BUROHAPPOLD ENGINEERING

UCL Slade School of Fine Art

Roofing and Elevation Repairs – Sustainability Statement

0045904

19 March 2020

Revision 05

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author	**Mark Dowson**
date	**19 Mar 2020**
approved	**Marco Mudoni**
signature	
date	**19 Mar 2020**

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1 Introduction

1.1 Scope of works

This report sets out a sustainability statement for the roofing and elevation repairs and associated works to the UCL Slade School of Fine Art. This building was built in 1871 and forms the North Wing of the Grade I listed Wilkins Building in UCL's Main Quad.

In relation to thermal upgrades, whilst this is a Grade I listed building, reasonable consideration has been made to date by the project team to improve the performance of the building envelope. Works that will lead to an improvement to thermal performance include:

- Replacement of rooflights and lanterns to roofs 9-13 with new triple glazed units in line with heritage
- Replacement of rooflights to roofs 4-7 with new double glazed units in line with heritage
- The provision of new roof insulation to existing slate and asphalt roofs in line with Part L2B
- Draught proofing to windows at the front of the building

Other measures include renovation works to windows across the building to overhaul units and improve joinery, replacing 2nd floor clerestory windows with new single glazed units and repairing existing copper roof 17. Whilst these other measures won't necessarily result in thermal U-value improvements they will increase the overall longevity of the building. The application as a whole will result in U-value improvements. In addition to the above, it should be noted that the building is already connected to the UCL district heat network.

1.2 Baseline performance

In terms of its Display Energy Certificate (i.e. a measure of performance based on actual energy use), the North Wing building currently achieves a DEC C (60) rating. Figure 1 provides a summary of baseline energy usage of the North Wing, versus similar buildings on the UCL campus. As shown, thermal energy usage is the largest per m2, thus justifying roofing and elevation repairs and associated works project under this planning appointment. In terms of electricity usage, North Wing performs relatively well, when compared with the estate.

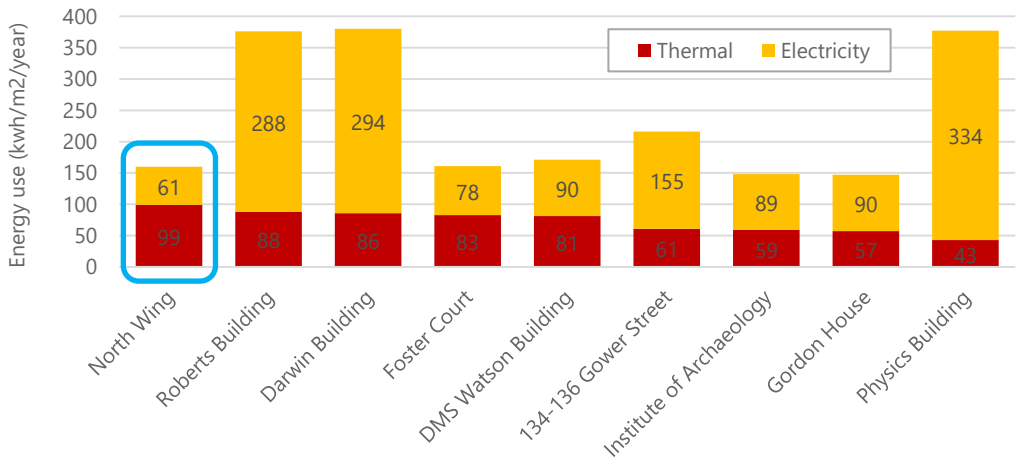


Figure 1 Energy use at North Wing compared to other similar UCL buildings *(UCL Sustainability, 2019 data)*

2 Proposed Improvements

2.1 Roofs and rooflights

Figure 2 illustrates the proposed roofing works resulting in thermal upgrades at the North Wing.

