

GLA Circular Economy Statement

Sproughton, 22 Courtenay Avenue



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GLA Circular Economy Statement

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Introduction

LOKI Architecture and Development has appointed Eight Versa to provide a Greater London Authority (GLA) detailed planning application compliant Circular Economy Statement to support the planning application for redevelopment of Sproughton, 22 Courtenay Avenue, London, N6 4LR.

This statement sets out how to meet the London Plan 2021 Policy SI 7 'Reducing waste and supporting the circular economy'. The Circular Economy Statement has been developed using the 'London Plan Guidance for Circular Economy Statements' issued in March 2022.

The purpose of this document is to outline actions taken to incorporate circular economy into the design. It sets out how CE principles, the concept of building in layers and appropriate design approaches have informed the design.

This document should be accompanied by the following supporting documents:

- Pre-Demolition Audit (By Eight Versa, 06 September 2023)
- Bill of Materials (Used for WLC report, 25 September 2023)
- WLC Report (Eight Versa, 25 September 2023)
- GLA CES template (Eight Versa, 27 September 2023) including recycling and waste reporting, building weight calculations & recycled content.
- Operational waste management plan (By Eight Versa, 03 September 2023)
- Circular Economy Workshop: minutes of meeting

GLA Circular Economy Statement

Sproughton, 22 Courtenay Avenue

Site Description

Description of the proposed development

The proposed project will replace the existing property with a new single dwelling that aims to have the highest possible environmental sustainability performance, alongside improved internal accommodation, and facilities more appropriate for a house in this area.

The design was driven by sustainability, which dictated the selection of materiality and enabled the power strategy to be informed by modern technology. The new house is proposed to be two stories above ground with a roof space, plus a two-level basement. The total GIA of the scheme is 2,681 m².

The location and sitting within the site are broadly similar to the existing building, although the orientation is changed as the sun path was the predominant driver in the design.

The substructure will use carbon capture and storage (CCS) by mixing an 8-10% mix of Biochar in the concrete, which reduces the CO₂ footprint of cement. The aggregate will be used from onsite rubble from demolished building masonry that wasn't suitable for re-use.

The superstructure will be constructed out of CLT and timber as the structural components. The external lime render on the facade is a natural, breathable material. The insulation will be made of hempcrete, which is carbon negative. The timber ceiling joists will be filled with air-dried clay plates, a hygroscopic material that ensures a comfortable indoor climate by controlling the humidity and tempering the temperature variations via absorption.

Description of Material reuse on site from existing structures

The proposed redevelopment consists of 13.7% material reuse from the existing building on site. A Pre-demolition audit (PDA) was conducted before making this decision. The results from the audit concluded that there is a potential to reuse approximately 275 tonnes of material, representing around 40% of total weight of material arising from deconstruction. The current structure is also at the end of its service life and does not meet the regulatory requirement of energy performance and material efficiency and the property is not used to its full potential. The detailed PDA report is attached as an appendix with this report.

The building massing is provided in figure 1a and a plan of the ground floor of the proposed scheme is shown in Figure 1b.



Figure 1a: Proposed 3D massing of the scheme



Figure 1b: Proposed ground floor plan of the scheme

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Approaches Adopted for Circularity

The circular economy design approaches can be found in the GLA CES template and are summarised below.

Existing structures design principles

The main design approach for the existing structures is *reuse and repurposing of material produced during demolition, material reuse onsite and diversion of demolition waste from landfill*.

To assess which elements and materials could be retained and reused, Pre-demolition audit has been carried out. The following has been concluded:

- The ambition for the site redevelopment is to replace the existing property with a new single dwelling that aims to have the highest possible environmental sustainability performance, alongside improved internal accommodation, and facilities more appropriate for a house in this area.
- Following the PDA, it was concluded that there was no scope to retain the existing building as it cannot deliver any of the client requirements for the project to a meaningful extent, relative to the proposed new construction (which requires the position currently occupied by the existing buildings).

During the design stage specific attention is paid by the design team to divert waste arising from the demolition works from landfill. Reusing rather than recycling items has been prioritised. It is believed that approximately 275 tonnes of material could potentially be reused, representing around 40% of the total weight of arisings. There are large quantities of weighty materials – such as concrete, brick, and timber that can be relatively easily incorporated into the new site designs.

Main design strategy - Repurposing and reuse

The following strategies have been proposed to re-use and repurpose the existing material onsite and offsite:

- Existing furniture to be **refurbished/ repurposed and reused** off site. The plan is to arrange an open house to sell/ donate the unused furniture.
- Fit-outs such as radiators, space heaters, and lighting (bulkhead and strip lighting) to be donated or recycled.

- Most of the bricks are to be **repurposed and reused on site**. Depending on the strength of the cement mortar, bricks that are unable to be reused are to be segregated either onsite or at a waste facility and crushed to produce recycled aggregate (RA) which can be used as fill material.
- Concrete blocks are to be crushed to aggregate.
- A significant proportion of the structural components will be **reused/ repurposed** by using as recycled aggregate of future sub structure and retaining wall.
- The hard landscaping concrete to be **reused** on-site during the construction period as storage yard and to be reused off site at the end of construction phase.
- Ceramic materials to be **reused off-site** (toilets and ceramic sinks).
- Any metal items that are unsuitable for reuse should be segregated on-site and sent for **recycling**.
- Smaller quantities of plastics contained within features such as guttering, window frames, and vinyl flooring are to be segregated for **recycling**.

For more detailed information on how each material will be disposed of, see the Pre-demolition Audit in the Appendices.

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New structures design principles

This section will give a summary of the circular economy approaches applied to the new proposed structure. These are further explained in the GLA CES template.

Building relocation

The building has limited potential to be relocated in entirety as it is a permanent structure with two basements, retaining wall and three above ground floors, the upper floors made of CLT columns and slab can be relocated at the end of life. Most of the components with loose fits can be easily relocated.

Component or material reuse

As stated in the previous section, the design team has conducted a PDA of existing materials to identify the potential for adaptive reuse or materials recovery. Components or materials from the existing structures are being reused on-site wherever possible. It is believed that approximately 275 tonnes of material could potentially be reused, representing around 40% of the total weight of arisings. The proposed strategies need to be finalized by the design team at a later stage.

Design for longevity

The strategy for longevity is to design with durable, high quality and low-maintenance materials. The substructure, main structural components, and façade have a long-life expectancy of 60 years. The secondary components such as windows, doors and finishes are of high quality and capable of retaining their value. The external works and internal spaces have also been designed for minimal maintenance to minimise and mitigate the need for premature replacement of components.

Design for adaptability and flexibility

The substructure and main structural elements have been designed for longevity; therefore, as these structures have a long-life expectancy, the development needs to be able to adapt to any future alterations, rearrangements or additions to suit other uses or patterns of use.

The open floor plan with non-load bearing internal partition provides a wide range of uses to be adopted. The large open space with gridiron structural elements layout makes internal structures and fit-out flexible, as they have no structural, load-bearing function and the partitions are easily movable. Future options such as an apartment building, resort, or care home are considered feasible. New stud walls can also accommodate smaller or bigger spaces for rooms and halls on the above ground floors.

Any kind of reformation could be easily achieved by the architectural strategies to provide the necessary spaces for a new enterprise. The floor-to-ceiling heights are flexible enough to accommodate any change in functionality.

In summary, the building provides relative adaptability in terms of design with a wide range of other specifications regarding fire rating, health and safety, as well as energy efficiency.

The building services are easily accessed and replaced. The equipment is modular and can be adjusted according to the user's requirements. The unoccupied areas (external and internal) of the site could be also adjusted in accordance with the new use.

Design for Replaceability

Major refurbishment for this proposed building is considered feasible. The facades will be constructed with wooden boards and glazing, where the glazing is considered to be adjustable to any change to meet the needs of the new use. Internal partition walls could be easily reformed or removed to comply with the new desired design standards. The roof could also be replaced partially or in its entirety if required by any potential future use. By placing the plant room in the -2 basement, any future modification or replacement in building services can be easily achieved without impacting the other layers of the building.

Design out waste

The team has worked closely to ensure that waste is designed out at every stage. Waste arising from the demolition of the existing structures has been minimised by reusing the existing structural demolition waste.

