Energy Report

52-53 Old Stein, Brighton

The Engineering Workshop LLP

31st January 2024

general@theengineeringworkshop.com

Document: 2307-TEW-ZZ-RP-ME-Energy Report-S0-P03

Executive Summary

This is an existing listed building with areas of special heritage important. Due to the heritage requirements, there is a limit to the possible refurbishment and improvement that can be carried out. This report details the areas that can feasibly be carried out to achieve the council requirements.

From this report, the recommendation for the building includes the following:

- Thermal improvements.
- Lighting and controls improvements.
- VRV heat pumps for heating.
- VRV heat pumps for hot water.
- Roof mounted photovoltaic system.
- Future district heating connection possibility.

Implementing these measures will provide a reduction in carbon emissions, **with a calculated reduction of over 19%** compared to the existing building.

The reduction in carbon emissions provides an annual saving of 10,427kgC02.

The draft Energy Performance Certificate for the improved building provides a “C” rating.

This report shows compliance with the BRIGHTON AND HOVE CITY COUNCIL Development Plan item DM44.

Contents

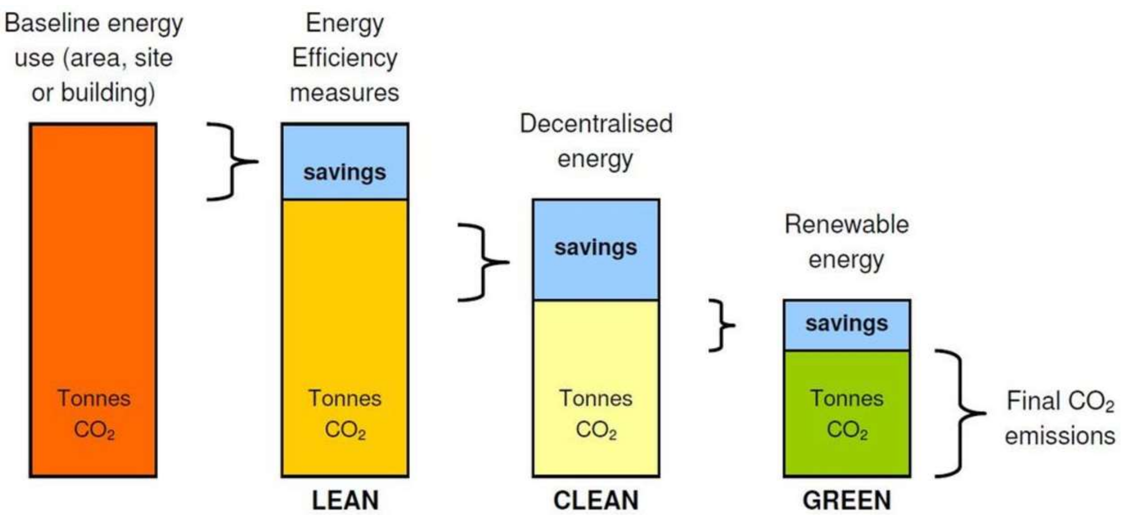
1.0 General

The Energy Feasibility Report has been prepared to support the proposals for the refurbishment of the existing building at 52-53 Old Stein, Brighton. The building encompasses the front buildings on the Old Stein elevation, as well as extended upper floors over the existing buildings to the rear with the rear elevation on the upper floors overlooking East Street.

The building is currently used as office facilities and is to be converted to provide student accommodation.

This report has been carried out by Nathan Williams CEng MCIBSE BENG(Hons) of THE ENGINEERING WORKSHOP LLP. Nathan is certified by CIBSE CERTIFICATION for energy assessment and the production of Energy Performance Certificates for buildings of Level 3, 4 and 5 including simulation. Nathan has over 30 years' experience in the industry and is a suitably qualified energy specialist. Nathans CV and relevant certificates are included in ***Appendix A****. Nathan is not connected with any low or zero carbon manufacturer or technology supplier.*

The approach taken during the consideration for this development is as depicted in the below graph.



The overall principles are:

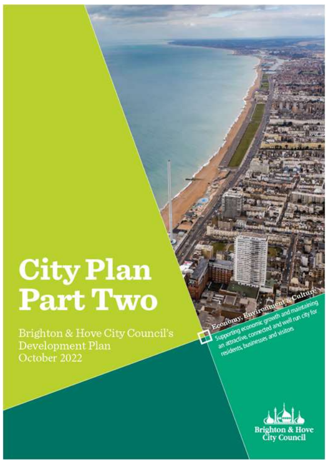
- **lean** – *initially focusing on passive methods, to reduce projected energy including improved thermal performance through improved U-values, reduced air leakage and optimization of useful solar gains through adjusting building orientation. Consideration to reduce building services energy consumption through the implementation of energy equipment such as low energy lighting, low loss hot water storage vessels, adaptive heating and hot water controls, and heat recovery ventilation systems.*

- **clean** – *an assessment of the viability and effectiveness of combined heat and power unit (CHP)*
- **green** – *feasibility into and effectiveness of various different renewable energy technologies including Solar thermal panels, Photovoltaic Panels Small Scale, Wind Turbines Ground Source Heat Pumps and Air Source Heat Pumps*

This report will consider the following:

- Passive design analysis
- Low carbon technology feasibility study

The report will follow the guidelines from the BRIGHTON AND HOVE CITY COUNCILS Development plan dated October 2022.



Extracts from DM44 Energy Efficiency and Renewables state:

2. **Non-residential development (major and non-major[105]) including conversions and changes of use to achieve at least 19% improvement on the carbon emission targets set by Part L (2013) until the Future Buildings Standards or any interim uplift in Part L which exceeds 19% improvement come into effect.**
3. **A minimum energy Performance Certificate EPC rating 'C' for conversions and changes of use of existing buildings to residential and non-residential use[106].**

Where it can be demonstrated that the minimum CO2 reduction targets cannot be met on-site, mitigation measures may be sought in accordance with City Plan Part 1 Policy CP7 Infrastructure and Developer Contributions.

All major residential and non-residential development will be expected to submit an energy statement to provide details of the building fabric efficiency and low and zero carbon energy technologies used including the size/capacity of the systems and the estimated CO2 savings that will be achieved.

The guidelines go on to say that the carbon emission factors for SAP10.1 or current should be used.

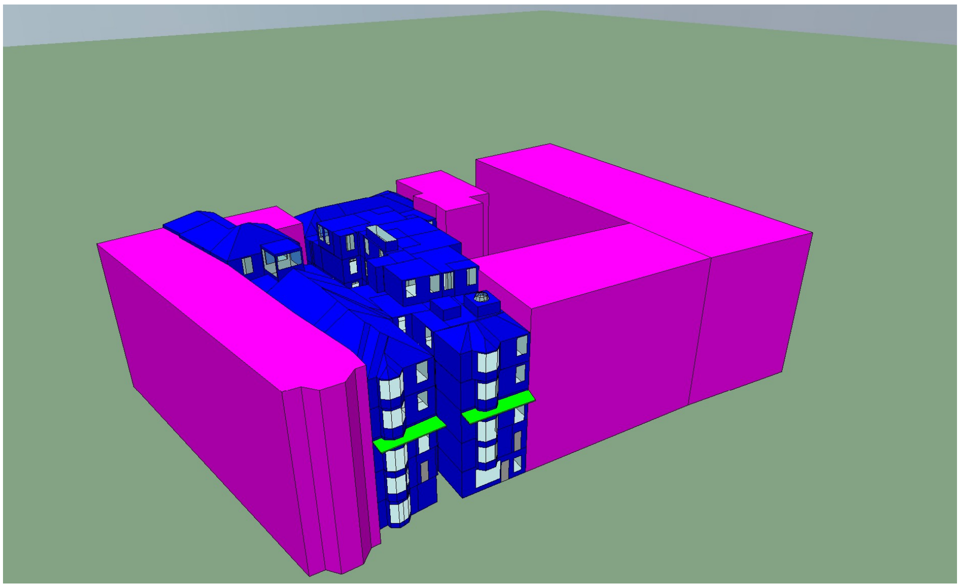
As there has been a major Part L update (PARTL 2021) which includes the updated SAP10 carbon emission factors – then this will be used for the calculation within this energy report.

2.0 The project

The project consists of the conversion of the existing building with a small new storey added to one side of the existing rear elevation.

The building has been modelled using IES-VE 2012 and in accordance with the Chartered Institute of Building Services Engineers (CIBSE) AM11 "*Building Performance Modelling*" requirements. The IES-VE software is Government approved software for the production of SBEM/EPC (*https://www.gov.uk/government/publications/department-for-communities-and-local-government-approved-software-for-the-production-of-non-domestic-energy-performance-certificates-epc*).

