13 Kemplay Road, Camden

Life Cycle Carbon Assessment

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V1.1

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JAWSustainability

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1 Introduction

This report summarises the life cycle carbon assessment for the redevelopment of 13 Kemplay Road to demonstrate that demolition and reconstruction provide a more sustainable alternative to the renovation of 13 Kemplay Road and to meet the sustainability requirements of the London Borough of Camden.

The site currently accommodates a 1950's end of terrace house set over 2 floors; ground and 1st. The current proposal is to demolish this building and redevelop the site. The proposed building will incorporate a different overall shape and involves the construction of a lower ground floor area and incorporating a room in the roof, increasing the floor space and as such the numberof potential occupants. Additionally a small, timber framed and clad secondary volume is to be built, further increasing the available floor area. Within this report, this proposal will be compared to anotional building case in which the existing building is renovated to the standards set in Building Regulations Part L1B (PL1B) and is extended to provide a comparable floor space as the proposed design. The site location is shown in Figure 1.1 below.

Figure 1.1 – 13 Kemplay Road Location.

2 Methodology

The aim of this life cycle carbon assessment is to compare carbon emissions associated with the redevelopment and operation of the new proposal, to the renovation and continued operation of the existing building.

All emissions associated with the proposed materials for the new development were calculated using One Click LCA's 'RICS: Whole life cycle assessment' Tool. Whole life-cycle carbon emissions are the total greenhouse gas emissions arising from a development over its lifetime, from the emissions associated with raw material extraction, the manufacture and transport of building materials, to installation/construction, maintenance, and eventual material disposal. The scope of the assessments carried out can be seen below in table 2.1.

Product			Construction		Use							End of Life			
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
Raw Material	Transport	Manufacturing	Transport	Construction	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Demolition	Transport	Waste Processing	Disposal
✓	✓	✓	✓	✓	✗	✗	✗	✓	✓	✓	✗	✓	✓	✓	✓

Table 2.1 10 Kemplay Road LCA scope.

Internal finishes and exterior areas have been excluded from both assessments as these items are functionally identical between scenarios. Additionally, the embodied carbon linked to the manufacture and installation of building services has been excluded. Although different services systems are utilised in each case, the embodied emissions linked to the manufacture and installation of these systems is negligible in comparison to their operational carbon emissions which are included in the assessment in both cases. Additionally the carbon emissions linked to the construction of both the basement and the secondary timber clad volume have been included in the renovation scenario as this allows for a similar level of floor space between both cases and as such, a more comparative analysis.

Final life cycle carbon emission values include operational energy and will allow for direct comparison between the lifetime carbon emissions of both options. In addition, the difference in the operational energy emissions was then calculated and compared to the material emissions to calculate a "payback time", at which point fewer emissions are produced from the construction and running of the new development, than the refurbishment and continued operation of the existing building. The assessment period of both buildings is 60 years.

This is a provisional life cycle assessment conducted prior to technical design, as such, it is based on as designed drawings and indicative building element build-ups provided by the design team, combined with assumptions on likely material use.

Operational energy emissions are quantified for the existing building assuming that all major thermal elements are upgraded to the 'upgrade values' set out in PL1B and for the proposed new development. Operational emissions are quantified using the approved Standard Assessment Procedure for the Energy Rating of Dwellings (SAP). This report has been checked by Jess James who is an On Construction Domestic Energy Assessor (OCDEA).

3 Notional Building - Refurbished Development

3.1 Building Fabric

Within the notional refurbished development, most of the existing external masonry and roofing is retained. Exterior walls, party walls and the roof would be upgraded with internal insulation to reach the required PL1B standard for fabric energy efficiency. External windows and doors are maintained as are internal floors. Internal partitions and non-load bearing walls would be demolished and replaced to allow for an internal layout functionally similar to that of the proposed new build development.

Significant work would be carried out on the lower ground floor to provide a similar level of usable living space as included within the proposed new build development, this would require additional works on the foundations to underpin the existing building and the construction of external and party retaining walls in order to accommodate the weight of the existing building.