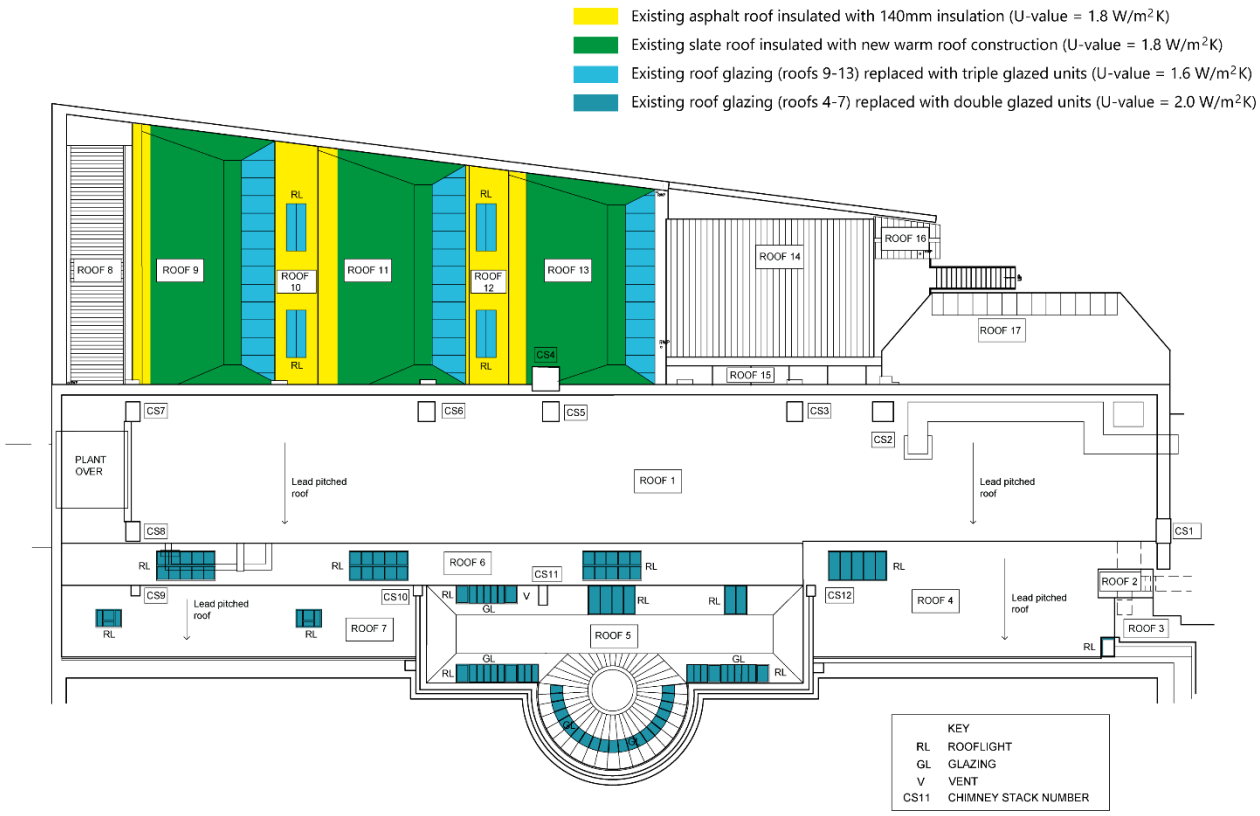
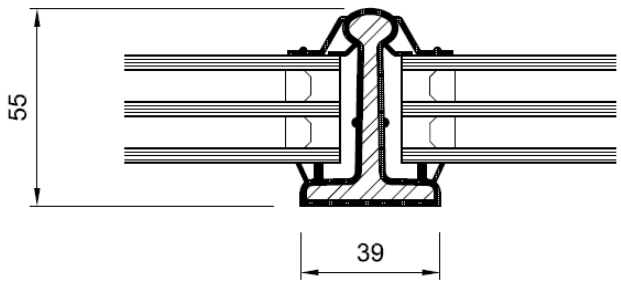


Figure 2 Mark-up of proposed thermal upgrade works to roofs

As shown, Roofs 9-13 will be insulated to the Part L2B U-value of 1.8 W/m^2.K. On these roofs, the existing single glazed rooflights and lanterns will also be replaced with new heritage approved triples glazed units achieving a U-value of 1.6 W/m^2.K. A section through the triple glazed unit is given in Figure 3 for information.

