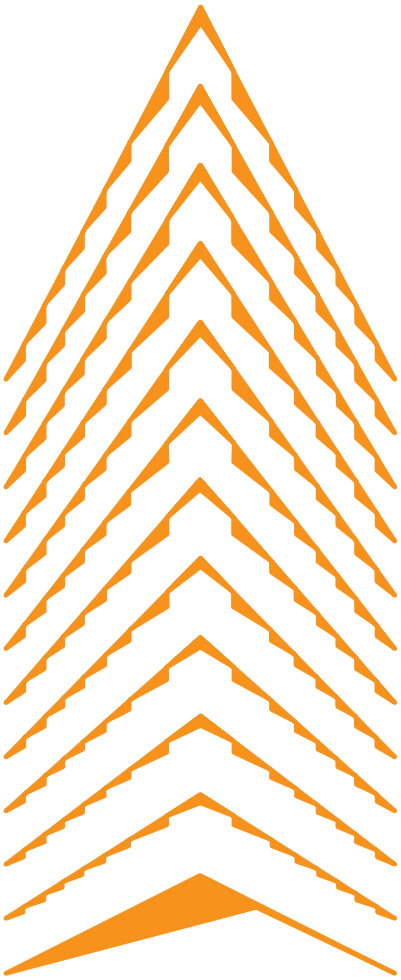

Kensington Forum

QUEENSGATE INVESTMENTS Rockwell

Kensington Forum Hotel – London

WHOLE LIFE CYCLE ASSESSMENT | JULY 2020

Date: 22/07/2020
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1.0 INTRODUCTION

Mainer Associates have completed a whole life/embodied carbon analysis (LCA) on the proposed Kensington Forum development in London, quantifying the as-designed embodied carbon emissions expressed as $kgCO_2e$. This analysis has been undertaken in accordance with the RICS Professional Statement (PS) *Whole Life Carbon Assessment for the Built Environment*. Mainer Associates have used One Click LCA software to complete this analysis, a recognised LCA software listed in the GLAs Draft Whole Life Carbon Assessment Guidance.

There are a number of interpretations on how embodied carbon, along with its assessment and quantification, can be defined. This assessment has primarily covered building life cycle stages (Table 1) A1-A5, B4 and C1-C4, and as such primarily focuses on definition1 and 2.

1. Embodied carbon assessment of built structures upon the point of practical completion – Stages A1-A5.
2. Embodied Carbon over the life cycle – Stages A1-A5, B1-B6 & C1-C4.
3. Whole Life Carbon – Stages A, B, C and D.

Table 1: Building Life Cycle Modules

WHOLE LIFE CARBON ASSESSMENT INFORMATION														
PROJECT LIFE CYCLE INFORMATION														SUPPLEMENTARY INFORMATION BEYOND THE PROJECT LIFE
A1 - A3			A4 - A5		B1 - B7					C1 - C4				D
PRODUCT Stage			CONSTRUCTION Stage		USE Stage					END OF LIFE Stage				Benefits and loads beyond the system boundary
[A1]	[A2]	[A3]	[A4]	[A5]	[B1]	[B2]	[B3]	[B4]	[B5]	[C1]	[C2]	[C3]	[C4]	
Raw material extraction & supply	Transport to manufacturing plant	Manufacturing & fabrication	Transport to project site	Construction & installation procedure	Use	Maintenance	Repair	Replacement	Refurbishment	Deconstruction Demolition	Transport to disposal facility	Waste processing for reuse, recovery or recycling	Disposal	Reuse, Recovering, Recycling Potential
					[B6] Operational energy use									
					[B7] Operational water use									

Cradle to gate

Cradle to practical completion (handover)

Cradle to grave

Scope

RICS Minimum Reporting Requirements

The New Draft London Plan requires all planning applications to demonstrate they have completed LCA on the proposed design taken into planning, and confirm the 'as-designed' embodied carbon position. Embodied carbon analysis undertaken on Kensington Forum meets the following minimum reporting requires set out by the RICS PS.