A small one story extension would be added at the side of the property, this would be built according to the specification outlined in the new build development plans.

Table 3.1 below details the materials included in each building element within the scope of the notional life cycle assessment, these materials were utilised where possible in the LCA with the closest possible alternative being used where specific products are not present in the database.

Building Element	Proposed Construction
Foundations	Reinforced concrete pile
Lower Ground Floor	Reinforced concrete slab (200mm), Damp proof membrane (0.9mm), Insulation (Kingspan K103, 100 mm), separation layer (0.5mm) Screed (35mm)
Ground Floor	Timber and metal web joist (Esi Joist), Plywood deck (15mm)
Upper floors	Existing structure (No embodied emissions)
Roof – main	Existing structure (No embodied emissions), Insulation (Kingspan Kooltherm K7 62.5mm) Insulated plasterboard to interior (Kooltherm K18)
Roof – Extension	Cold applied waterproofing, Ply Sarking board (18mm), Timber frame structure, insulation (Kingspan Kooltherm K7 66mm), plasterboard to interior.
Lower Ground Floor retaining wall	Tanking Membrane, Reinforced concrete (200mm), timber battens. Insulation (Kooltherm K118, 60mm), Vapour control layer (0.3mm), Plasterboard (12.5mm)
External Walls	Existing Masonry, Mineral wool Batts 100mm, plasterboard to internal
Party Walls	Existing Masonry, timber battens, Insulated plasterboard (Kooltherm K118, 60mm)

Table 3.1 Building element material breakdown.

To determine the fabric efficiency of each element in the notional case, retained and upgraded building elements are modelled using Building Regulations PartL1B minimum upgrade U-values. It is assumed that any newly built, or replaced building element in the notional, refurbishment case would be built to the same standard expected in the proposed new build design. As such, these elements are modelled using the U-value of the corresponding element from the proposed new build design. U-values used for the notional building operational energy calculations are shown below in table 3.2

Fabric Element	Estimated Performance
Lower Ground Floor	0.25 W/m^{2}K
External Walls	0.55 W/m^{2}K
Roof – main	0.16 W/m^{2}K
Roof – Extension	0.20 W/m^{2}K
Windows	2.0 W/m^{2}K, g=0.85
External Doors	3.0 W/m^{2}K
Air tightness	15 m^3/m^{2}h @ 50 Pa

Table 3.2 Building Fabric U-values.

3.2 Building Services

Within the notional renovation case, it is assumed the existing building services will be retained with the small addition of a comfort cooling system in bedrooms and the lower ground floor gym. The details of these services can be found below in table 3.3

Element	Proposed Specification
Heating	Mains Gas boiler, 91% efficient, 300l cylinder, Heat emitters: rads, controls: programmer, thermostat and TRVs
Cooling	N/A
Ventilation	Natural + Doc F compliant extract
Hot Water	As heating
Lighting	Low energy light fittings throughout

Table 3.3 Existing building services + cooling.

4 Proposed development

4.1 Building Fabric

The proposed development comprises the demolition of the existing building at 13 Kemplay Road. The proposed design would then be constructed in its place. The front-facing façade of this design is similar to the existing façade apart from the replacement of two smaller street-facingwindows with a bay window more in line with the surrounding buildings. The proposed design is set over 4 floors: lower ground, ground, 1st and the 2nd floor which is set into the mansard roof.

New external front and rear walls will be of a brick and block cavity construction with partial fill cavity insulation, providing a significant improvement to the energy performance of these elements. Similarly, the new roof is insulated to a greater level than is possible through refurbishment. The replacement of windows and doors throughout the property with timber framed double glazed units on the front and steel, thermally broken windows on the rear will also produce a significant improvement over the existing units. Foundation, lower floor slabs, retaining walls and party walls are all upgraded to the same level as that seen in the notional refurbishment case as these elements would be new in both scenarios. As in the refurbishment case, a small extension to the footprint of the original building would be located at the rear of the new build property, this will match the rest of the new building in terms of build-up and performance.