The main principle that has been applied to minimise waste from production and construction is by reusing as much material as possible on-site. This reduces waste from product sourcing, transportation, and construction. The site waste management plan will also include procedures and commitments to sort and divert waste from landfill. Waste arising from operations is to be reduced by setting waste targets for the scheme. Waste streams are carefully separated and sorted using signage and different bins and bins stores.

Demolition waste is reduced by choosing materials for the new structures that are reusable or recyclable at the end of life.

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End of Life Strategy

An end-of-life strategy is required as per section 4.7 of the GLA Circular Economy Guidance. It includes the end-of-life strategy for the entire development and assumptions on end-of-life scenarios for the main building elements and materials.

The development has been designed for longevity and is expected to have a life span of over 60 years. As the development has a long life expectancy, it should be able to anticipate and absorb future changes with regard to function and standards. The building design allows for ease of future refurbishment and enables the reuse of materials of the installed products at the end of life.

Communication and storage

It is essential that the End-of-Life strategy is communicated to the future building owners, managers, and occupiers. An H&S file and O&M maintenance guide and records of the development will be kept including as-built drawings, guidance in product specifications and drawings of elemental interfaces that clarify means of disassembly. This will facilitate the building deconstruction at the end of life.

Design for repair, refurbishment, refit, and end of life

The following points summarise the key building elements and their functional disassembly features, how they should be repaired and replaced and what the end-of-life scenarios are.

Structural frame

- The structural grid allows reconfiguration of the entire layout so the structure could be reused in a future redevelopment with similar use requirements, such as a residential complex, care home or resort etc. Columns and CLT floors can be disassembled into individual elements for reuse.

Floor slabs

- The floors are constructed with wooden boards and covered with paraquet finishes to protect them and elongate their durability and require little maintenance or replacement. The elements are expected to be directly reusable at end of life due to the standard sizes of the slabs.

Insulation

- Hemp insulation has been chosen over rigid insulation, as the batts are easily removable and could be directly reused or recycled.

Windows

- Windows will be triple glazed. The windows are to be of high quality, requiring minimum maintenance. Aluminium and glass can both be recycled or downcycled at the end of life.

End of Life Scenarios and design facilitation The end-of-life scenarios and how they need to be incorporated in the design are provided below.

Material	End of life scenario and design facilitation.
Aluminium	End of life scenario: Aluminium recycling. Design facilitation: Most of the aluminium is in the windows. Prefabricated windows to be specified at technical design stage which will make the recycling process easier. Material passports to be provided for ease of tracking at the end of life. Manufacturer to be chosen based on availability of take back schemes.
Bricks	End of life scenario: Brick reuse or repurposed as aggregate. (For sub-base layers) Design facilitation: Most of the brick is in the façade. Lime mortar to be used to make the end-of-life disassembly process easier as brick set in lime mortar are easy to disassemble. In case of damage to bricks during deconstruction process, the bricks can be repurposed as aggregate.
Vinyl and plastics	End of life scenario: Recycling Design facilitation: Suitable glue to be used during installation process that will make the disassembly process easier.
Concrete	End of life scenario: Crushed to aggregate. Design facilitation: Concrete elements to be designed as individual or stand-alone component. Steel is easy to segregate at the end of life and recycled in entirety but mixing concrete with other elements can add challenges to use it as aggregate.
Glass	End of life scenario: Glass recycling. Design facilitation: Most of the glass is in the windows. Prefabricated windows to be specified at technical design stage which will make the recycling process easier. Material passports to be provided for ease of tracking at the end of life. Manufacturer to be chosen based on availability of take back schemes.
Rockwool	End of life scenario: Recycling. Design facilitation: Most of the rockwool is in the insulation. Insulation rolls to be specified at technical design stage which will make the recycling process easier. Prefabricated wall unit options to be explored as well. Manufacturer to be chosen based on availability of take back schemes. Material passports to be provided for ease of tracking at the end of life.
Plasterboard	End of life scenario: Gypsum recycling. Design facilitation: Most of the gypsum is in the internal walls and ceiling. Prefabricated walls to be specified at technical design stage which will make the recycling process easier. Material passports to be provided for ease of tracking at the end of life. Manufacturer to be chosen based on availability of take back schemes.
Structural steel	End of life scenario: Steel recycling. Design facilitation: Steel elements to be designed as individual or stand-alone component. Steel is also easy to segregate at the end of life and recycled in entirety.
Timber	End of life scenario: Reuse. Design facilitation: Timber elements to be designed as individual or stand-alone component.

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Recycled content & Construction waste targets

According to policy requirements, 20% of the building material elements are to be comprised of recycled or reused content.

The targets for waste efficiency and diversion from landfill are stated below. These are the minimum local waste policy requirements.

- Diversion from landfill for reuse, recycling, or recovery:
 - Demolition: 95% tonnage
 - Excavation: 95% tonnage
 - Construction: 95% tonnage

It is expected that the contractor will monitor and record waste, water and energy use on-site which will assist in maximising the efficient use of resources. It is also expected that the main contractor will minimise the quantity of waste sent to landfill. This will be supported by:

- Pre-demolition audit (PDA) – an analysis of existing structures being considered for demolition.
- Site Waste or Resource management plan (RMP) – A management plan for waste from demolition, excavation, and construction with targets for efficiency
- Diversion from landfill records – Waste must be recorded for different waste streams and targets for diversion from landfill must be achieved.

Anticipated recycled content & waste quantities

For the CES template, the estimated Bill of Materials has been used to calculate the quantities of the main types of materials and considers the demolition of the existing structure and the newly proposed structures. Figure 2 shows a list of the main material types and the assumptions used in the estimation of waste arising from the development. The total weight of the materials in the new structures can be found in the GLA CES template and is 35,017 tonnes.

The end-of-life process, construction waste factor and recycled content are based on OneClick default values of generic materials used in the WLC assessment. Please refer to the GLA CES template for the waste arisings in tonnes and waste.

It is likely that the development will aim to have a higher recycled content than the industry averages. However, it is difficult to determine at this stage without knowledge of the specified materials and products.

Material Type	End of life process	Recycled content by mass	Construction waste factor
Aluminium	Aluminium recycling	0-80%	7.5%
Bricks	Brick/stone crushed to aggregate. (For sub-base layers)	0%	5%
Vinyl	Recycling	25%	10%
Concrete ready-mix	Crushed to aggregate	3%	4%
Concrete prefab	Crushed to aggregate	3%	0%
Concrete blocks	Crushed to aggregate	0%	7.5%
Glass	Glass recycling	0%	1%
Insulation	Up to 50% of recycling Landfill (inert waste)	75%	8%
Plasterboard	Gypsum recycling	1-25%	12.5%
Rock and stone	Brick/stone crushed to aggregate. (For sub-base layers)	0%	4.5%
Soil & aggregates	None	0%	0%
Structural steel	Steel recycling	0-90%	3.3%
Timber	Reuse and Wood incineration	0%	7.0%
Ceramic	Brick/stone crushed to aggregate. (For sub-base layers)	0%	10%

Figure 2: Assumptions for the Bill of Materials reporting

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Key commitments

The targets related to circular economy are summarised below and can be found in the GLA CES template.

	Target
1	A pre-redevelopment audit has been carried out to determine with a great degree of detail the reusability/recyclability of the materials in the existing structure.
2	A whole-life carbon (WLC) assessment in line with London Plan has been undertaken to determine the embodied and operational carbon emissions. The aim is to minimize quantities and embodied carbon of materials used.
3	It needs to be determined what percentage of the construction waste from the demolition and refurbishment will be recycled on-site and used for the development.
4	At least 20% of the content of the materials specified for the proposed building will be from either reused or recycled sources, according to the GLA's requirements. To achieve this, the quantities of purchased materials and their recycled content will be monitored throughout the procurement process. Material suppliers holding EPD or ISO 14021 certifications who will be able to demonstrate the actual recycled content will be favoured in the selection process.
5	At least 95% of the total materials specified in the proposed building should be recyclable at the end of their life. To achieve this, the quantities of purchased materials and their recyclability properties will be monitored throughout the procurement process. Material suppliers holding EPD or ISO 14021 certifications who will be able to demonstrate the actual recyclability will be favoured in the selection process.
6	At least 65% of operational/municipal waste will be recycled by 2030. To achieve this, waste management strategy and policy need to be established.