- LCA is carried out before the commencement of RIBA Stage 4.
- Substructure and Superstructure are assessed as a minimum.
- Life cycle modules A1-A5, B4, and B6 are assessed.
- A standard 60-year building life span is applied.

Design Information and Material Selections

Data on materials and material quantities have been taken from the following information:

- Kensington Forum Hotel - Bulk Quantities and Qualifications
- Kensington Forum Environmental Statement Volume 1
- BRUKL Reports

The material selections on our OneClick software have been commensurate to the level of design detail at this stage. Due to time limitations on this exercise we have worked with existing information from the team that was readily available, and the detail of information reflects very early design stages. Nonetheless we have established a credible embodied carbon analysis that can be taken forward and updated with increased accuracy in subsequent design stages, should the client wish to pursue embodied carbon savings. We have achieved a 100% completeness rating and Grade A plausibility check on OneClick, meaning all required and recommended elements are present and quality of data requirements set out by the RICS PS are met.

When making material selections in the software, we have initially opted for local and regional manufacturer data on materials with environmental product declarations (EPDs). This is to offer the team an accurate embodied carbon assessment of a given material for consideration in future design and procurement stages. Where specific qualifying carbon data for materials included in this assessment were not available, similar products or generic data has been used.

Element Groups Assessed

Table 2 confirms the RICS building elements that have been assessed using the above referenced design information. Please note, completeness has been determined on the detail required at the point of practical completion to give better indication on detail required, should the design team and client want to progress the

exercise at later RIBA Stages. Therefore, the majority of assessed building elements have been marked as amber due to the level of detail in design information and Mainer's experience in LCA completeness.

Key - RICS Building Element Group	
🔴	Not assessed – No data available
🟡	Assessed – Data received
🟢	Assessed – Data received and building element complete

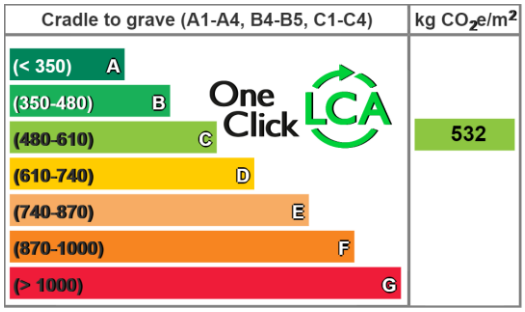
Table 2: RICS Building Element Groups

RICS Building Element Groups		
Element Group	Building Element	Stage
1. Substructure	1.1 Substructure	🟡
2. Superstructure	2.1 Frame	🟢
	2.2 Upper Floors	🟡
	2.3 Roof	🟡
	2.4 Stairs and Ramps	🟡
	2.5 External Walls	🟡
	2.6 Windows and External Doors	🟡
	2.7 Internal Walls and Partitions	🟡
	2.8 Internal Doors	🟡
3. Finishes	3.1 Wall Finishes	🟡
	3.2 Floor Finishes	🟡
	3.3 Ceiling Finishes	🟡
4. Fittings, Furnish	4.1 FFE	🔴
5. Building Services MEP	5.1 Sanitary Installations	🟡
	5.2 Services Equipment	🟡
	5.3 Disposal Installations	🔴
	5.4 Water Installations	🔴
	5.5 Heat Source	🔴
	5.6 Space Heating and Air Con	🔴
	5.7 Ventilation Systems	🔴
	5.8 Electrical Installations	🔴
	5.9 Fuel Installations	🔴
	5.10 Lift and Conveyor Systems	🟡
	5.11 Fire and Lighting Protection	🔴
	5.12 Communication and Security Controls	🔴
	5.13 Specialist Installations	🔴
	5.14 Builders Work in Connection to Services	🔴
6. Prefab Buildings and Building Units	6.1 Prefab Buildings and Building Units	⚪
7. Work to Existing Building	7.1 Minor Demolition and Alteration Works	⚪
8. External Works	8.1 Site Preparation Works	🟡
	8.2 Roads, Paths, Paving's	🟡

2.0 RESULTS SUMMARY

All embodied carbon figures will be provided in terms of global warming potential (GWP), expressed as $kgCO_2e$ or tCO_2e over a standard 60-year building lifespan.