In addition to the improved performance of the individual elements that make up the proposed new build property, the improved build quality over the existing building would result in a far lower air permeability for the whole building. High air permeability cannot be overcome through refurbishment, meaning that the significant reduction in air permeability seen here provides a significant reduction in heat loss and as such, energy use.

Table 4.1 details the materials included in each building element within the scope of the Proposed development life cycle assessment, these materials were utilised where possible in the LCA with the closest possible alternative being used where specific products are not present in the database.

Building Element	Proposed Construction
Foundations	Reinforced concrete pile foundations.
Lower Ground Floor	Reinforced concrete slab (200mm), Damp proof membrane (0.9mm), Insulation (Kingspan K103, 110 mm), separation layer (0.5mm) Screed (35mm)
Ground Floor	Timber and metal web joist (Esi Joist), Plywood deck (15mm)
Upper floors	Timber and metal web joist (Esi Joist), Plywood deck (15mm)
Roof – main	Clay tiles to the front and rear, timber tile battens breathable sarking membrane, New rafters (at 400mm centres) Insulation (Kingspan Kooltherm K7 filling all space between rafters), plasterboard to interior
Roof – Extension	Cold applied waterproofing, Ply Sarking board (18mm), Timber frame structure, insulation (Kingspan Kooltherm K7 66mm), plasterboard to interior.
Lower Ground Floor retaining wall	Tanking Membrane, Reinforced concrete (200mm), timber battens. Insulation (Kooltherm K12, 120mm), Vapour control layer (0.3mm), Plasterboard (12.5mm)
External Walls	Brick slips (27.5mm), calcium silicate board (10mm) external battens, vapor control layer, Structural Insulation panel (172mm) Timber battens, plasterboard (12.5mm)
Party Walls	vapor control layer, Structural Insulation panel (172mm) Timber battens, plasterboard (12.5mm)
Windows	Casement triple glazed windows
Doors and garage	Timber Doors

Table 4.1 Building element material breakdown.

U-values used for the proposed building operational energy calculations are shown below in table 4.2

Fabric Element	Estimated Performance
Lower Ground Floor	0.11 W/m^{2}K
External Walls	0.15 W/m^{2}K
LG retaining wall	0.15 W/m2K
Roof	0.16 W/m^{2}K
Windows – front	1.40 W/m^{2}K
Windows – rear	1.40 W/m^{2}K
Roof lights	1.60 W/m^{2}K
External Doors	1.60 W/m^{2}K
Air tightness	4 m^3/m^{2}h @ 50 Pa

Table 4.2 – Proposed development building fabric.

4.1.1 Building Services

The figures used for the building services of the proposed development are outlined in Table 4.3. A 16kw Samsung Electronics AE160JXYDEH has been used for calculation purposes, either this or a similar unit will be specified. The specification of an ASHP requires underfloor heating, this is only possible with low air permeability. As such this building services specification is only possible in the proposed new build development. In addition, a 0.75kWp solar array is to be placed on the upper

section of the mansard roof to supply renewable energy, further reducing energy demand from grid-supplied electricity.

Services Element	Estimated Performance
Heating	ASHP 1.2kw, 317% space heating efficiency, underfloor heating, Time and temperature zone control
Cooling	N/A
Ventilation	Natural ventilation and Part F compliant Extract
Hot Water	As heating
Lighting	100% low energy fittings

Table 4.3 – Proposed development building services.

5 Results

5.1 Building Embodied Emissions

The embodied emissions associated with the material inputs into the new development are shown in Table 5.1, broken down by RICS category. When taking into account only the life cycle emissions of materials and construction activities, the proposed refurbishment of 13 Kemplay Road results in a lifetime emission of 40,582 kgCO2e while the demolition and rebuilding of this property would emit 66,296 kgCO2e of life cycle emissions.