On Roofs 4-7, the existing single glazed rooflights will be replaced with new heritage approved double glazed units achieving a U-value of 2.0 W/m^2.K. A section through the double glazed unit is given in Figure 4 for information.

With regards to thermal insulation on Roofs 1-7, the relatively good condition and unexpended life expectancy of the leadwork precludes this element from being removed to insulate below.



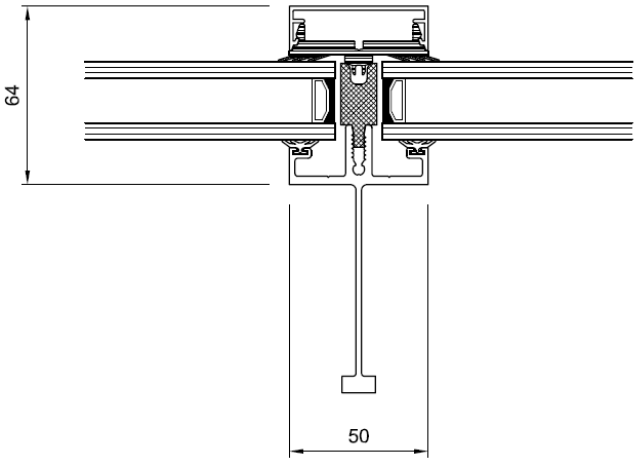
No.7 'Heritage' Lead Covered Steel Glazing Bar with 30mm triple glazed infill with krypton filled cavity

U-value = 1.6W/m²K

Dead load = 465N/m²

Base price = £525/m²

Figure 3 Triple glazed rooflight detail proposed for Roofs 9-13 and Roof 17



Thermally Broken Skyline Glazing Bar with 28mm double glazed infill with argon filled cavity

U-value = 1.4W/m²K

Dead load = 380N/m²

Base price = £275/m²

Figure 4 Double glazed rooflight detail proposed for Roofs 4-7

2.2 Insulation material resourcing

In relation to materials sourcing, whilst this project is not undergoing a formal BREEAM assessment, Table 1 sets out the sustainability credentials for insulation materials currently being specified for the roofing works. Certificates can be provided upon request.

Table 1 – Sustainability credentials of new insulation materials

Area	Insulation type	Responsible Sourcing	Green Guide Rating	Certificates
Slate roof	Kingspan Thermaroof K7	BES 6001 Excellent	A+	Link
Asphalt roof	IKO Enertherm	ISO 14001 (product)	A+	Link

2.3 Windows

Figure 5 and Figure 6 respectively, show the proposed works to renovate and replace glazing on the front and rear elevations of the building. As shown, the approach largely focusses on repairs and maintenance works. As part of these works, all windows to the front and rear of the building being renovated will be draught proofed. In addition, the single glazed 2nd floor clerestory windows will be replaced with new heritage approved single glazed units (softwood frame with nominal glass thickness of 4mm similar to Pilkington).

