,600$kgCO_2$ per annum
- Using BEIS 2020 greenhouse gas reporting updated 17th July 2020 current day emission 0.23314 $kgCO_2e$/kWh the kWh required is 54,050kWh

It is proposed that this 54,050 kWh per annum renewable energy generation will be met with the new photovoltaic system.

The new building roof will be provided with a Bauder Bio solar PV. We note that further solar panels may be provided by the college later.

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ONE PLANET LIVING
An initiative by Bioregional