Based on available information, the embodied carbon the of the materials and construction of Kensington Forum amounts to 51,954 tCO_2e. Information contained in BRUKL outputs indicate the operational energy of the development will in addition embody 314,610 tCO_2e over a 60-year life span, or 5,243 tCO_2e per annum. The energy strategy and performance of Kensington Forum has been addressed by other members of the design team. Therefore, to provide an insightful assessment into the sustainability on embodied impacts of materials and construction the following figures and visuals will focus on materials alone, and exclude operational energy figures.



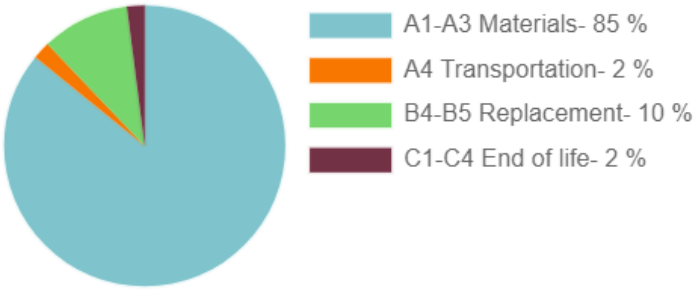


Table 3: $kgCO_2e$ by Building Elements and Life Cycle Stages

$kgCO_2e$ Building Elements and Life Cycle Stages						
Building Element	A1-A3 Extraction, Production	A4 Transport to Site	A5 Construction	B4 Replacement	C1-C4 End of Life	Total kg tCO_2e,
1. Substructure	12 493 664	262 446			93 913	12 850 023
2.1-2.4. Superstructure	11 401 449	411 336		113 223	593 043	12 519 051
2.5-2.6. Superstructure	1 065 314	3 291		339 847	9 871	1 418 324
2.7-2.8. Superstructure	6 930 028	180 967		355 809	85 334	7 552 137
3. Finishes	1 262 350	4 213		2 905 636	144 149	4 316 348
5. Services	582 559	1 563		491 309	1 524	1 076 954

kgCO_2e Building Elements and Life Cycle Stages						
Building Element	A1-A3 Extraction, Production	A4 Transport to Site	A5 Construction	B4 Replacement	C1-C4 End of Life	Total kg tCO_2e,
8. External Work	1 608 32 124	32 124		46 697		1 687 158
Construction Site Impacts (OneClick average)			2 405 438			10 527 928*
Total tCO_2e	35 349 853	895 940	2 405 438	4 205 823	974	51 54 075*
*Includes 'other materials' and annual water consumption in the total.						

3.0 RESULTS

The following section intends to outline where the most significant embodied carbon emissions lie across life cycle modules, building elements, and resource types, and should highlight to the team where efforts could be made to reduce embodied emissions in future design stages

All figures are given over the standard 60-year building life span.