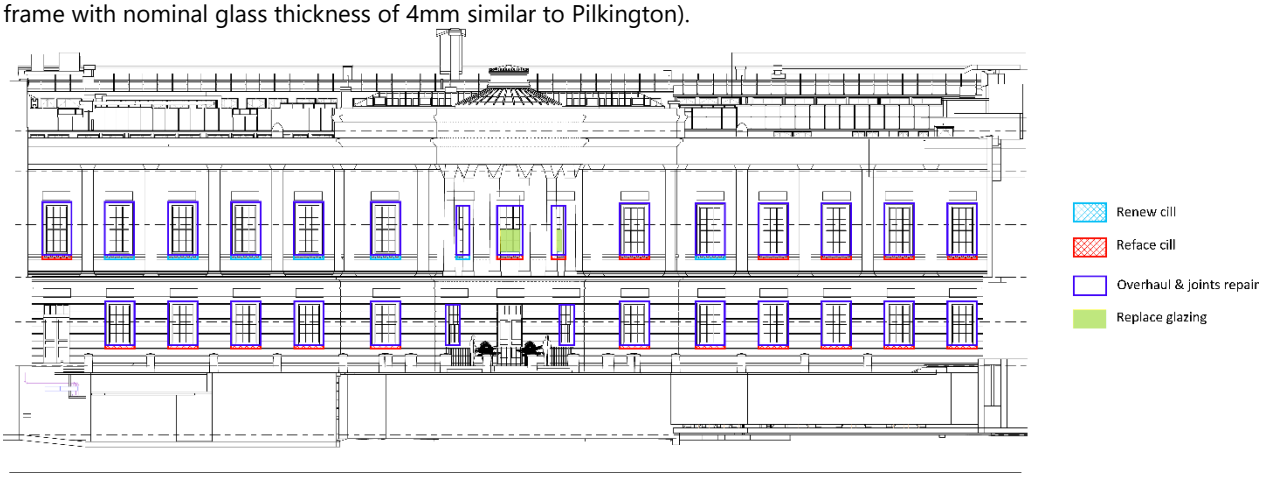


Figure 5 Proposed glazing works to front façade

Figure 6 Proposed glazing works to rear

3 Building fabric calculations

3.1 Overview

Energy and CO_2 saving calculations of the proposed thermal improvements have been calculated using the UCL Cost & Carbon appraisal tool. The steady state calculation methodology provides elemental heat loss calculations considering the actual building energy use and measured envelope area, as well as proposed U-value and infiltration improvements.

Table 2 gives the baseline and proposed U-values inputted into the calculation tool. The proposed roof U-values are in line with the minimum requirements of Part L2B. The proposed glazing U-values based on based on supplier data and also in line with Part L2B. Draught proofing to the front and rear of the building has been assumed to improve infiltration by 2.5 $m^3/h.m^2$ @ 50 Pa and 5 $m^3/h.m^2$ @ 50 Pa, respectively, based on the areas of treated windows.

Table 2 – Proposed improvements to envelope areas being thermally upgraded

	Baseline performance	Proposed improvement
Roof insulation	1.50 $W/m^2.K$	0.18 $W/m^2.K$
Rooflights (single glazed to double glazed)	5.70 $W/m^2.K$	2.00 $W/m^2.K$
Rooflights (single glazed to triple glazed)	5.70 $W/m^2.K$	1.60 $W/m^2.K$
Draught proofing to front and rear windows	20.0 $m^3/h.m^2$ @ 50 Pa	12.5 $m^3/h.m^2$ @ 50 Pa

Figure 7 shows the calculated improvement in space heating energy use for the proposed measures applied in combination. As shown, a 16.7% reduction in space heating energy usage is calculated.

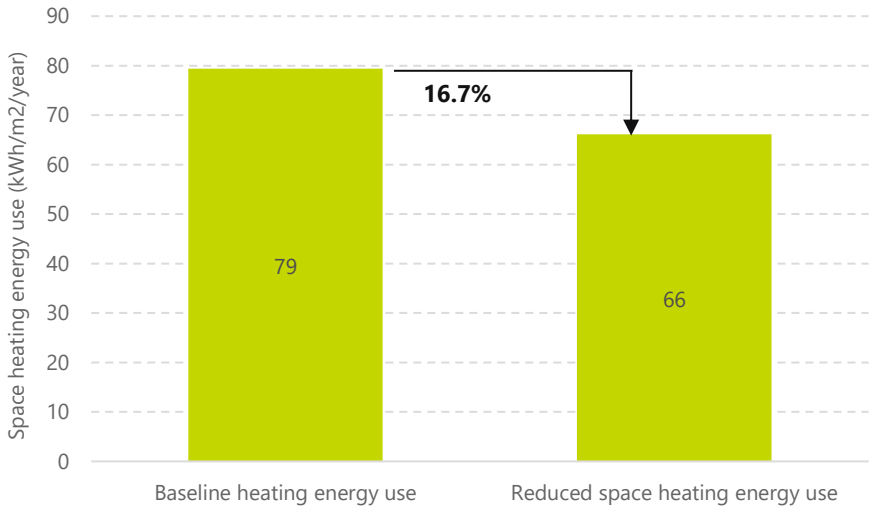


Figure 7 Space heating energy use reduction from proposed thermal improvements

3.2 Whole building CO_2 reporting

In line with the energy hierarchy reporting requirements for Camden, Table 3 shows the calculated 'lean, clean, green' CO_2 savings for the proposed upgrade works. In this calculation, total CO_2 include all energy uses (i.e. space heating, hot water and electrical energy use). Based on information provided by UCL, a carbon emissions factor of 0.216 $kgCO_2/kWh$ has been used to represent the UCL district network the existing building is connected to. For electricity usage, a grid carbon factor of 0.233 $kgCO_2/kWh$ has been applied in line with SAP 10.