The image below is taken from the software model.



The thermal model has been set up using the standard SBEM profiles for a student accommodation building to provide the energy demand for the regulatory items – heating/cooling, ventilation, lighting, hot water.

It should be noted that the building is a grade 2 listed and as such, there is limited opportunity for improving the existing building.

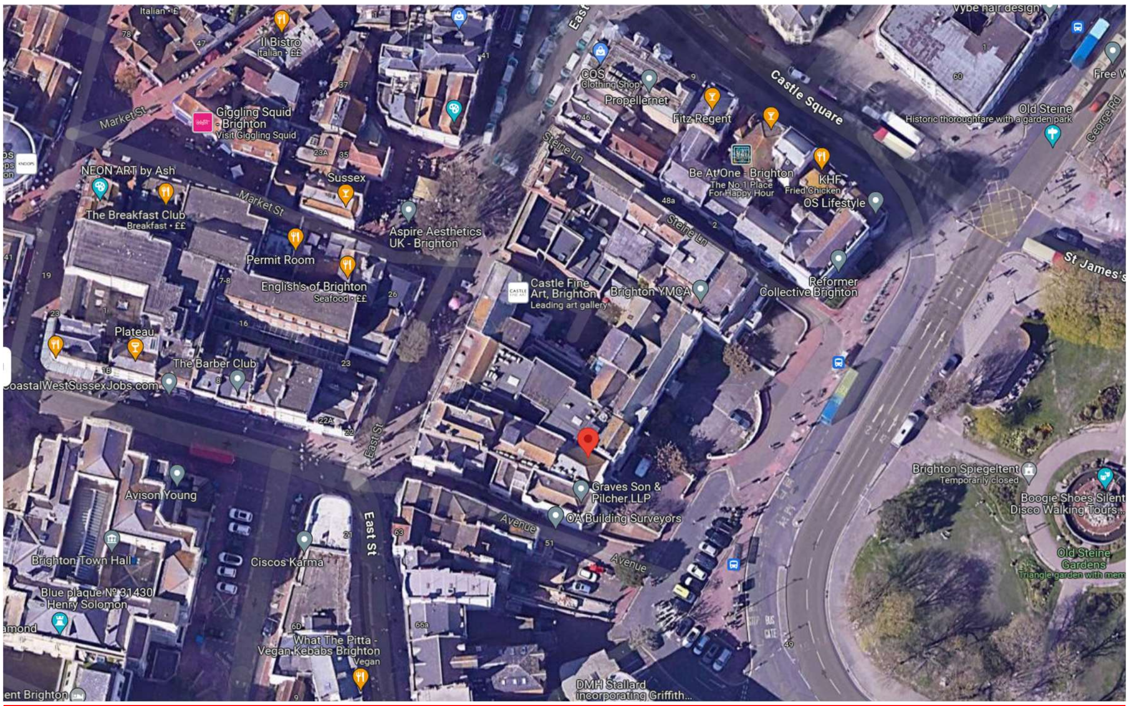
The current building energy strategy is:

- Improve thermal performance where feasible.
- New Lighting and control improvements.
- New VRV heat pumps.
- New VRV hot water generation.
- Roof mounted photovoltaics.

3.0 Passive design analysis

The Passive design section deals with the **LEAN** consideration of the development. This is the good design of the building prior to the application of technology.

<u>Site location</u>



The site development is within Brighton City center and is a dense urban location. Brighton is a coastal town on the South coast of England, the sea being less than 1mile directly south from the site.

This is an existing building with the only new build element a small additional storey on the third floor on one of the sides of the building – refer to the architects' drawings.

The building is grade 2 listed with the main areas of important heritage interest being the front section overlooking the Old Stein. The adjoining building, Marlborough House at 54 Old Stein is a Grade 1 listed building. The building sits within a conservation area.

Site weather

Brighton is located in the South coast of England.

The site weather will be typical for the South coast which will generally be milder in both winter and summer then then the rest of the UK. The prevailing wind will be southwesterly.

Microclimate

The local buildings are generally medium rise, 3 or 4 floor commercial and residential buildings and located tight around the site, with the front elevation open to the Old Stein square which is open to the sea. The building will be greatly influenced by the surrounding urban landscape – there will be solar shading to the lower floors, and wind tunneling effect.

There are inner courtyards in the space between buildings, with a small courtyard between 52-53 in the rear, and also to the side of 53 to the rear courtyard for Marlborough House. These provide a source of daylighting and ventilation through side windows to the rear of the building.

Building Design

The building is orientated on an east-west axis with the main elevations facing east and west. The long elevations are south-north facing although these elevations are mainly adjoining local buildings.

There are existing canopies to the listed elevation on Old Stein which remain. As an existing listed building, there is limited scope to modify the existing building perimeter or to add in additional solar shading.

There is potential to add in internal shading through the use of curtains/blinds for the student bedrooms. For solar control - typically light coloured roller blinds under manual control with a shading coefficient of 0.5 – this provide glare control, solar shading and maintain privacy when required.

The rooms are laid out in a functional arrangement with a central circulation space down each zone with rooms on either side. Room depths are generally 4-5.5m with window heights at 2.3--2.7m – within the [*Width<2xHeight]* rule of thumb for single side, single opening ventilation (refer to CIBSE AM10 2.4.1). As an existing building there is no scope to increase window sizes or openings. Due to the low occupancy in the rooms (1 person typically), the windows will provide sufficient fresh air naturally.

The building is existing and is listed. This provides additional restrictions on what scope there is for improving the thermal performance of the building. *Refer to section below for more information*.

The building is of medium weight with some thermal mass from the brickwork, but with an amount of timber framing. Internal heat gains will be low – this is not a high-density office space – and will be diverse across a time period.

Building Occupancy type

The building is being converted to student accommodation. There will be some staff facilities on site with a number of staff being present during the day. For the students, the building will be occupied 24hours a day during the educational period.

During the summer period when the students typically return home, the building will predominantly be empty although there is the possibility of using some of the rooms as short term lets during this period.

The staff will be responsible for operating the building services during the day and for responding to any breakdowns. As such, the staff will be authorized or trained in the operation of the systems as necessary. Student control would be limited to local temperature controls.

Daylighting strategy

As an existing building with no scope to increase window openings, the level of daylighting into the building will be as the current situation.

In practice, there is limited scope for daylighting linked lighting control systems. Student bedrooms would be manually switched as required by the student. Ensuites are typically internal and would be controlled on presence sensors.

Circulation spaces, the large common room on the third floor, and the Quiet Room on the third floor, are the only areas which would be able to benefit from daylight dimming control of lighting and this should be encouraged during the design process.

The lighting control will need to take into account the 24hour operation of the building.

Ventilation Strategy

The building will be naturally ventilated through the use of manually opening windows to maintain CO_2 levels. Mechanical extract ventilation will be limited to welfare facilities – ensuites, cooking areas, laundry.

6.0 Building Energy demands

Energy use by the building during its life is a key producer of carbon emissions and therefore the reduction in energy is important to provide a sustainable development. For this building, the key energy consumers that the building design can influence are the HEATING demands, HOT WATER generation and LIGHTING.

Lighting

Lighting is a mixture of LED and fluorescent lights typical for an office environment. This is used in the base line calculation along with manual switching (as existing).

The proposal is to use 100% LED fittings throughout. Manual switching will remain in the studios, however the ensuites and other areas can benefit from presence detection for automatic on-off control. As discussed above, daylight dimming control can also be provided to a limited number of areas.

Hot water

The existing hot water is a very low demand as the building was operating as offices. Hot water was provided locally by local electric water heaters. This is used in the base line calculation.

The hot water energy generation will be one of the largest changes in the energy demand to the building due to the change from office to student accommodation – primarily due to the increased number of sanitaryware being installed. The hot water demand for residential accommodation is greater than for an office area. The proposal is to use the heat pumps to generate hot water within centrally located cylinders.

Heating

The HEATING demand is determined by the thermal performance of the building and this is a continuation of the **LEAN** consideration in the section above.

As an existing building, there is limited scope for improving the existing building envelope compared to a new build. In addition, as the building is listed with sections of heritage importance, any proposals must be sympathetic to the existing details. The existing building is made up of a number of different constructions where the building has been adapted and modified over the years and this has been reviewed with various levels of improvement available.

The following table shows the current construction build-ups, the Building Regulation value for a new or “improved” element, and the proposed improvement.