Life Cycle Stages – Total $kgCO_2e$

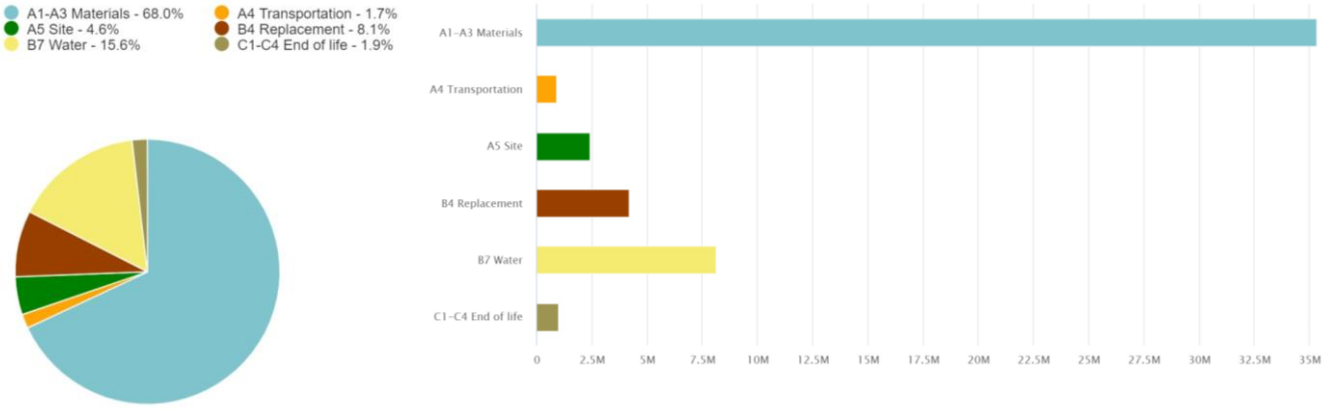


Table 3: $kgCO_2e$ by Life Cycle Stage

Life Cycle Stage	TOTAL $kgCO_2e$,
A1-A3 Extraction, Transport, Manufacture	35 349 853
A4 Transport to Site	895 940
A5 Construction	2 405 438
B4 Replacement	4 205 823
C1-C4 End of Life	974 530

RICS Building Elements - Total kgCO_2e

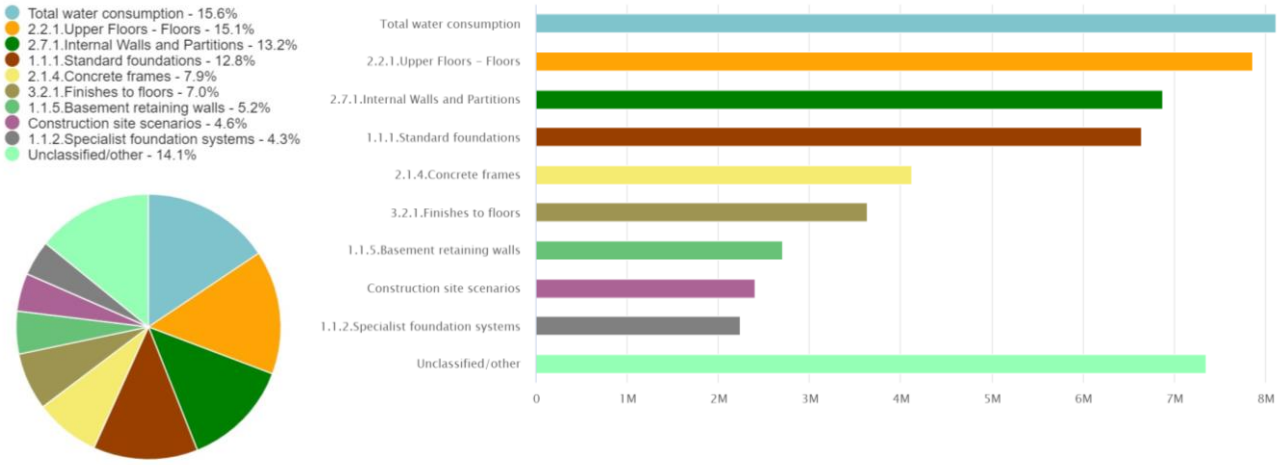
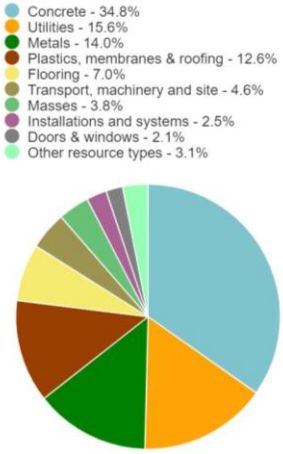


Table 4: kgCO_2e by Building Elements

RICS Building Elements	TOTAL kg CO_2e,
Water Consumption	8 100 00
2.2.1 Upper Floors	7 900 00
2.7.1 Internal Walls	6 900 00
1.1.1 Standard Foundations	6 600 000
2.1.4 Concrete Frames	4 100 000
3.2.1 Finishes to Floors	3 600 000
1.1.5 Basement Retaining Walls	2 700 00
Construction site scenarios	2 200 00
1.1.2 Specialist Foundation Systems	2 200 00
Other	7 300 000