RICS Category	LC Emissions – Refurb (kgCO2e)	LC Emissions – New build (kgCO2e)
Standard foundations	5640	5640
Lowest floor construction	9131	9131
Basement retaining walls	7247	7247
Floors	321	2764
Roofs	2028	4970
External enclosing walls above ground level	2004	17090
Windows and external doors	11441	11441
Construction site scenarios	2765	8008
Total (kgCO2e)	66296	40582

Table 5.1 Life cycle emissions discounting operational energy use.

5.2 Operation Energy Emissions

The operational energy emissions for the existing and proposed development are outlined in table 5.2. The difference in operational energy emissions between the new proposed development and the existing building is 1,680 kgCO2e/year.

	Gas				Electricity						
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	PV	Total (kWh/yr)	Electricity CO_2 (kg/yr)	Total Energy (kWh/yr)	Total CO_2 (kg/yr)
Refurb	6,459	7,076	13,535	2,842	75	308	-858	-550	-128	12,985	2,714

Table 5.2 Annual operational energy use per year for notional refurb case.

	Electricity						
	Space Heating (kWh/yr	Hot Water kWh/yr	Pumps and fans (kWh/yr	Lighting (kWh/yr)	PV (kWh/yr)	Total (kWh/yr	Electricity CO_2 (kg/yr)
New build	3,115	846	653	682	-858	4,438	1,034

Table 5.3 annual operational energy use for proposed new build case.

5.3 Combined Life Cycle Emissions

When operational energy use is added to the life cycle emissions, it is shown that the new build significantly outperforms the refurbishment option with life cycle emissions of 85,883 kgCO2e and 97,893 kgCO2e respectively as seen in table 5.3 below. This is a result of the significantly reduced heat loss from the fabric and build quality improvements which both improve heat retention and allow for the use of a highly efficient ASHP.

RICS Category	LC Emissions – Refurb (kgCO2e)	LC Emissions – New build (kgCO2e)
Standard foundations	5641	5641
Lowest floor construction	9132	9132
Basement retaining walls	7248	7248
Floors	322	2765
Roofs	2029	4971
External enclosing walls above ground level	2004	17090
Windows and external doors	11442	11442
Construction site scenarios	2765	8008
Electricity use	57311	19588
Total (kgCO2e)	97893	85883

Table 5.3 Life cycle emissions including lifetime operational energy use.

5.4 Payback Time

The results indicate that the total embodied emissions from the construction of the new development will be 66,296 kgCO2e not including operational energy use. The difference in total emissions between the new proposed development and the existing building is 12,010 kgCO2e. This indicates that the emissions from the construction and running of the new proposed development will be less than emissions from the refurbishment and continued running of the building in less than 6 years.

6 Conclusion

This report summarises the life cycle carbon assessment for the development at 13 Kemplay Road in the London borough of Camden.

The aim of this assessment is to determine the extent to which the demolition and rebuilding of the property at 13 Kemplay Road may provide long term carbon savings over an ostensibly similar renovation case.

All emissions associated with the proposed materials for the new development were calculated using One Click LCA's 'RICS: Whole life cycle assessment' Tool. Operational energy emissions were then quantified for the existing building, after renovation, and for the proposed new development using the approved Standard Assessment Procedure for the Energy Rating of Dwellings (SAP).

The results indicate that the total embodied emissions from the construction of the new development will be 66,296 kgCO2e. Whilst the total 60 year carbon emissions would come to 85,883 kgCO2e once operational energy over the buildings lifetime are included. In comparison, the renovation of the existing building to a standard which meets or exceeds Building Regulations PL1B requirements would generate a total of 40,582 kgCO2e before factoring in operational emissions and a total of 97,893 kgCO2e once operational energy over the buildings lifetime are included. The difference in operational energy emissions between the new proposed development and the upgraded, notional, existing building is 12,010 kgCO2e/year. This indicates that the emissions from the construction and running of the new proposed development will be less than the emissions from the refurbishment and continued running of the building in less than 6 years.

Figures in this report are based on provisional estimates of material and energy use.