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Appendices

1. WLC Report (Eight Versa, 25 September 2023)
2. Pre-Demolition Audit (By Eight Versa, 06 September 2023)
3. Bill of Materials (Used for WLC report, 25 September 2023)
4. GLA CES template (Eight Versa, 27 September 2023) including recycling and waste reporting, building weight calculations & recycled content.
5. Operational waste management plan (By Eight Versa, 03 September 2023)
6. Minutes of meeting

[illegible]

Consider Recovery Design Principles by Building Layer Consider Recovery Design Principles by Building Layer, which the design team is to discuss and describe. Please use the Recovery Design Principles to inform your discussion.	
Building Layer (e.g., Foundation, Structure, Envelope, Systems, etc.)	Design Team Discussion
Building Envelope	Address 1. Recovery Planning and Implementation Plan Address 2. Design Goals Address 3. Design Goals Address 4. Results and Goals Recovery System Results
Building for Resilience	Building for Resilience
Building for Sustainability	Building for Sustainability
Building for Resilience	Building for Resilience
Building for Sustainability	Building for Sustainability

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Whole Life Carbon - RIBA Stage 2

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Whole Life Carbon - RIBA Stage 2

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Executive summary

Introduction

Eight Versa has undertaken a whole life carbon (WLC) assessment to support the planning application for the proposed redevelopment works to Sproughton, 22 Courtenay Avenue, London, N6 4LR. The results presented in this report are in line with ISO 14040:2006, ISO 14044:2006, and EN 15978:2011 standards. The methodology followed is also aligned with the RICS's Whole Life Carbon Assessment for the Built Environment Professional Statement and GLA whole life carbon guidelines.

The purpose of this report is to provide insight into the development's environmental profile by measuring the carbon emissions over its entire life span. These results can be used to give an indication of the performance of the development in comparison with industry benchmarks or internally set targets. The analysis highlights carbon hot spots, which could potentially be a focus for carbon emission reduction measures.

Project description

The proposed project will replace the existing property with a new single dwelling that aims to have the highest possible environmental sustainability performance, alongside improved internal accommodation, and facilities more appropriate for a house in this area. The design was driven by sustainability, which dictated the selection of materiality and enabled the power strategy to be informed by modern technology. The new house is proposed to be two stories above ground with a roof space, plus a two-level basement. The total GIA of the scheme is 2,681 m².

The proposed redevelopment will consist of 13.7% reused materials from the existing building on site.

A Pre-demolition audit (PDA) has been conducted which concluded that there is a potential to reuse approximately 275 tonnes of material, representing around 40% of total weight of material arising from deconstruction. The current structure is also at the end of its service life and does not meet the regulatory requirement of energy performance and material efficiency. The detailed PDA report is attached as an appendix with this report.

Summary

The carbon emissions of the scheme are approximately:

- Upfront embodied carbon: A1-A5: **164** kgCO₂e/m²
- In-use and end-of-life embodied carbon: B-C (excluding B6-B7): **350** kgCO₂e/m²
- Whole life embodied carbon (A-C, excluding B6 -B7, including seq.): **282** kgCO₂e/m²
- Total whole life carbon (including B6 and B7 and seq. carbon): **616** kgCO₂e/m²

As part of the analysis, it has been identified that the greatest source of whole life carbon emissions is Construction product stage (A1-A3) followed by Operational emissions (B6). Therefore, particular focus should be paid to these sources to reduce carbon during future design decision-making.

In terms of performance, this project achieves a rating better than A+ (LETI targets) The project exceeds the extrapolated design targets for 2020-2030 and the aspirational targets set by GLA.

The options appraisal includes suggested changes to aspects of the design that may reduce the embodied carbon. The options appraised (from a carbon emissions point of view) should continue to be evaluated by the design team to determine suitability. Where they show a significant reduction in carbon emissions and are deemed suitable, they should be incorporated into the design. Further information can be provided to assist with this if required.

Whole Life Carbon - RIBA Stage 2

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Methodology

Life Cycle Assessment

The WLC assessment has been undertaken using 'One-Click LCA' building life cycle assessment software with the following principal data sources:

- Design and quantity information provided by the design team available at RIBA Stage 2, where quantities are missing One Click carbon designer model, templates and assumption on typical materials that make up a single-family dwelling are used.
- Energy consumption data provided by SAP 10.2.
- LCA data source(s): One-Click LCA (GLA/RICS) generic and product specific EPDs

The results presented are global warming potential.

Life Cycle Assessment (LCA) is a method for assessing potential environmental, resource and other impacts of a system including products, buildings, events and services. A LCA can provide cradle-to-grave results of the system including upstream and downstream factors. A graphical illustration of typical LCA stages is shown in Figure 1.

Buildings are a significant source of carbon emissions globally. These emissions occur due to construction products and activities as well as consumption of energy and water during use.

The environmental impact of a building can be reduced by designing for lower energy consumption and by consuming less construction products by opting for refurbishment over new-build and by integrating material efficiency design approaches. In addition, products that have a lower environmental impact should be selected.

Existing buildings are responsible for a major share of energy use and greenhouse gas emissions. Refurbishment of existing buildings may improve operational energy performance but will likely cause environmental impacts due to the newly installed construction products and components added to improve energy performance. However, new buildings, while potentially more energy efficient, typically use more construction products and therefore often have higher upfront construction carbon emissions compared with refurbishment.

To address these trade-offs and establish which approach will have the least environmental impact, it is essential to take a life cycle approach. Conducting an LCA will provide insight into the development's environmental profile including appraisal of options under consideration by the project team.



Figure 1: Stages included within an LCA.

Whole Life Carbon - RIBA Stage 2

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Study Boundary

To undertake a WLC assessment of a building, different aspects need to be considered at different life stages. What is and is not included is referred to as the scope of the assessment and different methodologies call for different scopes. This calculation is based on the assessment of:

- All construction elements
- Coverage of at least 95% of the construction cost, in the absence of a cost plan from the project quantity surveyor all the materials that make up the project are included in the assessment.

The following life stages are included in the scope of this assessment: -

- A1-A3: Product stage – raw materials supply, transport and manufacturing
- A4: Transport of the products to the construction site
- A5: Construction of the building
- B1: Use
- B2-B3: Maintenance and repair
- B4-B5: Material replacement and refurbishment
- B6: Operational energy use
- B7: Operational water use
- C1-C4: Deconstruction/demolition, waste processing and disposal
- D: Reuse, recovery and recycling potential

This assessment includes the following: Substructure; Frame; Upper Floors; Roofs; Stairs and Ramps; External Walls; Windows & Doors; Internal Walls; Internal Doors; Wall Finishes; Floor Finishes; Ceiling Finishes; FFE; Building Services; External works.

Study Period

The study period for this project is 60 years.

Assumptions and Standards

The following data has been used for this assessment:

- London Plan Guidance, Whole life-cycle carbon assessment, March 2022
- Design and quantity information provided by the design team available at RIBA Stage 2
- Where no or insufficient information was provided, Eight Versa have endeavoured to use reasonable assumptions.
- REEB operational water consumption data (unless specific water consumption data was provided by the design team)
- Average transport values for the UK, according to One-Click LCA (GLA/RICS) database
- Operational energy consumption data provided by SAP 10.2

The software used to undertake the analysis is One-Click LCA, which complies with:

- ISO 14040 2006: Environmental management – Life cycle assessment – Principles and framework
- ISO 14044 2006: Environmental management – Life cycle assessment – Requirements and guidelines
- EN 15978 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method

The results shown in this report do not consider any future decarbonisation for construction products.

Operational energy: Not decarbonised - to 'SAP 10.2' (PART L 2021).

A detailed schedule of items included in the assessment and associated factors is presented in the appendix B.

Assessment completion and quality assurance processes

The assessment is based on a bill of materials produced by Eight Versa based on information available at the design stage and includes all the assumptions made to ensure the assessment represents 100% of the permanent material required to complete the construction. The Bill of materials has been attached in the appendix and items included in the assessment are highlighted in green to demonstrate that **100%** of the material quantities have been included.