Element	Building Regulations W/m2.K	Assumed existing value W/m2K	Proposed improvement W/m2K	Comment
Existing Solid walls (lower floors Old Stein)	0.55W/m2K	1.70W/m2K	n/a	*Listed, no improvement feasible*
Existing brick front with timber frame (Old Stein)	0.55W/m2K	1.8W/m2K	0.90W/m2K	*Listed, limited improvement with internal lining*
Existing tile front with timber frame (East Street and Old Stein)	0.55W/m2K	2.27W.m2K	0.98W/m2K	*Some part of listed, limited improvement with internal lining*
Existing brick cavity wall (rear building section)	0.55W/m2K	1.42W/m2K	0.66W/m2K	*Internal insulated lining*
New brick external wall to new storey (rear building section)	0.26W/m2K		0.18W/m2K#	*New build*
Existing ground contact floor (Old Stein only)	0.25W/m2K	0.22W/m2K	n/a	*Listed, no improvement feasible*
Tiled pitched roof (Old Stein)	0.16W/m2K	2.7W/m2K	0.16W/m2K	*Listed, assume loft insulation added*
Existing timber flat roof (rear building section)	0.18W/m2K	1.7W/m2K	n/a	*Limited height to add in insulation*
New timber roof to new storey (rear building section)	0.18W/m2K		0.15W/m2K#	*New build*
Existing single glazed windows (Old Stein and East Street elevation)		5.2W/m2K	n/a	*Listed, cannot change*
Existing double glazed windows (rear building section)		3.4W/m2K		*Potential to replace with new*
Existing single glazed roof lights (Old Stein and rear section)		6.3W/m2K		
New double glazed windows (new storey)	1.6W/m2K		1.4W/m2K#	*New build and replacement*
New double glazed roof light (new storey)	2.2W/m2K		1.5W/m2K#	*New build and replacement*

Note # New values should be as per the notional values (NCM Modelling Guide 2021) for the notional building.

As an existing building, the air tightness is taken as 25m3/hr.m2@50Pa based on the National Calculation Method (NCM) guidelines. It is recommended that this is looked at to improve where possible during the construction process with a review of the external envelope and steps taken to improve. For this calculation, the air tightness has been left at the recommended 25 figure. This compares to a new build situation which would be looking a 3-5 typically.

Party walls and floors are assumed to have no heat transfer – for the model they have been allowed with brick (walls) and concrete (floor) for the thermal mass.

The existing heating to the building uses a mixture of electric panel heaters and local split heat pump units. These have been modelled using default values for the split heat pumps due to the age of the units.

The proposed new system will use a modern high efficiency VRV system to benefit from improved efficiency. Within the heritage sensitive areas (front section overlooking Old Stein), the proposal is to use electric panel heaters. This is to minimise the disruption to the heritage details.

District heating technology

There are no current district heating schemes within the vicinity of the building and therefore it is not possible to connect onto a system.

It would be possible to connect a future district heating system to the building. The main plantroom is currently located on the lower ground floor on the Old Stein elevation. This would allow a connection below ground from the street to the building. With a central plantroom serving the building, this provides scope to use the future district heating energy within the building.

A district heating connection is a future option.

Clean Technology

Clean requires the use of clean technology, notably the use of combined heat and power.

A combined heat and power unit for the scheme has not been considered. The space requirements within the existing building are unfeasible. With the SAP10 carbon emission, CHP is not as favorable.

The proposal is for the system to allow for the future connection of a DSITRICT HEATING SCHEME. This would need to run through the front courtyard into the main plantroom at the lower ground level.

The current proposal is not to use CHP.

Green Technology

Green is the consideration of the green technologies that the building could use. For further details on the technologies, refer to **APPENDIX B.**

A biomass boiler could generate the heating and hot water system. However the plantroom space required, the additional fuel storage at ground level would mean that the courtyard to the rear of Marlborough House would be enclosed to accommodate. Fuel deliveries would also be problematic with the access arrangements along East Street – being a busy retail area. The flue would also need to rise up above the surrounding buildings which would impact significantly on the listed section of the building. The higher sulphur content of the flue exhaust into an urban environment would also be detrimental to the area.

It is not considered that a biomass boiler is feasible for the site.

Ground coupled heat pumps are not viable in this existing building as there is not sufficient external ground area for either a horizontal system or vertical piles.

Ground coupled heat pumps are not feasible for this site.

The existing building is partly served with air source heat pumps (local split systems) with the external units located on the roofs. Therefore, it is feasible for the building to benefit from air source heat pumps.

The proposal is to use a VRV system rather than separate systems, to benefit from improved efficiencies. The system will also allow the hot water to be served from the VRV system into central cylinders, rather than local electric hot water heaters.

Air source heat pumps are feasible for this site.

A wind turbine has not been considered for this site. The adjacency of the existing buildings and the listed elevations to the building would mean it is not possible to connect a turbine to the building. The lack of external area would mean that it is not possible to install a column mounted unit.

A wind turbine is not considered feasible for this site.

Solar panels can also be installed onto the flat roofs of the building. These can either be the hot water versions or the photovoltaic versions.

The hot water versions would connect into the hot water cylinders and provide direct hot water generation from the solar power collected.

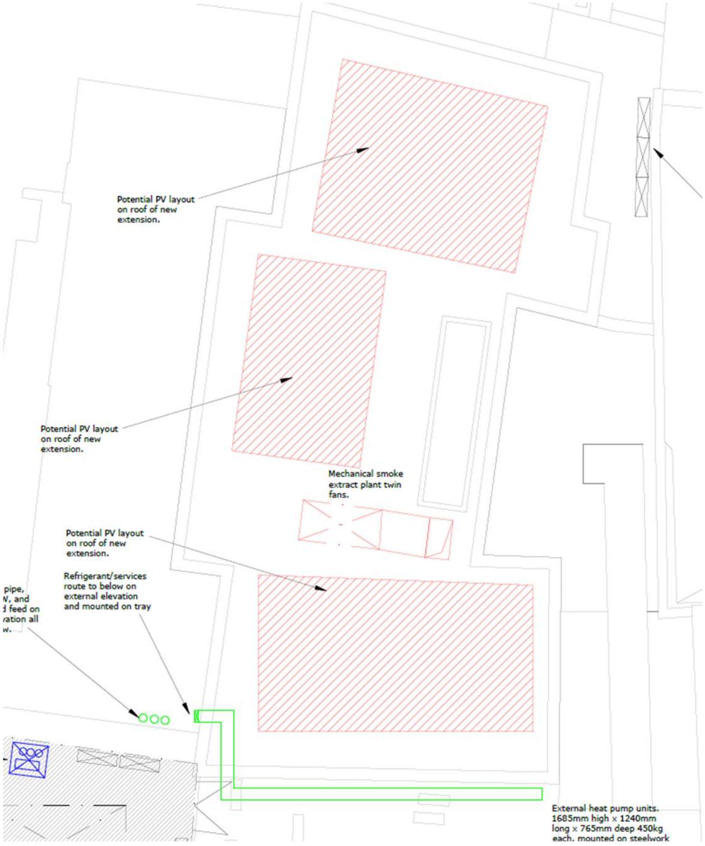
The photovoltaic type directly generates electricity, which is connected into the buildings electrical distribution system.

Due to the roof complexity and the limited plantroom space, the solar thermal panels are not being considered. Additional cylinders would be required to use a pre-heat to ensure that the hot water is available 24hours a day for the students, without wasting the solar power collected. The photovoltaic units will be more compatible with the proposed arrangements.

Solar photovoltaic is feasible for the site.

The proposal would be to install new panels on the new roof of the new storey being installed to the centre of the building. This is the only area of significant roof area that can be used due to the complex roof arrangement of the existing sections.

The aim of the photovoltaic system was to ensure that it is not visible from the street. The panels would be laid flat on roof (not pitched on supports), and not mounted on the roof pitches facing the street – Old Stein and East Street.



The approximate area of panels that could be installed would be **50m2**. This provides around 10kWp.

<u>Calculation</u>

The building was modelled as the proposed layout and function and using the existing thermal performance and systems. This was run using the BUILDING REGULATIONS PART L(2021) SBEM software. The calculations provide the BASELINE model from which to assess the improvements. This BASELINE model is the building in its existing state, but with changed function from an office to the student accommodation arrangement.

The improved insulation values were then used in the thermal performance (from the above table) to see the overall improvement this provided the model calculation.

Next the lighting was improved to 100% LED with PIR control in welfare facilities and daylight dimming control to the areas discussed above.

The heating was changed to new high efficiency air source heat pump VRV system for the rear and central sections with the front section (Old Stein) remaining as electric heating to minimise disruption.

The hot water was then changed from direct electric, to central cylinders fed from the heat pumps as the primary source.

Lastly the roof mounted photovoltaic system was added to the model to record the final improvement.

Please note that the improvements are cumulative for each model based on the previous model.