Table 3 – Whole building CO_2 reduction

	Commercial refurbishment		
	Total CO_2 (tCO_2)	Stage reduction (tCO_2)	Stage reduction (% CO_2)
Baseline	153.5	-	-
Be Lean	141.1	12.4	8.1%
Be Clean	141.1	-	-
Be Green	141.1	-	-
Total	141.1	-	-
Target (Be Green)	99.7	53.7	35.0%
Shortfall	41.3	41.3	26.9%

As shown, all CO_2 savings from the proposed works occur in the 'lean' section of the energy hierarchy. Overall, an 8.1% CO_2 saving is forecast. It is understood that the 35% CO_2 reduction target set by the GLA is not applicable to this project given that the refurbishment works do not include internal modifications to the building, nonetheless the shortfall has been reported on.

3.3 Percentage of project costs spent on energy efficiency

Camden Planning Guidance (Sustainability CGP3) highlights that refurbishment projects should aim to spend 10% of project costs on energy efficiency improvements. As shown in Table 4, circa 19.8% of total project costs have been spent on energy efficiency measures, rising to 27.4% when preliminaries, overheads and profits are excluded.

Table 4 – Energy efficiency cost assessment

Cost figures	**Cost (£)**
Draughtproofing front	£40,000
Draughtproofing rear	£84,000
Roofs 9-13 (warm lead/asphalt and triple glazing)	£218,750
Double glazed Heritage roof lights and lanterns to Roofs 4, 5, 6 and 7 and double glazed lights to Roof 5	£40,228
Project costs	£1,397,604
Project costs incl. prelims and OHP	£1,937,517
Percentage of total project costs spent on energy	**19.8%**
Percentage of project costs (excluding prelims and OHP) spent on energy	**27.4%**

4 Planning checklist

Camden Planning Guidance – Sustainability CGP3

The table below outlines the Camden Council planning requirements in relation to sustainability for existing buildings. Commentary in relation to the scope of the UCL Slade School of Fine Arts works is given for information.

Requirement	Commentary
Energy efficiency: existing buildings • All buildings, whether being updated or refurbished, are expected to reduce their carbon emissions by making improvements to the existing building. Work involving a change of use or an extension to an existing property is included. As a guide, at least 10% of the project cost should be spent on the improvements. • Where retro-fitting measures are not identified at application stage we will most likely secure the implementation of environmental improvements by way of condition. • Development involving a change of use or a conversion of more than 500sq m of any floorspace, will be expected to achieve 60% of the un-weighted credits in the Energy category in their BREEAM assessment. • Special consideration will be given to buildings that are protected e.g. listed buildings	*In terms of energy efficiency, the project scope includes roof insulation to copper, slate and asphalt roofing, together with the installation of new heritage approved triple and double glazed rooflights. Measures are expected to reduce heating energy use by 16.7%. In terms of total building CO_2 reduction (heating, DHW and electricity) an 8.1% reduction in CO2 is forecast. It is calculated that 19.8% of total project costs have been spent on energy efficiency measures, rising to 27.4% when preliminaries, overheads and profits are excluded.*
Decentralised energy • Where feasible and viable your development will be required to connect to a decentralised energy network or include CHP.	*The building is connected to the UCL district heat network, fed via a connection from the adjacent Kathleen Lonsdale Building.*
Cooling hierarchy • Proposals should align to the GLA cooling hierarchy: a. Minimising internal heat generation through energy efficient design b. Reducing the amount of heat entering the building in summer c. Use of thermal mass and high ceilings to manage the heat within the building d. Passive ventilation e. Mechanical ventilation	*Improvements to roof U-values will reduce conduction gains limiting overheating in summer. The building incorporates high ceilings and exposed brickwork. Proposed works do not involve adding any new cooling or mechanical ventilation systems to the building.*
Monitoring and management • Proposals should include appropriate Building Management Systems, metering, monitoring and management	*The project scope does not include any works to metering or BMS systems. Energy usage data for the building is collected on by UCL and managed online via the Fabriq energy management portal.*
Renewable energy • All developments are to target at least a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy technologies. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.	*The project scope does not include the provision of any renewable energy.*