The model and report have been internally verified by Eight Versa. The following verification processes have been used to ensure the accuracy and completeness of the assessment:

- The verifier is not involved in the project.
- The verifier and assessor have received training on using the building LCA tool that is recognised by the tool supplier (One-Click).
- The verifier and assessor have completed at least 20 different building LCAs for paying customers in the last two years. The verifier and assessor can interpret construction documentation (drawings, specifications, schedules etc.), evidenced by a suitable construction-related qualification and relevant experience.

Whole Life Carbon - RIBA Stage 2

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The scheme

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The design was driven by sustainability, which dictated the selection of materiality and enabled the power strategy to be informed by modern technology. The new house is proposed to be two stories above ground with a roof space, plus a two-level basement. The total GIA of the scheme is 2,681 m².

The location and sitting within the site are broadly similar to the existing building, although the orientation is changed as the sun path was the predominant driver in the design.

The substructure will use carbon capture and storage (CCS) by mixing an 8-10% mix of Biochar in the concrete, which reduces the CO₂ footprint of cement. The aggregate will be used from onsite rubble from demolished building masonry that wasn't suitable for re-use.

The superstructure will be constructed out of CLT and timber as the structural components. The external lime render on the facade is a natural, breathable material. The insulation will be made of hempcrete, which is carbon negative. The timber ceiling joists will be filled with air-dried clay plates, a hygroscopic material that ensures a comfortable indoor climate by controlling the humidity and tempering the temperature variations via absorption.

Description of Material reuse on site from existing structures

The proposed redevelopment consists of 13.7% material reuse from the existing building on site. A Pre-demolition audit (PDA) was conducted before making this decision. The results from the audit concluded that there is a potential to reuse approximately 275 tonnes of material, representing around 40% of total weight of material arising from deconstruction. The current structure is also at the end of its service life and does not meet the regulatory requirement of energy performance and material efficiency and the property is not used to its full potential. The detailed PDA report is attached as an appendix with this report.

The building massing is provided in figure 2a and a plan of the ground floor of the proposed scheme is shown in Figure 2b.



Figure 2a: Three-dimensional view of the proposed development showing building massing.

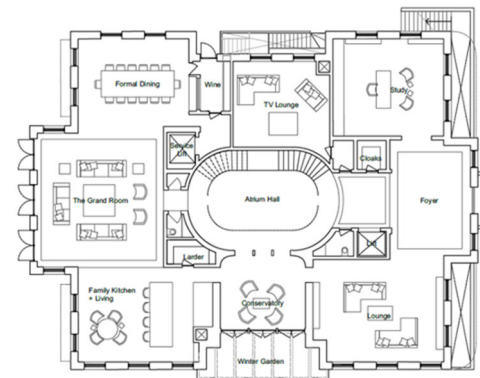


Figure 2b: Plan of the proposed ground floor layout

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LCA Results

Overview - Whole life carbon (life cycle modules A-C)

The following presents the whole life carbon results for the project. Whole life carbon refers to the carbon emissions from all life cycle stages of a building from cradle to grave, including operational energy and water, over the study period of **60 years**. The results may be used as the basis for comparison of the carbon emissions of different design options and for comparisons with other projects or industry benchmarks.

Whole life embodied carbon includes manufacturing, transport, construction, in-use, and deconstruction of construction products. The whole life embodied carbon emissions for this project, the sum of life cycle modules A1-A3, A4, A5, B1-B5 and C1-C4, is **515 kgCO₂e/m²**, while the results for all the modules and including the sequestered carbon (Biogenic carbon) is **282 kgCO₂e/m²**. This difference is due to use of CLT and timber for the structure.

Total whole life carbon, all modules including operational energy and water and excluding sequestered carbon, is **685 kgCO₂e/m²**. The total whole life carbon including all the modules and sequestered carbon, is **452 kgCO₂e/m²**.

The table below provides a summary of the carbon emissions for each stage. A detailed reporting table is presented in appendix A.

Life Cycle Stage/Module	Global warming potential [kg CO ₂ eq.] (incl. biogenic carbon)
Construction product stage (A1-A3)	368,815
Transportation to site (A4)	5,911
Construction installation process (A5)	65,223
Use (B1)	130,260
Maintenance and repair (B2-B3)	30,672
Replacement and refurbishment (B4-B5)	133,028
Operational Energy (B6)	453,933
Operational Water (B7)	2,304
End of Life (C)	647,050
TOTAL	1,212,716
Total biogenic carbon (A1-A3)	-624,480
Future reuse, recovery, and recycling potential (D)	-305,872

The D stage has been calculated as a potential figure, based upon OneClick default assumptions.

An elemental breakdown of Whole life carbon of the building shows that the biggest source of emission is the operational energy (regulated energy, unregulated energy, and water use). This is due to the 60 years study period. Building services and upper floor are the next two biggest sources of whole life carbon emissions, both account for 15% of the total project emission each. Currently the building services model is based on the GIA of the building and includes all the elements associated with electrical, mechanical, and plumbing installations. The results also include the replacements, and the replacement period is modelled based on CIBSE guidelines. Upper floors include three floor slabs and all the associated horizontal supports (beams and fixtures required)

Figure 3 shows the breakdown of whole life carbon by elemental category.

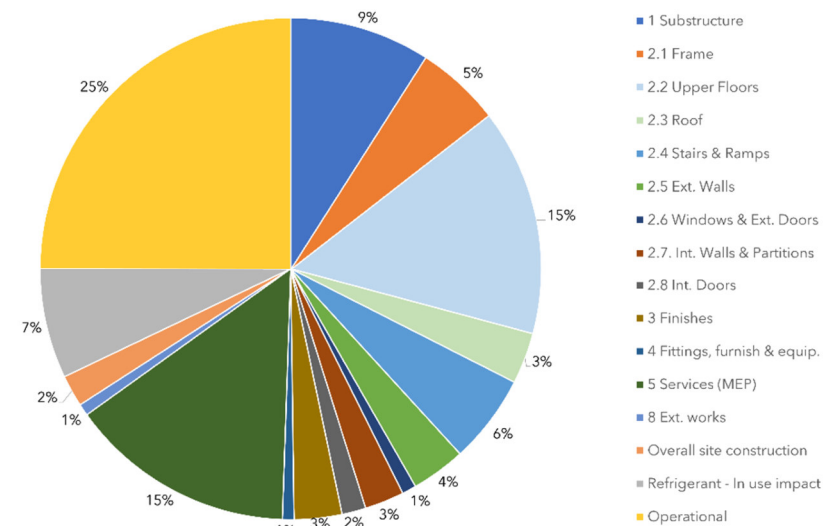


Figure 3: Whole life carbon breakdown by element [Global warming potential [GWP, kg CO₂e]]

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Overview - Upfront carbon (life cycle modules A1-A5)

The following presents the upfront carbon results for the project. Upfront carbon refers to the carbon emissions from the construction life cycle stage of a building from cradle to practical completion. This may be used as the basis for comparing the construction carbon emissions of different projects and options or as a comparison to industry benchmarks. It may be used as the basis of offsetting carbon - for the project to be considered 'Net zero-carbon - construction'.

Total upfront carbon emission for this project is **164 kg CO₂e/m² GIA**.

Figure 4 and 5 shows a detailed breakdown of upfront embodied carbon by elemental category and life cycle module. The analysis shows that the biggest source of upfront embodied carbon emission is building services equipment, the development has a ground source heat pump which has high embodied carbon associated with it. Additionally, substructure and super structure has optimized design at this stage and most of superstructure is CLT and timber based which has very low embodied carbon but building services are modelled based on typical single family dwelling data.