Model	TER	BER	TER % Improvement from previous model
Baseline	9.8	34.7	n/a
Thermal improved values	9.8	28.7	17.1%
Lighting and control improvement	9.8	28.5	0.7%
VRV Heat pumps	9.6	28.1	1.6%
Heat pump hot water	8.4	26.1	7.1%
Roof mounted PV	8.4	25.4	2.7%

Implementing all these measures would provide a total improvement of 26.8%.

This shows that the target of a 19% improvement is feasible for the building and can be achieved through a number of the measures shown above.

Further improvements may be possible – for instance replacing the existing double-glazed units in the rear and central section with new improved units.

As this is a listed building, the final measures taken will need to be sympathetic to the existing structure and details and may change from those detailed above. Additional scope for further improvements, especially to the thermal insulation, should be investigated further as this provides the largest improvement on the building.

The achievable target for the building is a 19% improvement from the existing level.

7.0 Conclusion

This report shows that it is feasible with the limitation of this existing listed building to achieve a 19% improvement in the carbon emissions from the existing level using the Building Regulations Part L:2021 SBEM calculation.

The calculations show that a 19% improvement can be made from the existing building using the following recommended options:

- Thermal improvement – upgrading existing constructions where possible and respecting the listed building and its significant heritage details.
- Lighting – improving the lighting with new LED fittings and new lighting controls suitable for the function of the rooms.
- VRV heat pumps – new high efficiency all electric heating system with a mixture VRV heat pumps and electric panel heaters.
- VRV hot water – replacing the existing local electric hot water systems with a central storage system heated from the high efficiency VRV heat pump system.
- Roof mounted photovoltaics – new roof mounted PV panels located flat on the central roof section so as not to be visible to the street.
- Future potential to connect in a district heating source by using a central plantroom strategy.

The reduction in carbon emissions provides an annual saving of 10,427kgC02.

As a listed building, the measures proposed are sympathetic to the existing listed building and in particular the important heritage details.

The draft Energy Performance Certificate for the building currently shows the building falling within the Grade “C” range depending upon the measures taken. This shows that the BRIGHTON AND HOVE CITY COUNCIL Development plan can be complied with (this calls for a minimum “C” rating for existing or change of use buildings – see first section above).

APPENDIX A

Nathan Williams CV

APPENDIX B

RENEWABLE TECHNOLOGIES

APPENDIX C

BRUKL OUTPUTS FOR MODELS

DRAFT EPC FOR FINAL MODEL

APPENDIX A

NATHAN WILLIAMS CV

The Engineering Workshop LLP

Nathan Williams

Partner

BEng (Hons) CEng MCIBSE

Summary

- Chartered Engineer with over 28 years' experience in building services engineering
- Member of Chartered Institute of Building Services Engineers
- Client–facing project management
- Specialises in dynamic thermal modelling and building simulation methods.

Key Projects

Kings cross Central, Building R6 (2015- ongoing) Contract Value: £30,000,000
Residential project consisting of 14 stories and 76 apartments. Responsible for delivering the Stage 4 MEP design and Revit model.

Eltham College, Millennium block (2010-2014) Contact Value: £14,000,000
New build three storey classroom block with sixth form centre

Christ Hospital, Horsham (2009-2011) Contract value: £7,000,000
New build classroom block with library on third floor, natural ventilation scheme

Newhaven Fire Station, East Sussex (2013 – 2015) Contract Value: £3,200,000
Fire station along with facilities for the local police services and the local district authority.

Battle of Britain, Dover, Kent (2010-2015) Contract Value: £2,500,000
Award winning building to provide interactive exhibition commemorating the Battle of Britain

Ashford Gateway, Kent (2011- 2014) Contract Value: £4,100,000
Combined library and office provision for different council services.

Ashford Care Home, Kent (2012-2015) Contract Value: £6,300,000
New Extra Care Residential building containing 72 independent apartments.

William Harvey Hospital, Ashford, Kent (2010-2013) Contract Value: £4,500,000
Conversion of existing general areas into two new operating theatres and associated facilities.

Professional Qualifications

- First Class BEng (Hons) in Building Services Engineering
- Member of the Chartered Institute of Building Services Engineers *(since 2004)*
- Registered Chartered Engineer with the Engineering Council *(since 2005)*
- Registered CIBSE Low Carbon Consultant *(since 2008)*
- Registered Energy Assessor Level 3, 4 and 5 (SBEM and dynamic thermal simulation) (LCEA015347)

Experience

Nathan has a wide range of experience ranging from residential projects, to large commercial projects including leisure, retail, education, healthcare, pharmaceutical and conservation/heritage schemes. Recent projects have included sustainable designs and low energy systems with low energy social housing schemes, and energy reviews at higher education establishments.

Additionally, Nathan is responsible for thermal modelling and simulation which enables a dynamic view of a building to look at energy, overheating, ventilation, and daylight performance. Options and improvements can quickly be assessed and implemented.

Education

University	**University of Hertfordshire** Sept 1998 to June 2001
Qualification	First Class BEng (Hons) in Building Services Engineering

APPENDIX B

RENEWABLE TECHNOLOGIES

The following of options have been considered for this development:

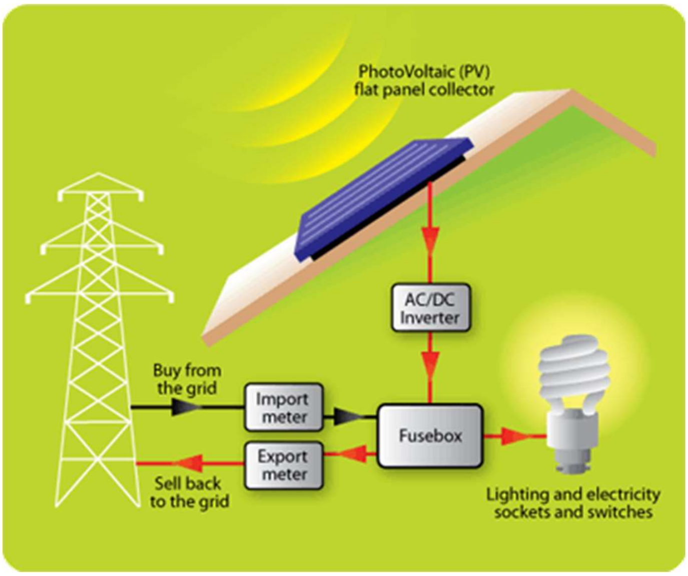
- Solar photovoltaics'
- Solar thermal
- Wind turbines
- Biomass boiler
- Heat pumps

Solar photovoltaic's

A typical photovoltaic panel is shown opposite. The panels operate by converting solar energy into electrical energy. The electrical energy generated is usually a DC supply and is then converted to a 230V AC supply by an invertor to match the typical UK electrical supply conditions. For this building a three phase 415V system will be feasible as the building will be working from the three electrical phases.

Although there will be planning conditions, it is considered feasible to install the panel on the proposed new flat roofs. The calculation has been based on flat panels; however subject to further design and planning conditions, it may possible to angle the panels and improve the output. The total amount could be up to 60m2 and still allowing maintenance access on the roof. A lower amount has been proposed in the main body of this report due to the access restrictions on to the roof and health and safety risks.

Photovoltaics connect very simply into the main distribution board. The panels would be connected into groups and run through invertors to match the generated electricity to the National Grid frequency. This equipment can be located in the second floor store room as ideally it needs to be as close to the PV panels as possible to minimize cable losses from the DC side. The connection is made simply into a spare fuse way on the main distribution board. The diagram below shows a schematic arrangement.



It is worth noting that the peak output from the PV panels will only occur during peak solar conditions, generally during the summer periods.

There is considerable market discussion in relation to FEED-IN-TARIFS with the government currently proposing a number of changes to the tariff structure. This will likely mean that the financial benefit to the owner will be considerably reduced and pay-back periods extended.

Despite the reduced financial benefits from the system, the panels themselves will generate electricity for use by the owner and reduce their carbon emissions for the building.

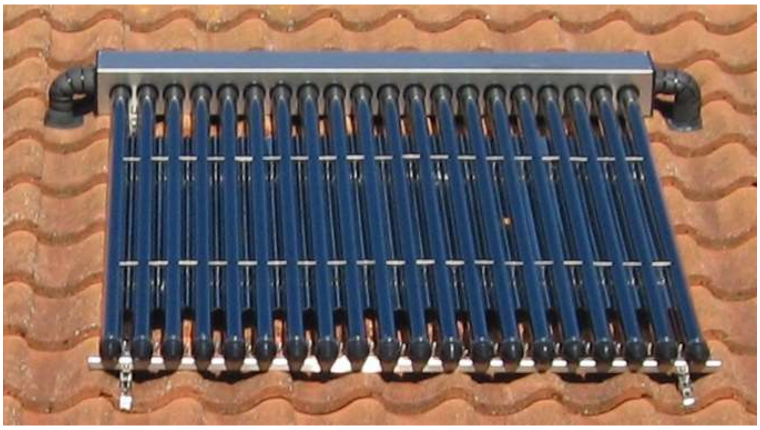
Photovoltaic panels are currently recommended for the project.

