4 Oak Hill Park, London Borough of Camden

Life Cycle Carbon Assessment

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V2.0

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JAWSustainability

Contents

1 Introduction

This report summarises the life cycle carbon assessment for the redevelopment of 4 Oak Hill Park to ensure that demolition and reconstruction provide a more sustainable alternative to the renovation of 4 Oak Hill Park and to meet the sustainability requirements of the London Borough of Camden.

The site currently accommodates a 1970s 2 storey single family residential property with attached 3 storey annex. The current proposal is to demolish this building and redevelop the site, mirroring the overall design of the existing building whilst modernising the facade, general construction and building services of the building. I addition the footprint of the building is to be expanded to the rear creating usable living space from what is currently an overshadowed courtyard. Within this report, this proposal will be compared to a notional building case in which the existing building is renovated to the standards set in Building Regulations Part L. The site location is shown in Figure 1.1 below.

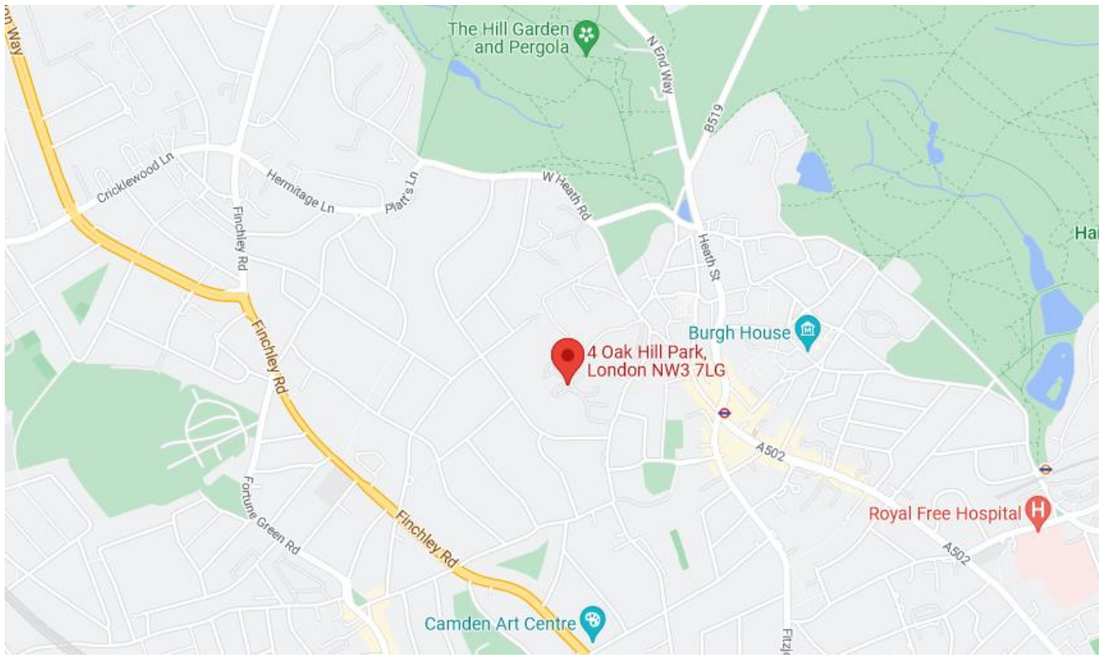

Figure 1.1 – 4 Oak Hill Park Location.

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 4 Oak Hill Park LCA scope.

Internal finishes, exterior areas and external windows and doors have been excluded from both assessments as these items are functionally identical between scenarios.

Final life cycle carbon emission values include operational energy and will allow for direct comparison between the lifetime carbon emissions of both options.

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 Part L of the Building Regulations (PL)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. The small 3rd floor annex is demolished whilst the lower two levels are retained. Exterior walls, party walls and the roof would be upgraded with internal insulation to reach the required PL standard for fabric energy efficiency. External windows and doors are replaced. Most internal partitions and internal floors are retained although some load bearing walls are demolished to

created more open spaces and to allow for an internal layout functionally similar to that of the proposed new build development.

A two-storey extension would be added at the rear and the east 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 foundations to new areas. Existing foundations retained to the remainder of the building.
Ground Floor	300 RC concrete slab for new sections, supported by new piles. Existing concrete GF retained in existing areas
Upper floors	RC Concrete slab varying between 300mm and 450mm in thickness as required. supported by RC concrete pillars for newly build sections. Existing sections retained
Roof – main	Existing structure (No embodied emissions), Insulation (Kingspan Kooltherm K7 62.5mm minimum), Insulated plasterboard to interior (Kooltherm K18)
Roof – Extension	Bauder green roof assembly, Ply Sarking board (18mm), RC concrete slab (250mm) supported by RC concrete pillars, insulation (Kingspan Kooltherm K7 62.5mm minimum), insulated plasterboard to interior (Kooltherm K18)
External Walls	New sections to be built according to new build specifications seen below. Existing Masonry, timber battens, Insulation (Kooltherm K118, 60mm)
Internal walls	Existing masonry, New internal walls to be built to new build specification seen below

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 Part L 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
External Walls	0.55 W/m^{2}K
Roof – main	0.16 W/m^{2}K
Roof – Extension	0.12 W/m^{2}K
Windows	1.2 W/m^{2}K, g=0.85
External Doors	1.2 W/m^{2}K
Air tightness	8 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 replaced. The nature of the existing property means that the air permeability rate cannot be reduced to the level in which an ASHP could be utilised, as such a modern gas boiler is used. The details of these services can be found below in table 3.3

Element	Proposed Specification
Heating	Mains Gas boiler, 91% efficient, 500l cylinder, Heat emitters: rads, controls: programmer, thermostat and TRVs
Ventilation	Natural + Doc F compliant extract
Hot Water	As heating
Lighting	Low energy light fittings throughout

Table 3.3 Existing building services.