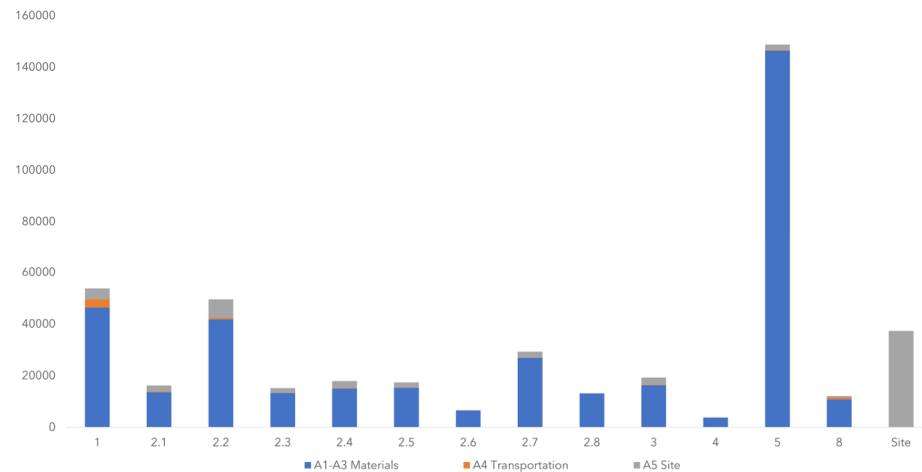


Figure 4: Upfront embodied carbon detailed breakdown [Global warming potential [GWP, kg CO₂e]]

Overview - Life cycle assessment

The assessment shows that the greatest source of whole life carbon emissions over the study period will come from Construction product stage (A1-A3) followed by Regulated operational emissions (B6a) and Replacement and refurbishment (B4-B5).

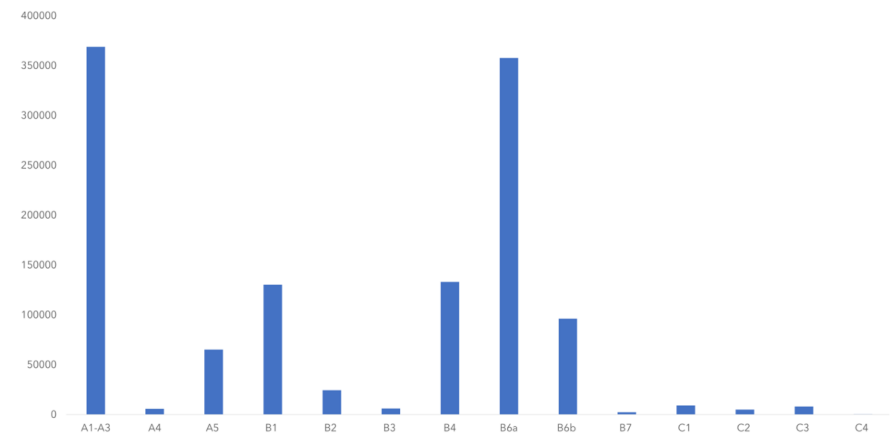


Figure 5: Upfront embodied carbon detailed breakdown [Global warming potential [GWP, kg CO₂e]]

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WLC reduction actions - Included in assesment

Several actions have been analysed that have reduced the whole life carbon of the project. These actions have either been supplied by the design team as part of the design process or have been chosen by the LCA consultant as suggestions, taking into consideration the type of building and suitability of the change.

The following table and figures show the design options appraised at this stage and their associated changes. For each design option, the changes and results are expressed compared with the baseline design (negative numbers represent the excessive carbon compared to the baseline design shown as blue line).

Design option	Change(s) from baseline	A-C Total kg CO ₂ e/m ² compared to current baseline
1	Timber and CLT superstructure chosen against industry baseline/ typical practice of concrete structure. Both are modelled using the Carbon designer tool of One Click LCA, to ensure fair comparison. For the concrete model substructure has concrete foundation with 20% GGBS replacement and 97% recycled content in reinforcement (Industry average). The superstructure is also made of reinforced concrete columns, beams, upper floor slabs and roof. For the chosen option, which is CLT and timber, the substructure is made of low embodied carbon concrete mix with 8-10% Biochar and recycled aggregate from demolished building masonry that wasn't suitable for re-use. The beams, columns, slabs are all made up of CLT and timber.	183.59
2	Tufted wall-to-wall carpet, 6.6mm, 3.15 kg/m ² , pile material 80% wool, 20% PA with a textile acoustic backing compared with wooden floor finishes. Wooden finishes have been chosen as the sustainable option as it needs no replacement compared to carpet needing a replacement every 15 years.	38.74
3	Mineral wool insulation compared with hemp insulation. Hemp has been chosen for its lower embodied carbon and higher biogenic carbon content	5.22

Figure 6: Options compared with baseline.

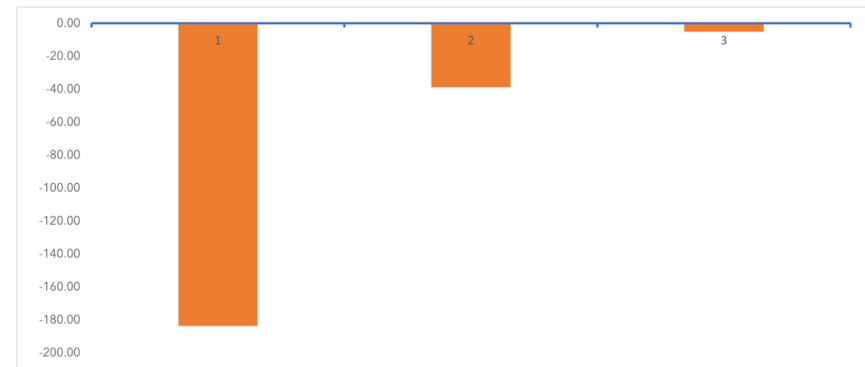


Figure 7: Upfront embodied carbon (Life cycle modules A1-A5) options compared with baseline [GWP, kg CO₂e / m² GIA]

The first action has resulted in massive saving of 184 kg CO₂/m². The concrete structures' carbon emissions are roughly 230% of the chosen timber structure. The baseline design has also been optimized by using recycled aggregate and using industrial byproducts as cement replacement.

The second action has reduced the whole life carbon emission of the project by 38.74 kg CO₂/m². This is mainly due to frequent replacements of wall-to-wall carpet, the chosen floor finish in the current baseline of the project is wooden paraquet flooring. It has low embodied carbon and needs no replacement throughout the service life of the building.

The third action shows a comparison of different insulation types. In the current baseline of the project, hemp insulation has been considered instead of the industry standard of using mineral wool insulation. Hemp has been chosen for its lower embodied carbon and higher biogenic carbon content.

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WLC reduction actions - To be explored at later stages

Options appraisal considers changes to aspects of the design that may reduce the embodied carbon at further stages of the project.

The options appraised (from a carbon emissions point of view) should continue to be evaluated by the design team to determine suitability. Where they show a significant reduction in carbon emissions and are deemed suitable, they should be incorporated into the design. Further information can be provided to assist with this if required.

The following table and figures show the design options appraised at this stage and their associated changes. For each design option, the changes and results are expressed compared with the baseline design (e.g., an option with a negative number is an improvement over the baseline design).

Design option	Change(s) from baseline	A-C Total kg CO ₂ e/m ² compared to current baseline
1	Blown cellulose insulation option to be explored for roof in comparison to hemp insulation.	-0.48
2	50% of the stairs to be steel and 50% CLT, currently the stairs have a high impact and options to reduce that can be explored in the future by looking for options of light weight steel structure for the secondary stairs	-0.84

Figure 8: Options compared with baseline.

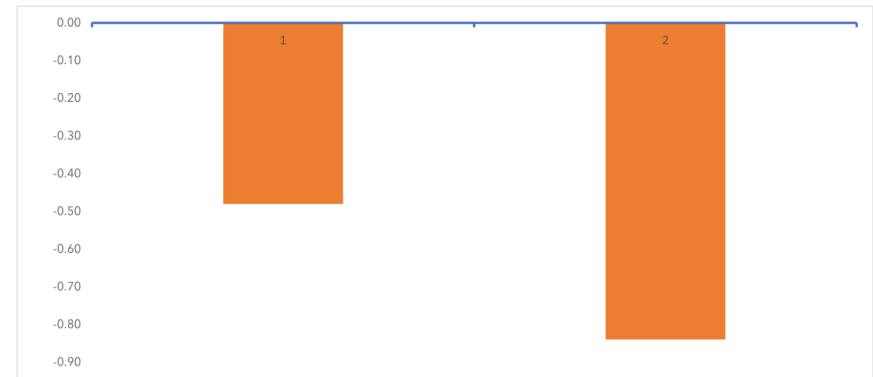


Figure 9: Upfront embodied carbon (Life cycle modules A1-A5) options compared with baseline [GWP, kg CO₂e / m² GIA]

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Net Zero Carbon - Construction

Net zero carbon - Construction

In outline, a 'Net Zero Carbon (NZC) - Construction' project is a project where the following are met after practical completion using as-built information: -

- The building's upfront carbon has been measured.
- The buildings whole life carbon has been measured.
- The project team can justify that they reduced upfront carbon emissions during the design stages as far as the reasonably can
- The remaining 'residual carbon' emissions (that could not be mitigated) are offset using a suitable offsetting scheme

Carbon reduction - Construction

Depending on the NZC scheme applied for, there is currently little firm guidance in terms of how much upfront carbon emissions should be reduced by. The following examples may be applicable in justifying the claim:

- Demonstrate that the project carried out options appraisal and selected favourable options
- Demonstrate the project has met a recognised best practice target or benchmark

In terms of the former, option appraisal is a project specific activity that is often carried out as part of building LCA.