Solar thermal

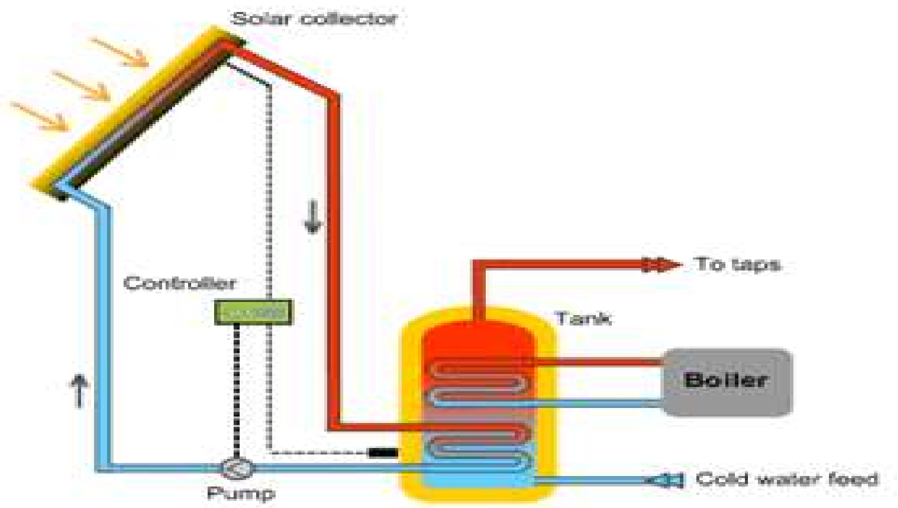
Hot water demand for this development will be fairly constant throughout the day – although the demand will be quite low as the main use of hot water will be for hand washing. To benefit best from this application, and to ensure that hot water is available for the users of the building, a solar buffer tank is recommended before the hot water cylinder is heated by the boiler or other heat source. This will ensure that a bulk of water is always available for the solar energy to be collected in.

A solar thermal system consists of solar water panels located on the roof and connected via pipe work to the hot water cylinder. A small pump and control package circulates the water through the roof mounted panel when the water in the panel is above set temperatures – thus transferring the heat from the panel to the cylinder.

A typical solar panel is shown below; this is an evacuated tube model which is typically more efficient than the flat panel type (the flat panel type look similar to the photovoltaic panels):



A typical solar panel system (without the solar buffer) is shown below:



The performance of the system will be very dependent upon actual hot water consumption in real life as well as the weather.

The key to a well performing system is to ensure that the hot water storage is adequate for the size of the panels. If the store is too small, then the store will quickly overheat and the excess heat may need to be "dumped" too atmosphere; leading to an energy waste.

The solar thermal panels would be sized based on the roof area available and the hot water demand to the building. As discussed in the PV section, the amount of roof space available is considerable. To accommodate a buffer vessel and additional plant for the solar thermal panels will be probelematic considering the small plantroom spaces provided. In addition, the hot water system needs to be available 24hours a day as the building is constantly occupied. As such, a buffer or pre-heat vessel would be required for the solar thermal system thus increasing the plantroom space required. It is considered more feasible to install photovoltaic panels.

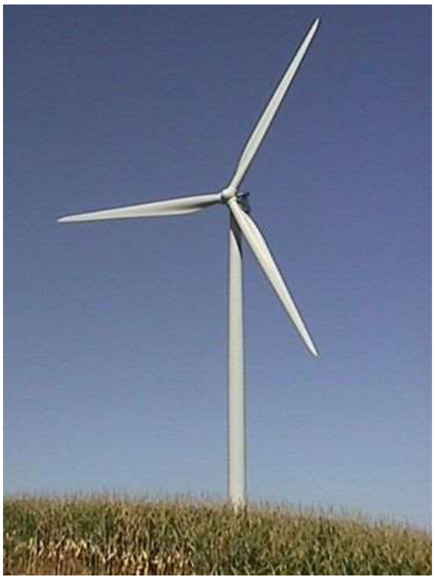
The use of solar thermal panels are not currently recommended.

Wind turbines

Wind turbines are very controversial and will be subject to strict planning and conservation conditions.

There are two main types of turbines – horizontal and vertical units.

Horizontal relates to the blade position. The horizontal units are the typical wind turbine.



Vertical units have the blades mounted vertically. There are a variety of different pattern types. These units are less common in the UK – there are only 1 or 2 suppliers in the UK market.

There are advantages and disadvantages for each type. The vertical type operate better in turbulent wind conditions as the blades are rotated by wind from any condition – therefore urban areas can benefit from these units.

The horizontal units are either fixed to the prevailing wind direction or rotate to meet the wind. Their power output is generally better than the vertical units.

Both units require a large installation space. To access the turbine the column mounting the turbine is hinged at the base so that the turbine can be lowered to ground level. For this to happen, adequate space needs to be provided to allow the full height of the column to be laid on the ground.

The connection of the wind turbine to the electrical system is similar to that for the photovoltaics' – the electrical energy generated is converted to match the National Grid supply and connected into a spare fuse way on the distribution board. Both three phase and single phase wind turbines are available.

The new electrical supply to the building will be three phase and therefore the wind turbine would need to match to ensure a balance across the phases. The sitting of the turbine will need to be considered; however, there is scope within the carpark for the installation. It must be remembered that the turbine masts normally lever from ground level to allow the turbine to be lowered to ground level for maintenance. Therefore, space needs to be provided for this action.

The site location, being an urban location, would mean that wind patterns will be variable and therefore the vertical unit would be the recommended option.

To achieve the full use of the system, the electricity generated by the system needs to be fed back into the National Grid. Wind turbines do benefit from the governments feed-in-tariffs although these are subject to changes.

The key to selecting wind turbines is to ensure that the units are selected on realistic data and are not overly optimistic in their energy yields.

The current planning requirements for the site preclude the application for a wind turbine. Due to the site size and location, it is recommended that rather than a small building mounted unit, a much larger site based unit would be more efficient and provide a larger energy production.

Due to the planning implications, it is not considered that a wind turbine would be acceptable to the local planners in this location. This is an existing building with little external space and with listed sections, and alongside a Grade 1 listed building.

For this particular building, the wind turbine option is not being considered.

Biomass boiler

A biomass boiler uses wood chip or wood pellets to provide heat energy to the building.

The main challenge with biomass boilers are the space requirements. The boilers themselves tend to be larger than traditional boilers plus the requirement for fuel storage and access arrangements to deliver the fuel.

A new boiler room would need to be found of around 4m x 4m with an additional space for the fuel storage of around 4m x 3m. The fuel store would need to be adjacent the boiler room and a similar size, and both would need to be located at ground level with space and access for fuel deliveries by a lorry.

The sizing of the biomass boiler is important. Typical plant selection is based on the peak load; however, the peak load will occur infrequently within a building. It is beneficial to size the boiler so that it will operate at full load for the longest period – boilers operate at their maximum efficiency at full load. This would then require a buffer vessel to allow the boiler to operate a peak efficiency for longer and allow the control of the system during partial load periods. A biomass boiler does not have the same flexibility in being able to be turned up/down as a conventional gas boiler and this impacts on the design of the system and ultimately, requires a larger plantroom for the increased equipment.

The biomass boiler would connect into a water-based heating system (radiators or water underfloor heating) in a similar manner to a traditional boiler. The advantage of the biomass boiler is that the temperatures it produces are at conventional temperatures (unlike heat pumps which provide a much lower water temperature when operated efficiently).

The flue from the boiler will have a higher Sulphur content than a traditional boiler and because of that the flue will need to discharge higher above the building typically 1.5m above the roof height.

Another challenge is the maintenance requirement. The boilers will require weekly checks by a competent person to check and empty ash containers and to ensure the system is working correctly (mainly that the augers are free from obstacles).

The current proposed layouts do not allow space for a biomass boiler and fuel storage.

The large fuel store and flue heights would be problematic for planning. Frequent fuel deliveries to the building would also be a problem for the client as the access road to the building is not used for vehicle transports and mainly supports public movements.