Resource Type - Total kgCO_2e



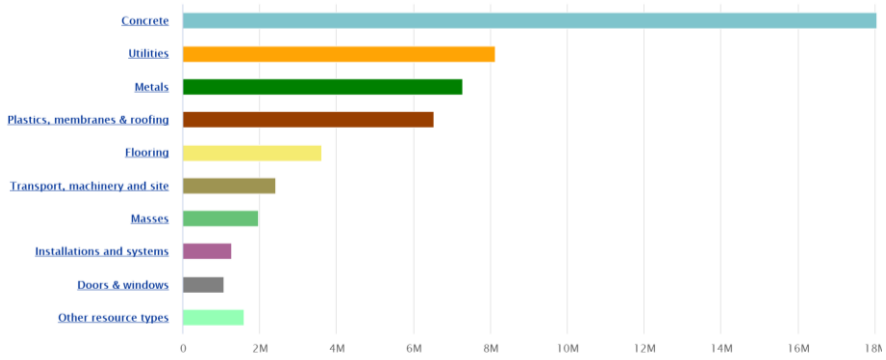
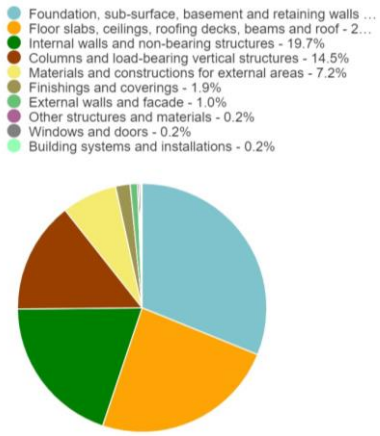


Table 5: tCO_2e Most Contributing Material, Life Cycle Stages A1-A3

Most Contributing Materials (tCO_2e)			
No.	Resource	Cradle to Gate Impacts (A1-A3)	Of Cradle to Gate (A1-A3)
1.	Ready-mc concrete high strength C50/60	10,355 tons CO_2e	29.0%
2.	Waterproofing membrane	6,465 tons CO_2e	18.6%
3.	Ready-mix concrete C32/40 CEM I	4,534 tons CO_2e	12.8%
4.	Profiled stell decking for composite floor slab	2,736 tons CO_2e	7.7%
5.	Reinforcement steel rebar	2,305 tons CO_2e	6.5%
6.	Concrete blocks	1,556 tons CO_2e	4.4%
7.	Metal framing for gypsum plasterboard	1.532 tons CO_2e	4.3%
8.	Kerbs	1 486 tons CO_2e	4.2%
9.	Carpet Tiles	832 tons CO_2e	2.4%
10.	Mineral Wool Insulation	586 tons CO_2e	1.7%