In terms of the latter, a number of industry benchmark initiatives have begun to gain recognition in the last few years including the following: -

- LETI ([link](#))
- RIBA 2030 Climate Challenge ([link](#))

These two sources are aligned for whole life carbon (A-C). For NZC - Construction however, the LETI source is more relevant as upfront targets have been published alongside whole life targets, whereas RIBA only publish whole life targets.

Both sources only cover a limited range of high-level building types and assume new build rather than refurbishment. This needs to be considered when selecting the most suitable target and when interpreting results as an indication of performance. The most suitable benchmark for this project is **LETI Residential**.

As shown in figure 10, the LETI benchmarking system presents an A++ to G range of performance that is visually like the scaling system seen on white goods. Each level has a numerical upfront target for a limited range of building use types. Key levels include:

- 'E' - Representing 'Current Average Building Design' (of 2020)
- 'C' - the LETI Design 2020 target (for buildings being designed between 2020 and 2030)
- 'A' - the LETI Design 2030 target (for buildings designed from 2030)

Upfront Embodied Carbon, A1-5 (exc. sequestration)

	Band	Office	Residential (6+ storeys)	Education	Retail
	A++	<100	<100	<100	<100
	A+	<225	<200	<200	<200
LETI 2030 Design Target	A	<350	<300	<300	<300
	B	<475	<400	<400	<425
LETI 2020 Design Target	C	<600	<500	<500	<550
	D	<775	<675	<625	<700
	E	<950	<850	<750	<850
	F	<1100	<1000	<875	<1000
	G	<1300	<1200	<1100	<1200

Figure 10: LETI upfront carbon targets

This project achieves a rating **better than A+**. The project meets extrapolated design targets for 2020-2030.

Recommendations to achieve "better than A++" LETI band

The following recommendations can help design team achieve better performance for embodied carbon targets.

- The analysis concluded that the biggest source of upfront emissions is building services equipment and upper floor slabs, in the future stages using more efficient design and precise quantities can help project lower its emissions
- After maximizing the opportunities from concrete quantities reduction in substructure, the amount of recycled content (Ground granulated blast furnace slag (GGBS), and fly ash) can be increased as much as possible based on input from the structural engineer to further lower emissions.
- Currently, due to lack of information regarding material to be specified, generic EPDs (Environmental product declarations) are used. Specifying products manufactured by local facilities using green energy and local materials can help project achieve better LETI targets.

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Conclusions

The assessment concludes that the greatest source of whole life carbon emissions over the study period will come from Construction product stage (A1-A3) followed by Operational emissions (B6).

It should be noted that when implementing more sustainable materials specification, careful consideration should also be given to the lifespan of a given material or element options as multiple replacements can significantly increase the embodied carbon emissions. A schedule of replacement rates used in this study has been provided in the Appendix B for reference.

The options appraisal includes suggested changes to aspects of the design that may reduce the embodied carbon. The options appraised (from a carbon emissions point of view) should continue to be evaluated by the design team to determine suitability. Where they show a significant reduction in carbon emissions and are deemed suitable, they should be incorporated into the design. Further information can be provided to assist with this if required.

In terms of performance, this project achieves a rating better than A+ (LETI targets) The project exceeds the extrapolated design targets for 2020-2030 and the aspirational targets set by GLA.

Recommendations for further work

A subsequent analysis should be undertaken post-construction (i.e. upon commencement of RIBA Stage 6 and prior to the building being handed over, if possible).

During an as-built update, it is expected that major assumptions will be eliminated as accounting for Environmental Product Declarations where possible. Should the project be aiming for 'Net Zero Carbon - Construction', an assessment at this stage is required.

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Appendix A - Detailed reporting table

Result category	Biogenic carbon	A1-A3	A4	A5	B1	B2	B3	B4-B5	B6 Regulated	B6 Upreg.	B7	C1	C2	C3	C4
Demolition												9115.4			
Substructure	-105209	46349.81	3168.16	4210.04		3,274.1	818.5						1629.9	106094.6	109.41
Frame	-81657	13576.72	236.37	2330.28		983.8	245.9						200.46	82263.23	
Upper Floors	-212546	41780.65	593.52	7099.91		3,014.9	753.7						450.07	213986.8	18.67
Roof	-34415.31	13240.85	129.15	1809.63		925.0	231.3	7155.69					129.41	36699.83	11.76
Stairs & Ramps	-84826	15005.91	232.26	2674.79		1,091.6	272.9						178.66	85426.38	
Ext. Walls	-44135	15262.5	174.4	1875.97		1,055.0	263.8	638.38					122.12	44670.92	39.25
Windows & Ext. Doors	-3899	6454.41	50.17	166.02		406.5	101.6	5462.51					137.55	3923.55	0.76
Int. Walls & Partitions	-14723	26892.76	86.93	2268.73		1,782.4	445.6						198.38	14749.52	65.98
Int. Doors	-13963	13063.08	42.78	0		798.7	199.7						32.91	14052.11	4.47
Finishes	-27606	16269.86	199	2798.93		1,174.2	293.5	6186.16					188.19	28989.93	91.97
Fittings, furnish & equip.	-1497	3753.4	10.24	53.96		232.6	58.2	7949.08					13.31	1507.38	0.51
Services (MEP)		146357.1	299.1	2080.59		9,063.8	2,266.0	105636.5	357644.6	96288	2303.88		826.14	98.95	39.74
Ext. works		10807.95	689.18	561.54		734.8	183.7						877.74	103.75	
Overall site construction				37292.71											
Refrigerant emissions					130260										

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Appendices

GLA Submission template

Bill of material

Pre demolition audit (PDA)

[illegible]

Key	
	Data automatically calculated - no direct input required
	Cells that require information / data inputting
	N/A

[illegible]

Assessment of existing buildings and structures		A pre-detonation audit and pre-detonation audit have been completed to assess the viability of existing meeting structures. Both audits have concluded that there is more value in demolishing the existing building due to different functional requirements and the unsuitability of the existing structure.
Current measures implemented and pre-construction meeting (PCO)		#0000
Percentage of the percentage of the year used (percentage) can be made up at planning (PCO)		12.71%

	Actions included in WLC measurement results reported	WLC reduction (kg CO ₂ e/GJ) (MA)
Summary of key actions in relation to how Bio-cycle carbon estimates that have informed this assessment, including the WLC reduction	Trotter and C-7 are gas storage clusters against solid residue, typical practice of concrete structures. Both are modelled using the Carbon Designer tool of One Click LCA, whereas fair practices for the concrete rebar sub cluster are provided based on with 20% CCSDS replacement and 20% structural concrete as reinforcement (structures). The paper states that it is more realistic to assume that concrete rebar is made from recycled steel than virgin steel and used for 80 years. For these clusters, which is C-7 and Trotter, this material is made of reinforced concrete core with 8% B-S-BE and better aggregate than standard building materials that are useful suitable for its use. The baseline, columns data are made up of C-7 and Trotter. This material is known using of 94% CCSDS. The concrete structure carbon estimates are roughly 25% higher than Trotter structure clusters.	18.59
	Trotter wall was made of concrete, 1.6m x 1.0 m typical pile material used by Trotter. Trotter's concrete beams were chosen as the sustainable option as it needs no replacement compared to usual existing replacement every 15 years.	36.74
	General waste disposal compared with heavy insulation. Heavy has been chosen for its low embodied carbon and higher biogenic carbon	5.22