The building is also predominantly heated by air source heat pumps, therefore a biomass boiler replacing the heat pumps would be very costly and disruptive for a reducing gain. The biomass boiler would need to be sized for the base building demand and not the peak heating – this would require a smaller biomass boiler; but would also require additional to provide a back-up and top-up for the peak demands. Therefore, in terms of capital expenditure, there is no saving for replacing the gas boilers as they would still be required.

<u>A biomass boiler is not a recommended proposal for the building.</u>

Air source heat pumps

Air source heat pumps utilizes the energy in the air to provide heat energy to the building. This energy is provided by hot water in a similar manner to a conventional boiler. The efficiency of the heat pump is linked to the temperature of the water provided by the system – the lower the temperature the better the efficiency. Therefore, heat pumps are ideally suitable for connection to underfloor heating systems which use water at lower temperatures than a conventional radiator system (typically around 45 deg C compared to a conventional 80 deg C).

The heat pumps connect to a buffer vessel and then to the heating system.

The main challenge of the heat pump is that they will need to be located externally and they generate noise. Modern units are reasonably quiet; however, this must be a consideration in the sitting of the units especially when in a residential or rural area.

To get the best benefit from the system, the heat pumps should be accurately sized against the actual building loads.

Heat pumps are not efficient at generating hot water for domestic use. As mentioned above, heat pumps operate efficiently at 40-45 deg C, hot water generation should be at 60 deg C. There are two options for hot water generation; either a top-up heat source is used (electric immersion heaters or an oil/LPG boiler); or the hot water generation is treated separately from the heating system.

The water based air source heat pump would replace the gas fired boiler. As the building is currently proposed as predominantly heated by a refrigerant air source heat pump, this means that the changing of the gas boiler to heat pump would be relatively small with reducing gains.

<u>For this project, water air source heat pumps are not currently recommended for this project.</u>

The refrigerant air source heat pumps work on the same principle, except the output is direct to air (from the internal units) rather than to water in the units discussed above. The current proposal is to use refrigerant heat pumps to provide the main heating and cooling to the space.

The use of refrigerant heat pumps for heating is considered a low carbon technology. The calculations will need to show that the building modelled with the heat pump for heating, will perform better than the building with a conventional boiler. This improvement in carbon reduction is the amount that can be attributed to the buildings overall LZC reduction.

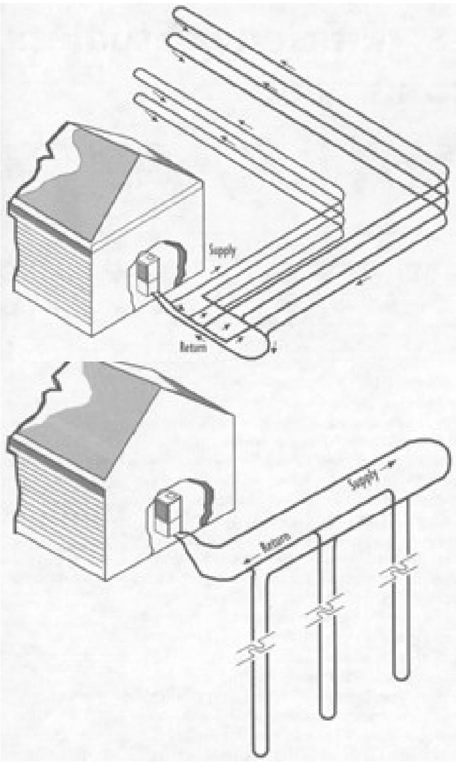
The other advantage of the refrigerant heat pump is that higher water temperatures can be achieved thus allowing for efficient hot water generation.

For this project, refrigerant air source heat pumps are proposed.

Ground source heat pumps

Ground source heat pumps operate similar to the above, except rather than using the air as the heat reservoir for the refrigeration cycle, they use the ground. This has the benefit in that the ground temperature (10 deg C to 14 deg C) remains quite stable over the year compared to the air temperature (-5 deg C up to 30 deg C).

This results in a much-improved energy efficiency of the units compared to the air source units.



The units require a connection to the ground. This is either a horizontal connection or a vertical connection. The horizontal connection is typically by the use of trenches around 1.5m deep.

Vertical connection is by boreholes which can be up to 40m deep. The details of either system are dependent upon the actual ground conditions at the site.

The amount of floor area required for a horizontal array, as a rule of thumb, is in excess of the total floor area of the building. At this site, there is insufficient ground area surrounding the site for a horizontal ground array.

There would need to be a number of boreholes, possibly up to 20 for this building load. The cost of each borehole would be prohibitive for the project. There is insufficient external area for this number of boreholes. The installation of boreholes would be a risk to the listed building and the adjacent listed building.

Ground source heat pumps are not currently recommended for this project.

APPENDIX C

BRUKL OUTPUTS FOR MODELS

The following BRUKL outputs are generated from the various IES models to match the results complied in section 6.0.

- BASELINE MODEL
- THERMAL IMPROVED MODEL
- LIGHTING IMPROVED MODEL
- VRV HEAT PUMPS MODEL
- VRV HOT WATER MODEL
- PHOTOVOLTAIC MODEL

The draft EPC for the proposed measures is the final document.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

BASELINE MODEL

As designed

Date: Thu Dec 14 16:08:23 2023

Administrative information

Building Details

Address: 52-53 Old Stein, Brighton, BN

Certifier details

Name: Nathan Williams

Telephone number: 01245 206801

Address: Elizabeth House, Baddow Road, Chelmsford, CM2 0DG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.24

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.24

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 259.35

The CO_2 emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	9.87	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	34.69	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	103.88	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	364.81	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	1.45	1.87	1S000000:Surf[1]
Floors	0.18	0.22	0.22	BM000002:Surf[0]
Pitched roofs	0.16	1.41	1.55	3R000027:Surf[54]
Flat roofs	0.18	0.67	2.72	BM000001:Surf[1]
Windows** and roof windows	1.6	4.03	5.24	BM000002:Surf[2]
Rooflights***	2.2	2.86	6.38	3R000001:Surf[17]
Personnel doors^	1.6	2.2	2.2	BM000000:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

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

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

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

^ For fire doors, limiting U-value is 1.8 W/m²K

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	25

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- EXISTING electric heating and hot water

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- EXISTING General split system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2	2	0	-	-
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

"No HWS in project, or hot water is provided by HVAC system"