<table>
<tr>
<td>Sustainability assessment tools (BREEAM)
• Submission of a pre-assessment report at the planning application stage. The report should summarise the design strategy for achieving your chosen level of BREEAM and/or Code for Sustainable Homes and include details of the credits proposed to be achieved.
• Pre-assessment report is to be carried out by a licensed assessor. The name of the assessor and their licence number should be clearly stated on the report.
• You are strongly encouraged to meet the following standards in accordance with Development Policy DP22 - Promoting sustainable design and construction:
<table>
<tr><th>Time period</th><th>Minimum rating</th><th>Minimum standard for categories (% of un-weighted credits)</th></tr>
<tr><td>2010-2012</td><td>‘very good’</td><td rowspan="2">Energy 60%
Water 60%
Materials 40%</td></tr>
<tr><td>2013+</td><td>‘excellent’</td></tr>
</table>
</td>
<td>Because of the limited nature of the project scope, a BREEAM assessment is not proposed.

Broadly speaking, the roofing and elevation repair works are following the principles of the following BREEAM credits:
- Ene 04 Passive design
- Mat 04 Insulation
- Mat 03 Responsible sourcing</td>
</tr>
<tr>
<td>Water efficiency
• The Council expects all developments to be designed to be water efficient by minimising water use and maximising the re-use of water. This includes new and existing buildings.
• The Council will require developments over 1000sq m to include a grey water harvesting system, unless the applicant demonstrates to the Council’s satisfaction that this is not feasible.</td>
<td>The project scope does not include any alterations to water fittings in the existing building, or the provision of grey/rain water harvesting.</td>
</tr>
<tr>
<td>Sustainable use of materials & waste
• All developments should aim for at least 10% of the total value of materials used to be derived from recycled and reused sources. This should relate to the WRAP Quick Wins assessments or equivalent. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.
• Major developments are anticipated to be able to achieve 15-20% of the total value of materials used to be derived from recycled and reused sources.
• Construction waste and waste to landfill should be minimised</td>
<td>Materials will predominantly be selected based on heritage requirements, however where feasible new insulation materials will aim to achieve a BRE green guide rating of A/A+ and be sourced from suppliers that can provide responsible sourcing certification (e.g. ISO14001 as a minimum). Regarding waste, the contractor will be required to provide a site waste management plan.</td>
</tr>
<tr>
<td>Adapting to climate change
• All development is expected to consider the impact of climate change and be designed to cope with the anticipated conditions.</td>
<td>Works to insulate and ‘make good’ of the existing roof and draught proof existing windows will increase the resilience of the building to extreme weather events.</td>
</tr>
<tr>
<td>Brown roofs, green roofs and green walls
• The Council will expect all developments to incorporate brown roofs, green roofs and green walls unless it is demonstrated this is not possible or appropriate. This includes new and existing buildings. Special consideration will be given to historic buildings to ensure historic and architectural features are preserved.</td>
<td>Due to the heritage restrictions, brown roofs, green roofs and/or green walls are not feasible.</td>
</tr>
</table>