	Further potential opportunities	WLC reduction potential (kg CO ₂ e/t) / t/a
Identify further opportunities to reduce the development's whole life-cycle carbon emissions, including the WLC reduction potential	Steel column insulation option to be explored for roof in comparison to hemp insulation	-0.48
	20% of the stairs to be steel and 50% CLT. Currently the stairs have a high impact and options to reduce that can be explored in the future by looking at options of light weight steel structure for the secondary stairs	-0.94

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Summary - AREAS				
	Name	TOTAL	unit	Free notes
	TOTAL GIA	2,681	m2	2681 as per architect's email

Summary - FACILITATING WORKS				
0. Facilitating works	Name	TOTAL	unit	Specifications, assumptions, free notes
	Demolition	880	m2	Added in GLA template for demolition emissions associated to existing building

Summary - MATERIAL INVENTORY				
1. Substructure	Name	TOTAL	unit	Specifications, assumptions, free notes
1.1	Minus 2 Basement slab - Added as mix design of C40 concrete	106	m3	Concrete with 8-10% BioChar mixed in; slab thickness assumed 175 mm.
	- Cement (OPC)	36616	kg	
	- Biochar (10% replacement)	4068	kg	
	- Coarse aggregate (recycled)	102868	kg	
	- Fine aggregate	84162	kg	
	- Water	19	m3	
	- Reinforcement	10623	kg	100 kg/m3
	Retaining wall	141	m3	Concrete with recycled aggregate and high GGBS content
	- Cement (OPC)	53747	kg	
	- Coarse aggregate (recycled)	136254	kg	
	- Fine aggregate	111477	kg	
	- Water	25	m3	
	- Reinforcement	17588	kg	125 kg/m3
	Minus 1 Basement slab	655	m2	CLT/Timber flooring; hemp insulation (300 mm thick)
2. Superstructure	Name	TOTAL	unit	Specifications, assumptions, free notes
2.1 Frame	CLT columns	6,755	kg	From One Click LCA model - Carbon designer tool; 304 m of 215 x 190 mm CLT columns
	CLT beams	40,277	kg	From One Click LCA model - Carbon designer tool; 824 m of 215 x 418 mm CLT beams
	Steel Tube (340mm diameter)	151	kg	Cleveland Reclaimed coated with intumescent paint; Weight = 2.8 kg/m, Length = 3 m
2.2 Upper floors	All floor areas except wet areas	936	m2	Timber frame (hemp insulation / <i>clay tile base (ceiling)</i> + <i>engineered timber flooring</i> - <i>Included in finishes</i> 36cm thick timber ceiling joists will be filled with air-dried clay plates - U-value = 0.14 W/m2K
	Wet areas	90	m2	Timber frame (hemp insulation / <i>clay tile base (ceiling)</i> + <i>engineered timber flooring</i> - <i>Included in finishes</i> 36cm thick timber ceiling joists will be filled with air-dried clay plates - U-value = 0.14 W/m2K
	Balcony	52	m2	
2.3 Roof	Roof covering	619	m2	Includes flat and sloped roof - Super insulated (Solar Panels on top) - U-value = 0.13 W/m2K
	Dormer windows	26	m2	Highest spec and operable
2.4 Stairs and ramps	Timber stairs	33	m	Stairs are timber frame with engineered timber flooring tops; 14.5 m high each
2.5 External walls	External enclosing wall	751	m2	<i>Internal clay plaster</i> /Pavaderm wood wool fibre/Battens/ CLT-Timber frame with hemp lime insulation/ Wood Fibre Sarking Board/Battens/ External Wood Wool render board/External Lime Render - U-value = 0.15 W/m2K
2.6 Windows and external doors	Windows	111	m2	Triple Glazed (Bespoke IQ Glass / Norrsken or Similar) - U-value = 0.8 W/m2K
	External doors + External Arched Doors	65	m2	FSC Certified timber doors finished with wax
2.7 Internal Walls and Partitions	Timber stud Wall (Above ground)	1,005	m2	Timber stud Wall (Pavadentro/Wood Wool / <i>Clay Plaster</i>)
	Timber stud Wall (Below ground)	630	m2	Timber stud Wall (Vapour board/Wood Wool / <i>Clay Plaster</i>)
2.8 Internal doors	FSC Certified timber doors	223	m2	Solid core wooden doors (71 single doors, 20 double doors)
3. Internal finishes	Name	TOTAL	unit	Specifications, assumptions, free notes
3.1 Wall finishes	Paint	2,386	m2	Painted partitions and linings; Emulsion for interior use with recycled paint content, 0.168 kg/m2, 1.4 kg/l, Dulux Trade Evolve Matt
	Clay plaster + Tadelakt plaster finish	2,386	m2	Tadelakt plaster finish for bathroom/wet spaces area included
3.2 Floor finishes	Timber flooring	1,266	m2	Engineered timber flooring
	Natural Grip Paver	415	m2	VT.359 Natural Grip Paver from EcoFriendly Tiles
	Linoleum Flooring	436	m2	Forbo Linoleum Flooring
	NatraTexEco Flooring	171	m2	
3.3 Ceiling finishes	Clay tile/ board	1,026	m2	22 mm clay board (EBB clay board)
4. Fittings, furnishings & equipment	Name	TOTAL	unit	Specifications, assumptions, free notes
4.1 Fittings, furnishings & equipment	Kitchens	3	#	FFE unknown at this time so the below is assumed Model includes ovens, hobs, refrigerators, dishwashers, washing machines, cabinets and sink for each unit
5. Core building services	Name	TOTAL	unit	Specifications, assumptions, free notes
5.1	Sanitary installations	21	#	Ceramic standard installation with cistern
	Toilets/ WC	25	#	Ceramic (Standard installation)
	Bath	2	#	Acrylic (Standard installation)
	Shower	15	#	incides showers over baths
5.2	Service equipment			
	None			None specified at stage 2
5.3	Disposal installations			
	Sewage system for residential building	2,681	m2	GIA based model includes pipe network, ducts, valves, drains, pumps and plumbing accessories
5.4	Water installations			
	Water distribution network for residential building	2,681	m2	GIA based model includes polypropylene pipe network, pipe insulation, valves, water meters and accessories
5.5	Heat source			
	Ground source heat pump	130	KW	Model for pipe work, circulating pumps as per 130 KW heat pump added
5.6	Space heating and air conditioning			
	Air source heat pumps - Residential units	2,681	m2	Ground source heat pump with a COP of 3.0 as the main heating system. Heat will be provided underfloor heating
	Under floor heating	2,681	m2	GIA based template includes manifolds, thermostats, quarter turns, copper pipe work and accessories
5.7	Ventilation systems			
	M+VR	2,681	m2	Balanced ventilation with heat recovery; model includes pipe network, ducting, valves, fire dampers and accessories

5.8	Electrical installations				
	Power cabling system for residential building	2,681	m2	GIA based model includes copper cables and PVC cables conduits	
	Lighting system for residential building	2,681	m2	GIA based model includes lamps, LED lights, light switches, socket outlets, junction boxes, cable connectors and accessories	
	Earthing system for residential building	2,681	m2	GIA based model includes earthing system for residential buildings	
5.9	Fuel installations and systems				
	None			Not required for residential building	
5.10	Lift and conveyor installations or systems				
	Lift x 2 floors	1	#	Lift system with a payload of 1,000 kg (13 people) is modeled	
	Lift x 5 floors	1	#	Lift system with a payload of 1,000 kg (13 people) is modeled	
5.11	Fire and lightning protection				
	Fire detection and alarm system	2,681	m2	GIA based model includes control panels, smoke detectors, indicator lights, fire alarms and cabling	
	Lighting protection system for apartment building	2,681	m2	GIA based model includes aluminium wire rods, pipe network and steel sheets	
5.12	Communication, security and control systems				
	Communication network for apartment building	2,681	m2	GIA based model includes routers, tv sockets, LAN cable, wiring and accessories	
5.13	Special installations or systems				
	PV panels	265	m2		
5.14	General builder's work				
	None			Not included at stage 2	
6 Prefabricated Buildings and Building Units					
	Name	TOTAL	unit	Specifications, assumptions, free notes	
	NONE				
7 Work to Existing Building					
	Name	TOTAL	unit	Specifications, assumptions, free notes	
	NONE				
8. External works					
	Name	TOTAL	unit	Specifications, assumptions, free notes	
8.2.1	New Block Paving/Paving	1,088	m2	Stone paving blocks	
	Reused paving on site	689	m2	Stone paving blocks	