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
Bmt Studio 02 Cooking area	-	-	0.4	-	-	-	-	-	-	-	N/A
Bmt Studio 02 WC	-	-	0.4	-	-	-	-	-	-	-	N/A
Bmt Studio 02 Shower	-	-	0.4	-	-	-	-	-	-	-	N/A
Bmt Studio 01 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
Grd Studio 03 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
Grd Studio 04 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
1st Studio 05 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
1st Staff Welfare	-	-	0.4	-	-	-	-	-	-	-	N/A
1st Studio 06 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 07 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 08 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
2nd Studio 14 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 15 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 19 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 18 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 17 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 16 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 13 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 10 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 09 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 11 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 12 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 20 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 21 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 22 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 23 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 24 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 25 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 26 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 31 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 30 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 29 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 28 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 36 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 37 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 35 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 34 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 38 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 39 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 32 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 33 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 27 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
Bmt Studio 02 Cooking area	161	-	-
Bmt Studio 02 WC	235	-	-
Bmt Studio 02 Shower	187	-	-
Bmt Studio 02	96	-	-
Bmt Common Lobby and Stairs	259	-	-
Bmt Studio 01	97	-	-
Bmt Common Stiars	214	-	-
Bmt Studio 02 Lobby	241	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
Bmt LV Switch room	80	-	-
Bmt Studio 01 Ensuite	160	-	-
Grd 52 Entrance hallway	158	-	-
Grd Studio 03	103	-	-
Grd Stairwell circular	139	-	-
Grd Lobby	228	-	-
Grd Studio 03 Ensuite	183	-	-
Grd Lift	123	-	-
Grd Store	130	-	-
Grd 53 Entrance hallway and stairs	131	-	-
Grd Reception Desk	77	-	-
Grd Studio 04 Ensuite	205	-	-
Grd Studio 04	98	-	-
1st Stairwell circular	144	-	-
1st Studio 05	101	-	-
1st Studio 05 Ensuite	131	-	-
1st Lobby	227	-	-
1st Lift	130	-	-
1st Store	130	-	-
1st Lobby	191	-	-
1st Stairwell	159	-	-
1st Staff Welfare	163	-	-
1st Studio 06	100	-	-
1st Studio 06 Ensuite	115	-	-
2nd Stairwell circular	130	-	-
2nd Lobby	184	-	-
2nd Lift	99	-	-
2nd Studio 07	96	-	-
2nd Studio 07 Ensuite	154	-	-
2nd Studio 08	95	-	-
2nd Studio 08 Ensuite	174	-	-
2nd Lobby	178	-	-
2nd Stairwell	150	-	-
2nd Lobby	211	-	-
2nd Studio 14	103	-	-
2nd Studio 14 Ensuite	135	-	-
2nd Studio 15 Ensuite	160	-	-
2nd Studio 15	115	-	-
2nd Lobby	172	-	-
2nd Studio 19 Ensuite	166	-	-
2nd Studio 19	108	-	-
2nd Studio 18 Ensuite	142	-	-
2nd Studio 18	106	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
2nd Studio 17	114	-	-
2nd Studio 17 Ensuite	144	-	-
2nd Studio 16 Ensuite	151	-	-
2nd Studio 16	115	-	-
2nd Circulation 3	125	-	-
2nd Studio 13	108	-	-
2nd Studio 13 Ensuite	132	-	-
2nd Plantroom	79	-	-
2nd Corridor rear stairwell	151	-	-
2nd Cupboard	130	-	-
2nd Circulation 1	111	-	-
2nd Circulation 2	117	-	-
2nd Cupboard	130	-	-
2nd Store	113	-	-
2nd Studio 10	105	-	-
2nd Studio 10 Ensuite	159	-	-
2nd Studio 09 Ensuite	129	-	-
2nd Studio 09	106	-	-
2nd Studio 11 Ensuite	144	-	-
2nd Studio 11	114	-	-
2nd Studio 12 Ensuite	143	-	-
2nd Studio 12	114	-	-
3rd Studio 20	94	-	-
3rd Stairwell circular	157	-	-
3rd Studio 20 Ensuite	143	-	-
3rd Lift	80	-	-
3rd Studio 21	93	-	-
3rd Studio 21 Ensuite	157	-	-
3rd Stairwell	169	-	-
3rd Lobby	133	-	-
3rd Laundry Staff	103	-	-
3rd Lobby	158	-	-
3rd Studio 22	100	-	-
3rd Studio 22 Ensuite	135	-	-
3rd Studio 23 Ensuite	143	-	-
3rd Studio 23	111	-	-
3rd Studio 24 Ensuite	142	-	-
3rd Studio 24	112	-	-
3rd Studio 25 Ensuite	128	-	-
3rd Studio 25	107	-	-
3rd Plantroom	57	-	-
3rd Studio 26	101	-	-
3rd Studio 26 Ensuite	132	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
3rd Lobby	148	-	-
3rd Studio 31	115	-	-
3rd Studio 31 Ensuite	156	-	-
3rd Studio 30 Ensuite	138	-	-
3rd Studio 30	108	-	-
3rd Studio 29	107	-	-
3rd Studio 29 Ensuite	157	-	-
3rd Studio 28	115	-	-
3rd Studio 28 Ensuite	154	-	-
3rd Quiet Study	92	-	-
3rd Stairwell	168	-	-
3rd Lobby	251	-	-
3rd Stairwell central	109	-	-
3rd Circulation 1	114	-	-
3rd Circulation 2	125	-	-
3rd Stairwell rear	142	-	-
4th Studio 36	107	-	-
4th Studio 36 Ensuite	156	-	-
4th Studio 37	102	-	-
4th Studio 37 Ensuite	178	-	-
4th Lobby	146	-	-
4th Stairwell central	152	-	-
4th Studio 35 Ensuite	140	-	-
4th Studio 35	101	-	-
4th Studio 34	103	-	-
4th Studio 34 Ensuite	141	-	-
4th Studio 38	99	-	-
4th Lobby	120	-	-
4th Stairwell	137	-	-
4th Studio 38 Ensuite	132	-	-
4th Studio 39 Ensuite	126	-	-
4th Studio 39	94	-	-
4th Studio 32	106	-	-
4th Studio 32 Ensuite	136	-	-
4th Studio 33 Ensuite	155	-	-
4th Studio 33	108	-	-
4th Lobby	163	-	-
3rd Studio 27	114	-	-
3rd Studio 27 Ensuite	151	-	-
3rd Break out area	88	-	-
4th Lift overrun	47	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Bmt Studio 02	NO (-64.1%)	NO
Bmt Studio 01	NO (-48.6%)	NO
Grd Studio 03	NO (-67.4%)	NO
Grd Reception Desk	NO (-75.8%)	NO
Grd Studio 04	NO (-47.8%)	NO
1st Studio 05	NO (-53.2%)	NO
1st Studio 06	NO (-35.5%)	NO
2nd Studio 07	NO (-60.3%)	NO
2nd Studio 08	NO (-60.7%)	NO
2nd Studio 14	NO (-93.2%)	NO
2nd Studio 15	YES (+4.7%)	NO
2nd Studio 19	NO (-42.5%)	NO
2nd Studio 18	NO (-27.1%)	NO
2nd Studio 17	NO (-16.9%)	NO
2nd Studio 16	NO (-11.4%)	NO
2nd Studio 13	NO (-66.6%)	NO
2nd Studio 10	NO (-80.4%)	NO
2nd Studio 09	NO (-40.7%)	NO
2nd Studio 11	NO (-21.5%)	NO
2nd Studio 12	NO (-25.5%)	NO
3rd Studio 20	NO (-52.7%)	NO
3rd Studio 21	NO (-49.1%)	NO
3rd Studio 22	NO (-28.1%)	NO
3rd Studio 23	NO (-7.8%)	NO
3rd Studio 24	NO (-5.3%)	NO
3rd Studio 25	NO (-39.8%)	NO
3rd Studio 26	NO (-91.9%)	NO
3rd Studio 31	NO (-15.3%)	NO
3rd Studio 30	NO (-44.5%)	NO
3rd Studio 29	NO (-15.8%)	NO
3rd Studio 28	YES (+14.9%)	NO
3rd Quiet Study	YES (+34.5%)	NO
4th Studio 36	NO (-27.6%)	NO
4th Studio 37	NO (-15.3%)	NO
4th Studio 35	NO (-32.4%)	NO
4th Studio 34	NO (-32.1%)	NO
4th Studio 38	NO (-90.7%)	NO
4th Studio 39	NO (-86.6%)	NO
4th Studio 32	NO (-70.6%)	NO
4th Studio 33	NO (-41.7%)	NO
3rd Studio 27	YES (+17.7%)	NO
3rd Break out area	YES (+29.9%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	1582.8	1582.8
External area [m²]	1989	1947.7
Weather	SOU	SOU
Infiltration [m³/hm²@ 50Pa]	25	3
Average conductance [W/K]	3705.38	876.68
Average U-value [W/m²K]	1.86	0.45
Alpha value* [%]	21.92	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
100	**Residential Institutions: Universities and Colleges**
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	200.19	47.23
Cooling	1.85	0.18
Auxiliary	1.49	1.41
Lighting	11.75	6.74
Hot water	21.19	17.84
Equipment*	14.53	14.53
TOTAL**	**236.46**	**73.39**

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	4.2
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*4.2*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	699.65	277.23
Primary energy [kWh_{PE}/m²]	364.81	103.88
Total emissions [kg/m²]	34.69	9.87

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	477.1	22.6	71.1	4.4	0	1.86	1.42	2	2
	Notional	167.8	7	16.8	0.4	0	2.78	4.63	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	887.4	0	308.1	0	2.7	0.8	0	1	0
	Notional	369.1	0	72.7	0	2.6	1.41	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

THERMAL IMPROVED MODEL

As designed

Date: Thu Dec 14 16:36:53 2023

Administrative information

Building Details

Address: 52-53 Old Stein, Brighton, BN

Certifier details

Name: Nathan Williams

Telephone number: 01245 206801

Address: Elizabeth House, Baddow Road, Chelmsford, CM2 0DG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.24

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.24

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 259.35

The CO_2 emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	9.85	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	28.75	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	103.73	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	302.51	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.87	1.7	BM000002:Surf[1]
Floors	0.18	0.22	0.22	BM000002:Surf[0]
Pitched roofs	0.16	0.76	1.1	3R000027:Surf[54]
Flat roofs	0.18	0.43	1.72	3R000009:Surf[1]
Windows** and roof windows	1.6	4	5.24	BM000002:Surf[2]
Rooflights***	2.2	2.23	6.38	3R000001:Surf[17]
Personnel doors^	1.6	2.2	2.2	BM000000:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

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

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

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

^ For fire doors, limiting U-value is 1.8 W/m²K

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	25

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- EXISTING electric heating and hot water

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- EXISTING General split system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2	2	0	-	-
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

"No HWS in project, or hot water is provided by HVAC system"