Mass by Classifications/Building Element - Total kg



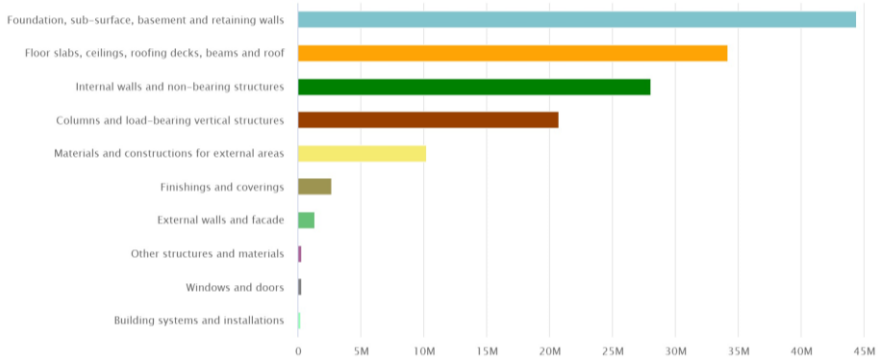
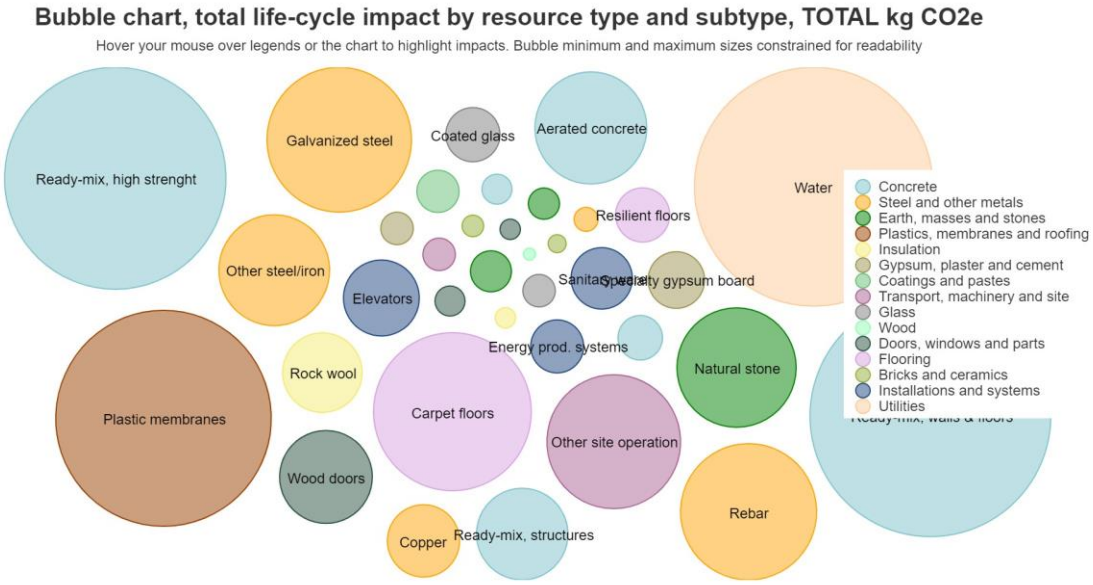


Table 6: Total Mass kg by Building Element

Classification/Building Element	Kg To nearest million	%
Foundations, sub-surface, basement and retaining walls	44 000 000	31.15%
Floor slabs, ceilings, roofing decks, beams and roof	34 000 000	23.99%
Internal walls and non-bearing structures	28 000 000	19.72%
Columns and load bearing structures	21 000 000	14.54%
External areas	10 000 000	7.18%
Finishes and Coverings	2 700 000	1.89%
External walls and façade	1 400 000	0.96%
Other structures	300 000	0.21%
Windows and doors	280 000	0.2%
Building systems	240 000	0.17%

Bubble Chart Visual - Total $kgCO_2e$



4.0 POTENTIAL EMBODIED CARBON SAVINGS

This section outlines brief recommendations on ways embodied carbon could be designed or procured out of the development in future design stages, including an initial analysis on potential savings associated with concrete.

Concrete

Ready-mix concrete throughout the substructure and upper floors embodies a significant amount of carbon, contributing a combined 34.8%. There is clear opportunity to reduce this contribution through specification of concrete with increased cement replacement. Current concrete selections have assumed CEM I specifications, meaning no cement replacement. Switching these to a specification with 50% ground granulated blast furnace slag (GGBS) replacement has significant potential to reduce embodied carbon for this material category and the development on a whole, offering a 3,024 tCO_2e saving.

The team and future contractor should consider this change and appraise against any cost or construction programme implications. There are now also more innovative products more widely available on the market whereby concrete suppliers offset embodied emissions to offer net-zero products.

This is just one material type that has undergone initial analysis and has been included here to illustrate the potential for improving the sustainability of Kensington Forum from an embodied carbon perspective. Comparative analysis could be applied to other material categories and elements where hotspots are clearly identifiable. An example would be the waterproof membrane which is the second most significantly contributing material.

Other Recommendations for Embodied Carbon Savings

- During procurement stage consider the manufacturer/supplier of weatherproofing membranes in detail. Ensure options being considered have environmental product declarations as this will allow accurate comparisons to be made.
- The majority of emissions lie in the A1-A3 life cycle stages - include embodied carbon factors in procurement decisions.
- Only procure materials with environmental product declarations for accurate comparisons and the most informed procurement choices.