4 Proposed development

4.1 Building Fabric

The proposed development comprises the demolition of the existing building at 4 Oak Hill park. The proposed design would then be constructed in its place. The front-facing façade of this design is almost identical to the existing building in shape and scale but utilises brick at lower levels and reconstituted stone on the upper floors. The proposed design is set over 2 floors: Ground and 1st.

New external front and rear walls will be of a brick and block cavity construction with partial fill cavity insulation(100mm), 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 steel, thermally broken windows on the rear will also produce a significant improvement over the existing units. New ground floors will be a 300mm RC raft supported by RC pile foundations, The buildings frame is of an RC concrete construction in which columns and structural walls of RC concert support the upper floors . these are of an RC concrete construction with a slab thickness of either 300mm or 450mm as required. As in the refurbishment case, an 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.

New roofs will be formed of a 250mm concrete slab and will feature a Bauder Biosolar System on top of 2 layers of 100mm Kingspan K12 insulation.

Internal walls will be steel framed partitions with plaster board and a 3mm skim coat of plaster.

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 is very difficult to 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. This allows for the use of renewable energy technologies for the provision of heating and hot water. In this case the proposal is to utilise a 14 KW ASHP alongside an electric top up.

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.
Ground Floor	300mm concrete raft, 3mm screed skim coat
Upper floors	RC concrete slab varying between 300mm and 450mm as required
Roof – main	Bauder green roof assembly, Ply Sarking board (18mm), RC concrete slab (250mm) supported by RC concrete pillars, insulation (Kingspan Kooltherm K12 2*100mm).
External Walls	Brick to lower level, reconstituted stone to upper level, insulation (Kingspan Kooltherm 106 or 108 cavity board 100mm), Lightweight blockwork (100mm), dabs, plasterboard, plaster (3mm skim)
Internal walls and partitions	92mm metal stud framework, 21mm plywood, 15mm plasterboard, 3mm skim finish
Windows	New steel thermally broken system 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
External Walls	0.14 W/m^{2}K
Roof	0.11 W/m^{2}K
Windows – front	0.80 W/m^{2}K
Roof lights	1.2 W/m^{2}K
External Doors	1.2 W/m^{2}K
Air tightness	3 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 14kw Mitsubishi ECODAN 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 4 kWp solar array is to be placed on the upper section of the flat green roof to supply renewable energy, further reducing energy demand from grid-supplied electricity.

Services Element	Estimated Performance
Heating	ASHP 14kw, 344% efficient underfloor heating, Time and temperature zone control
Ventilation	Natural ventilation + doc F compliant ventilation
Hot Water	As heating with additional electric boiler top up (100% eff)
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 refurbishment of 4 Oak Hill Park results in a lifetime emission of 123,111 kgCO2e while the demolition and rebuilding of this property would emit 271,134 kgCO2e of life cycle emissions.

RICS Category	LC Emissions – Refurb (kgCO2e)	LC Emissions – New build (kgCO2e)
Substructure	37281	100050
Frame	6390	10807
Upper Floors	21151	48270
Roof	20726	37682
Stairs & Ramps	173	173
Ext. Walls	17665	38225
Int. Walls & Partitions	1945	12562
Construction site activities	17505	21400
Demolition	272	1961
Total (kgCO2e)	**123111**	**271134**

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 2,692 kgCO2e/year.

	Gas			Electricity			Total Energy (kWh/yr)	Total CO_2 (kg/yr)
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)		
Refurb	23347	3025	**26372**	75	883	**958**	**27330**	**5761**

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

	Electricity				
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr	Electricity CO_2 (kg/yr)
New build	9865	2272	1033	**13170**	**3068**

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 out performs the refurbishment option with life cycle emission of 455,267kgCO2e and 468,804 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)
Substructure	37281	100050
Frame	6390	10807
Upper Floors	21151	48270
Roof	20726	37682
Stairs & Ramps	173	173
Ext. Walls	17665	38225
Int. Walls & Partitions	1945	12562
Construction site activities	17505	21400
Demolition	272	1961
Operational energy use	345692	184133
Total (kgCO2e)	**468804**	**455267**

Table 5.3 Life cycle emissions including lifetime operational energy use.

6 Conclusion

This report summarises the lifecycle carbon assessment for the development at 4 Oak Hill Park 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 4 Oak Hill Park 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 **271,134**kgCO2e. The difference in operational energy emissions between the new proposed development and the existing building is **2,692** kgCO2e/year. This indicates that the emissions from the construction and running of the new proposed development will be less then emissions from the continued running of the building in its current state well within the 60 year timeframe of the assessment.

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