Flooding • Developments must not increase the risk of flooding, and are required to put in place mitigation measures where there is known to be a risk of flooding. Within the areas shown on Core Strategy Map 5 (Development Policies Map 2) we will expect water infrastructure to be designed to cope with a 1 in 100 year storm event in order to limit the flooding of, and damage to, property.	*The project scope does not include any alternations impacting on flood risk. Based on an FRA for the adjacent Kathleen Lonsdale building, it is understood however that the site has a low risk of flooding.*
External lighting • Lighting can have particular negative impacts on biodiversity. Unnecessary lighting should be avoided. Where lighting may harm biodiversity timers or specific coloured lighting will be required to minimise any disturbance.	*The project scope does not include any alterations to external lighting.*
Local food growing • We encourage food to be grown wherever possible and suitable. Rooftops and shared spaces such as gardens and parks provide opportunities.	*Due to heritage restrictions, spaces for local food growing will not be feasible.*
Biodiversity • Proposals should demonstrate how biodiversity considerations have been incorporated into the development; if any mitigation measures will be included; and what positive measures for enhancing biodiversity are planned.	*The design team aims to ensure that there will be no negative change in the site's existing ecological value as a result of the refurbishment.*

5 Summary

This report provided a sustainability statement for the UCL Slade School of Fine Art roofing and elevations repairs project. The report described the proposed thermal upgrades to slate, copper and asphalt roofs at the rear of the building, as well as replacement of rooflights with double and triple glazed heritage approved units, draught proofing to windows at the front and rear of the building, as well as replacement of clerestory windows on the 2nd floor front elevation with new single glazed units.

In addition to setting out data on the baseline performance of the building, space heating energy saving calculations and CO_2 calculations have been prepared. As shown, space heating energy savings of 16.7% are forecast compared to the existing building. In terms of total CO_2 (including heating, hot water and electricity use) an overall saving of 8.1% is calculated. With regards to the Camden Sustainability CGP3, it is estimated that 19.8% of total project costs have been spent on energy efficiency measures, rising to 27.4% when preliminaries, overheads and profits are excluded. This exceeds Camden's expectation that 10% of project costs are spent on energy efficiency.

In terms of wider items in the Camden Sustainability CGP3, whilst a number of measures are restricted by the scope of the works and heritage nature of the building, it should be noted that the existing building is already connected to the UCL district heat network. Furthermore, efforts have been made by the project team to responsibly source new insulation materials in line with good practice. In terms of energy monitoring, UCL are also actively monitoring the operational energy use of the building remotely on their Fabriq energy management platform.

It is acknowledged by the project team that future refurbishment works to the building would be beneficial to further improve the long-term sustainability of the building. Table 5 provides a summary of the main interventions identified. Should this works go forward (under a separate planning application) it would warrant a full sustainability statement, e.g. BREEAM pre-assessment, dynamic 'lean, clean, green' energy modelling as well as overheating assessment.

Table 5 – Future opportunities for improving building performance

Fabric	- Investment in new glazing / secondary glazing for all windows in line with heritage requirements - Review feasibility of internal wall insulation - Treatment of thermal bridges - Draught proofing to chimneys to reduce potential sources of heat loss - Roof insulation to areas not currently included in the scope of works once the lifespan of lead cladding has been expended
HVAC	- Replacement of all major MEP systems (heating, ventilation, lighting etc) - Replacement of constant speed fans/pumps with modern variable speed systems - Increased heat capacity and/or insulation to basement areas, currently experiencing under heating - Modernisation of specialist extract systems, particularly those serving studio and workshop spaces
Renewables	- Review feasibility for the installation of a solar photovoltaic array (e.g. on 'Roof 1' which is pitched favourably and south facing)

With regards to works included in the scope of this application, Appendix 1 sets out Building Regulations Part L2B requirements, which the project team will be aiming to achieve as far as reasonably practical in agreement with Building Control.

Appendix A – Part L2B requirements

5.1 Thermal elements (i.e. roofing works)

In relation to Building Regulations compliance, the proposed roofing works will be notifiable under Part L2B. As the UCL Slade School of Fine Art is Grade I listed, any requirements to comply with the Part L2B are subject to approvals by Building Control and listed building consent. Heritage issues take precedent, but improvements to the external U-values are typically welcomed by Building Control.

In relation to upgrading *thermal elements*, such as roofs, walls, floors, Part L2B will place a legal obligation to improve the U-value to minimum standards or better, depending on the scope of the *renovation* or *replacement* works. Further description of the requirements is set out below:

Renovation of thermal elements

Where a thermal element is subject to *renovation* (e.g. the provision of new layers, or replacement of existing layers) and at least 50% of the surface area of the element is being renovated, Part L2B states that the performance of the whole element should be improved to achieve or better the U-values in Table 6. This also applies if more than 25% of the surface area of the entire envelope (i.e. external walls, floor, roof, windows, doors and roof lights) undergoing renovation, thus constituting a *major renovation*.