- Procurement of finishes with longer lifespans e.g. carpet and ceiling tiles. The majority of embodied emissions for finishes lie in the B4 replacement stage. Longer life spans will reduce this impact. Innovative carpet suppliers such interface also now offer net-zero carpet ranges.
- Select metal and steel specifications with recycled content.
- Review the annual water consumption estimates in the Environmental Statement and look at ways to reduce this.
- Use mineral wool insulation and avoid XPS or EPS insulation types.

More generally, apply circular economy (CE) principles to every aspect of future design and build. A selection is listed here:

- Design out materials and waste.
- Apply circular economy 'R' principles to design and procurement – reuse, remanufacture and recycle.
- Design for disassembly and utilise dry construction techniques where viable.
- Procure materials from suppliers with take back schemes where possible.
- Select materials that are made from recycled content and are themselves recyclable.
- Use bio-materials where possible.
- Consider service-models and suppliers who champion 'Extended Producer Liability' (EPL). This is becoming increasingly popular with lighting and facades system.

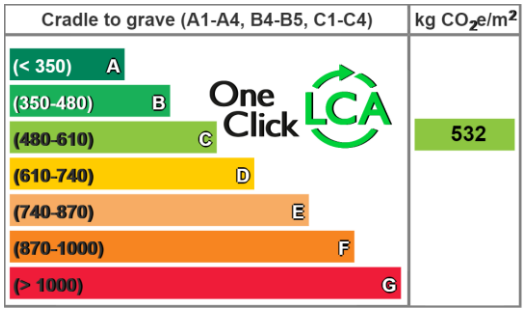
5.0 CONCLUSIONS

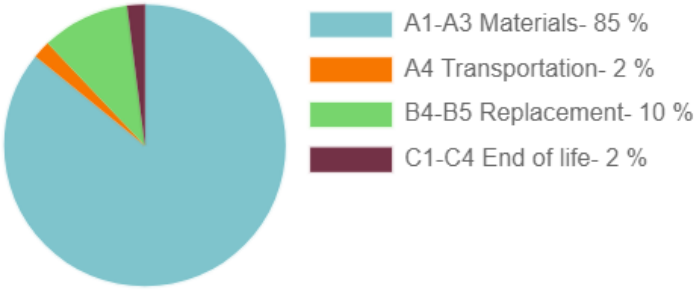
Whole life/embodied carbon analysis has been undertaken for the Kensington Forum development in accordance with the RICS Professional Statement: *Whole Life Carbon Assessment for the Built Environment.* Mainer Associates have used One Click LCA software to complete this analysis, a recognised LCA software listed in the GLAs Draft Whole Life Carbon Assessment Guidance.

The scope of this analysis, and the design information material selections and quantities have been based on is set out in Section 1.0. The embodied carbon associated with the materials and construction of Kensington Forum amounts to 51,954 tCO_2e. We have provided embodied carbon figures for the following life cycle modules over a 60-year standard life span:

A1-A3 Production, Extraction, Manufacture: 35 349 tCO_2e
A4 Transport: 895 tCO_2e
A5 Construction: 2 405 tCO_2e
B4 Replacement: 4 205 tCO_2e
C1-C4: End of Life: 974 tCO_2e
Operational Water: 8 122 tCO_2e

Consideration can also be given to the embodied emissions associated with the development's operational energy. BRUKL reports provided to Mainer Associates indicate the operational energy of the development will additionally embody 314,610 tCO_2e over a 60yr life span, or 5,243 tCO_2e per annum.





Mainer Associates have also completed the GLAs WLC reporting template (Appendix C) to the best possible detail in light of current design detail and current abilities of LCA software to disaggregate data to the template's requirements. The template is indicating 499.75kgCO_2e/m^2 GIA for modules A1-A5 which betters the GLAs benchmark for hotels, 750kgCO_2e. This is likely to increase should the embodied carbon exercise be progressed further but could be used as a guide in improving the developments sustainability.

6.0 APPENDIX

A – Data Sources

B - Detailed Report

C – Template

D – Template qualifications