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
Bmt Studio 02 Cooking area	-	-	0.4	-	-	-	-	-	-	-	N/A
Bmt Studio 02 WC	-	-	0.4	-	-	-	-	-	-	-	N/A
Bmt Studio 02 Shower	-	-	0.4	-	-	-	-	-	-	-	N/A
Bmt Studio 01 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
Grd Studio 03 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
Grd Studio 04 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
1st Studio 05 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
1st Staff Welfare	-	-	0.4	-	-	-	-	-	-	-	N/A
1st Studio 06 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 07 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 08 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
2nd Studio 14 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 15 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 19 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 18 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 17 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 16 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 13 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 10 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 09 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 11 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
2nd Studio 12 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 20 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 21 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 22 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 23 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 24 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 25 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 26 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 31 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 30 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 29 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 28 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 36 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 37 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 35 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 34 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 38 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 39 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 32 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
4th Studio 33 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A
3rd Studio 27 Ensuite	-	-	0.4	-	-	-	-	-	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
Bmt Studio 02 Cooking area	161	-	-
Bmt Studio 02 WC	235	-	-
Bmt Studio 02 Shower	187	-	-
Bmt Studio 02	96	-	-
Bmt Common Lobby and Stairs	259	-	-
Bmt Studio 01	97	-	-
Bmt Common Stiars	214	-	-
Bmt Studio 02 Lobby	241	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
Bmt LV Switch room	80	-	-
Bmt Studio 01 Ensuite	160	-	-
Grd 52 Entrance hallway	158	-	-
Grd Studio 03	103	-	-
Grd Stairwell circular	139	-	-
Grd Lobby	228	-	-
Grd Studio 03 Ensuite	183	-	-
Grd Lift	123	-	-
Grd Store	130	-	-
Grd 53 Entrance hallway and stairs	131	-	-
Grd Reception Desk	77	-	-
Grd Studio 04 Ensuite	205	-	-
Grd Studio 04	98	-	-
1st Stairwell circular	144	-	-
1st Studio 05	101	-	-
1st Studio 05 Ensuite	131	-	-
1st Lobby	227	-	-
1st Lift	130	-	-
1st Store	130	-	-
1st Lobby	191	-	-
1st Stairwell	159	-	-
1st Staff Welfare	163	-	-
1st Studio 06	100	-	-
1st Studio 06 Ensuite	115	-	-
2nd Stairwell circular	130	-	-
2nd Lobby	184	-	-
2nd Lift	99	-	-
2nd Studio 07	96	-	-
2nd Studio 07 Ensuite	154	-	-
2nd Studio 08	95	-	-
2nd Studio 08 Ensuite	174	-	-
2nd Lobby	178	-	-
2nd Stairwell	150	-	-
2nd Lobby	211	-	-
2nd Studio 14	103	-	-
2nd Studio 14 Ensuite	135	-	-
2nd Studio 15 Ensuite	160	-	-
2nd Studio 15	115	-	-
2nd Lobby	172	-	-
2nd Studio 19 Ensuite	166	-	-
2nd Studio 19	108	-	-
2nd Studio 18 Ensuite	142	-	-
2nd Studio 18	106	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
2nd Studio 17	114	-	-
2nd Studio 17 Ensuite	144	-	-
2nd Studio 16 Ensuite	151	-	-
2nd Studio 16	115	-	-
2nd Circulation 3	125	-	-
2nd Studio 13	108	-	-
2nd Studio 13 Ensuite	132	-	-
2nd Plantroom	79	-	-
2nd Corridor rear stairwell	151	-	-
2nd Cupboard	130	-	-
2nd Circulation 1	111	-	-
2nd Circulation 2	117	-	-
2nd Cupboard	130	-	-
2nd Store	113	-	-
2nd Studio 10	105	-	-
2nd Studio 10 Ensuite	159	-	-
2nd Studio 09 Ensuite	129	-	-
2nd Studio 09	106	-	-
2nd Studio 11 Ensuite	144	-	-
2nd Studio 11	114	-	-
2nd Studio 12 Ensuite	143	-	-
2nd Studio 12	114	-	-
3rd Studio 20	94	-	-
3rd Stairwell circular	157	-	-
3rd Studio 20 Ensuite	143	-	-
3rd Lift	80	-	-
3rd Studio 21	93	-	-
3rd Studio 21 Ensuite	157	-	-
3rd Stairwell	169	-	-
3rd Lobby	133	-	-
3rd Laundry Staff	103	-	-
3rd Lobby	158	-	-
3rd Studio 22	100	-	-
3rd Studio 22 Ensuite	135	-	-
3rd Studio 23 Ensuite	143	-	-
3rd Studio 23	111	-	-
3rd Studio 24 Ensuite	142	-	-
3rd Studio 24	112	-	-
3rd Studio 25 Ensuite	128	-	-
3rd Studio 25	107	-	-
3rd Plantroom	57	-	-
3rd Studio 26	101	-	-
3rd Studio 26 Ensuite	132	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
3rd Lobby	148	-	-
3rd Studio 31	115	-	-
3rd Studio 31 Ensuite	156	-	-
3rd Studio 30 Ensuite	138	-	-
3rd Studio 30	108	-	-
3rd Studio 29	107	-	-
3rd Studio 29 Ensuite	157	-	-
3rd Studio 28	115	-	-
3rd Studio 28 Ensuite	154	-	-
3rd Quiet Study	92	-	-
3rd Stairwell	168	-	-
3rd Lobby	251	-	-
3rd Stairwell central	109	-	-
3rd Circulation 1	114	-	-
3rd Circulation 2	125	-	-
3rd Stairwell rear	142	-	-
4th Studio 36	107	-	-
4th Studio 36 Ensuite	156	-	-
4th Studio 37	102	-	-
4th Studio 37 Ensuite	178	-	-
4th Lobby	146	-	-
4th Stairwell central	152	-	-
4th Studio 35 Ensuite	140	-	-
4th Studio 35	101	-	-
4th Studio 34	103	-	-
4th Studio 34 Ensuite	141	-	-
4th Studio 38	99	-	-
4th Lobby	120	-	-
4th Stairwell	137	-	-
4th Studio 38 Ensuite	132	-	-
4th Studio 39 Ensuite	126	-	-
4th Studio 39	94	-	-
4th Studio 32	106	-	-
4th Studio 32 Ensuite	136	-	-
4th Studio 33 Ensuite	155	-	-
4th Studio 33	108	-	-
4th Lobby	163	-	-
3rd Studio 27	114	-	-
3rd Studio 27 Ensuite	151	-	-
3rd Break out area	88	-	-
4th Lift overrun	47	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Bmt Studio 02	NO (-64.1%)	NO
Bmt Studio 01	NO (-48.6%)	NO
Grd Studio 03	NO (-67.4%)	NO
Grd Reception Desk	NO (-75.8%)	NO
Grd Studio 04	NO (-47.8%)	NO
1st Studio 05	NO (-53.2%)	NO
1st Studio 06	NO (-35.5%)	NO
2nd Studio 07	NO (-60.3%)	NO
2nd Studio 08	NO (-60.7%)	NO
2nd Studio 14	NO (-93.2%)	NO
2nd Studio 15	YES (+4.6%)	NO
2nd Studio 19	NO (-42.6%)	NO
2nd Studio 18	NO (-27.2%)	NO
2nd Studio 17	NO (-16.9%)	NO
2nd Studio 16	NO (-11.4%)	NO
2nd Studio 13	NO (-66.6%)	NO
2nd Studio 10	NO (-80.4%)	NO
2nd Studio 09	NO (-40.7%)	NO
2nd Studio 11	NO (-21.5%)	NO
2nd Studio 12	NO (-25.5%)	NO
3rd Studio 20	NO (-52.7%)	NO
3rd Studio 21	NO (-49.1%)	NO
3rd Studio 22	NO (-28.1%)	NO
3rd Studio 23	NO (-7.8%)	NO
3rd Studio 24	NO (-5.2%)	NO
3rd Studio 25	NO (-39.8%)	NO
3rd Studio 26	NO (-91.9%)	NO
3rd Studio 31	NO (-15.3%)	NO
3rd Studio 30	NO (-44.5%)	NO
3rd Studio 29	NO (-15.9%)	NO
3rd Studio 28	YES (+14.9%)	NO
3rd Quiet Study	YES (+34.5%)	NO
4th Studio 36	NO (-27.2%)	NO
4th Studio 37	NO (-14.7%)	NO
4th Studio 35	NO (-31.9%)	NO
4th Studio 34	NO (-31.7%)	NO
4th Studio 38	NO (-90.7%)	NO
4th Studio 39	NO (-86.6%)	NO
4th Studio 32	NO (-70.5%)	NO
4th Studio 33	NO (-41.3%)	NO
3rd Studio 27	YES (+17.7%)	NO
3rd Break out area	YES (+29.9%)	NO