Table 6 - Part L2B building fabric standards for upgrading retained thermal elements

Element	Renovation of building fabric average U-value (W/m^2K)	Threshold building fabric U-value (W/m^2K)
Pitched roof insulation at ceiling level	0.16	0.35
Pitched roof insulation at rafters	0.18	0.35
Flat roof or integrally insulated roof	0.18	0.35
Wall –external or internal insulation	0.30	0.70
Floor	0.25	0.70

If achieving the relevant U-value is not technically or functionally feasible or would not achieve a simple payback of 15 years or less, the element should be upgraded to the best standard that is possible.

Replacement of thermal elements

Where the whole or any part of an individual thermal element is being *replaced*, and the replacement constitutes *major renovation*, or in the case of part replacement amounts to the replacement of more than 50% of the thermal elements surface area; the whole of the thermal element must be replaced so as to ensure that it complies with Building Regulations Part L1A, in so far as it is technically, functionally and economically feasible.

Table 7 - Part L2A building fabric standards for replacement thermal elements

Element	Limiting fabric parameters (W/m^2K)
Roof	0.20
Wall	0.30
Floor	0.25

5.2 Controlled fittings (i.e. roof lights, windows and doors)

Similarly to thermal elements, Part L2B will place a legal obligation to improve the U-value of *controlled fittings* to minimum standards depending on the scope of the *renovation* or *replacement* works. Controlled fittings, i.e. windows, roof lights and doors, refers to the 'whole unit' including the frame. Again, exceptions to Part L2B requirements are possible for heritage buildings, or if works are not technically or economically viable. Further description of the requirements is set out below.

Renovation of controlled fittings

Renovating a controlled fitting (e.g. replacing glazing in a window or rooflight, whilst maintaining the existing frame, or repairing cills, joints and seals etc) is not providing a new controlled fitting and as such does not have to meet the Part L standards. Where practical however, it would be sensible to meet Part L standards and/or apply draught proofing to improve thermal performance.

Replacement of controlled fittings

Where controlled fittings are being provided, reasonable provision would be to install draught proofed units meeting the U-value requirements in Table 8. In addition, insulated cavity closers should be installed where appropriate.

Table 8 - Part L2B requirements for controlled fittings

Fitting	Standard
Windows	1.8 W/m^{2}K for the whole unit
Roof lights	1.8 W/m^{2}K
Doors (high usage entrances)	3.5 W/m^{2}K
Doors (all other pedestrian doors)	1.8 W/m^{2}K

Where the replacement windows are unable to meet the requirements Table 8 due to the need to maintain the external appearance of the façade or the character of the building, replacement windows should meet a centre pane U-value of 1.2 W/m2K. As an alternative, single glazing should be supplemented with low-e secondary glazing. In this latter case, weather stripping should be on the secondary.

5.3 Compliance route and consequential improvements

The two main approaches to comply with the requirements of Building Regulations Part L2B are:

- Elemental compliance: all replacement and renovation measures should comply with minimum performance standards relating to fabric, glazing, mechanical and electrical services;
- Emissions approach: whole building energy modelling demonstrating that Building Emissions Rate (annual carbon dioxide emissions) of the Actual building is less than a Notional Building with the limiting elemental Part L2B values.

Elemental compliance is generally acceptable for all situations where projects involve changes to the building envelope (only) where mechanical and electrical services are not being replaced, provided for the first time or will result in an increase in capacity. This would therefore be the proposed approach for this project.

Similarly, consequential improvements, are not applicable if the project does not involve an extension, the provision of any new fixed building services or proposals to increase their installed capacity. This is the case for the UCL Slade School of Fine Art project.

Mark Dowson
Buro Happold Ltd.
17 Newman St,
Fitzrovia,
London
W1T 1PD
UK
T: +44 (0) 20 7927 9700
Email: mark.dowson@burohappold.com