Summary - OPERATIONAL ENERGY AND WATER					
	Name	TOTAL	unit	Specifications, assumptions, free notes	
	Regulated Electricity demand - From UK national grid	43,829	kWh/year	SAP 10.2 output (PV generated electricity subtracted)	
	Unregulated Electricity demand - From UK national grid	11,800	kWh/year	SAP 10.2 output	
	Electricity demand - From PV panels	13,971	kWh/year	PV generated electricity subtracted from regulated electricity output above	
	Gas consumption		kWh	Electrified building	
	Water consumption - Residential units	292	m3/year	100 L/person/day - on average 8 residents assumed	

Pre-Demolition Audit Report

Sproughton, 22 Courtenay Avenue

Document Information

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Pre-Demolition Audit Report

Sproughton, 22 Courtenay Avenue

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Executive Summary

Overview

The aim of this report is to contribute to the sustainable management of materials arising from the proposed redevelopment and demolition works to Sproughton, 22 Courtenay Avenue, London, N6 4LR.

The results of audit can help identify and formalise options for reuse and recycling of products and materials involved within the demolition process and to divert them from landfill where possible.

A non-invasive visual survey of the site was carried out on Tuesday 14th July 2023.

Waste arising

An overall total of 700 tonnes of construction material is predicted to arise because of the proposed redevelopment work, with an estimated volume of 434 cubic metres.

The waste materials have been divided into Key Demolition Products (KDP).

Brick is the largest KDP arising 415 tonnes, followed by concrete (214 tonnes), timber (40 tonnes), Clay roof tiles (17 tonnes), and steel (6 tonnes). There are also smaller amounts of ceramic, glass, carpet, and acrylics.

Targets

It is recommended that a target of 95% diversion of waste from landfill (by weight) should be set, with a minimum 20% target for material reuse on site to meet the aspirational targets set by the Greater London Authority (GLA).

Results summary

Reuse, rather than recycling, of items should always be prioritised. Approximately 275 tonnes of material could potentially be reused, representing around 40% of total weight of arisings.

A reuse target of 40% by weight is therefore recommended, this is twice as high as the 20% aspirational target set by GLA.

An estimate of the total percentage of waste materials that can be repurposed or recycled is 58% by weight. A total diversion from landfill target of 95% (Reuse + Recycle) by weight is therefore achieved.

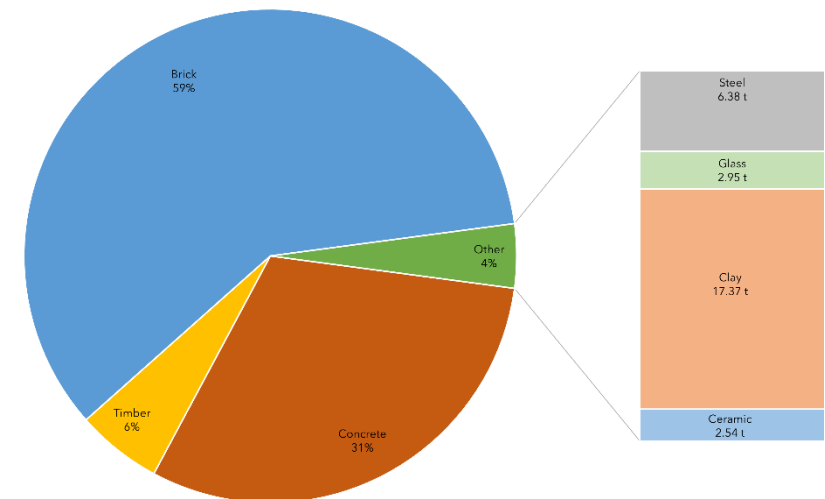


Figure a: Percentage weights by material

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The Requirement

Eight Versa has been appointed to carry out a Pre-Demolition Audit of Sproughton, 22 Courtenay Avenue, London, N6 4LR.

The aim of the audit is:

- To provide an understanding of the types and amounts of products and materials arising during the redevelopment/ demolition.
- To optimise the management of products and materials from the demolition and provide recommendations to the design team and demolition contractor in line with the waste hierarchy i.e., maximise reuse and recycling and minimise waste to landfill.
- To provide technical advice on the reuse of products and recycling of material on site
- To facilitate better links and communication within the supply chain and provide details of local charities, organisations and companies who may be able to deal with the products and materials arising.
- To provide data to help with populating the Resource Management Plan.
- To advise on targets for the reuse and recycling of products and materials arising during the demolition

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Site Details

The site

Sproughton is located at the northwest end of Courtenay Avenue in the Bishops sub-area of the Highgate Conservation Area. The Highgate Conservation Area, designated in 1967 (Haringey) straddles both the London Boroughs of Haringey and Camden, with the subject site located in the former of the two.

Sproughton is neither statutorily listed, nor locally listed; it is not identified as a positive contributor to the Conservation area and is not aligned with a key vista as prescribed by the London Borough of Haringey.

Sproughton has been altered over time both internally and externally, with the addition of a conservatory to the garden side of the house, a new portico, and the extension of the garage and accommodation annexe in the 1960s.

The main construction material of Sproughton is red brick external façade with concrete and timber structure. An investigation on buildings constructed in the same period reveals that most houses had shallow brick strip footing and concrete ground floor slabs used for the extension works. External wall are one brick thick solid walls in Flemish bond. Upper Floors are made of softwood joists built into walls. Internal walls were constructed with half brick walls covered with lime plaster. Internal doors are made of softwood and external with hardwood. External windows are single glazed with wooden frame and roof is covered with clay tiles.



Fig 1a: Existing elevation of Sproughton

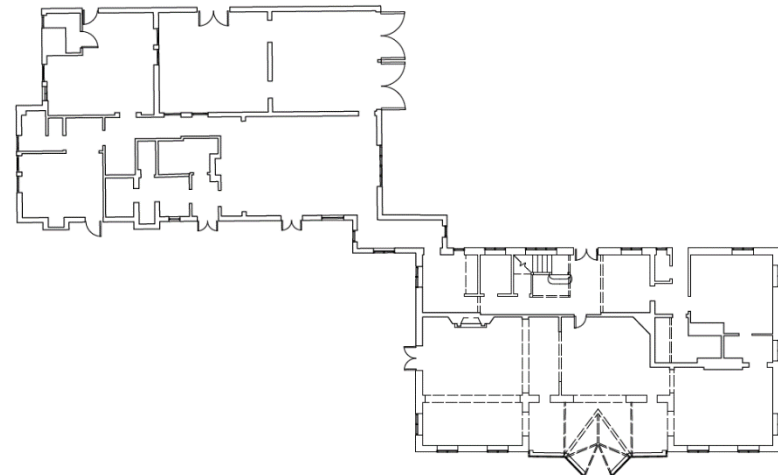


Fig 1b: Existing ground floor plan

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The proposed project

The proposed project will replace the existing property with a new single dwelling that aims to have the highest possible environmental sustainability performance, alongside improved internal accommodation, and facilities more appropriate for a house in this area.

The design was driven by sustainability, which dictated the selection of materiality and enabled the power strategy to be informed by modern technology. The new house is proposed to be two stories above ground with a roof space, plus a two-level basement.

The location and sitting within the site are broadly similar to the existing building, although the orientation is changed as the sun path was the predominant driver in the design.

The substructure will use carbon capture and storage (CCS) by mixing an 8-10% mix of Biochar in the concrete, which reduces the CO₂ footprint of cement. The aggregate will be used from onsite rubble from demolished building masonry that wasn't suitable for re-use.

The superstructure will be constructed out of CLT and timber as the structural components. The external lime render on the facade is a natural, breathable material. The insulation will be made of hempcrete, which is carbon negative. The timber ceiling joists will be filled with air-dried clay plates, a hygroscopic material that ensures a comfortable indoor climate by controlling the humidity and tempering the temperature variations via absorption.

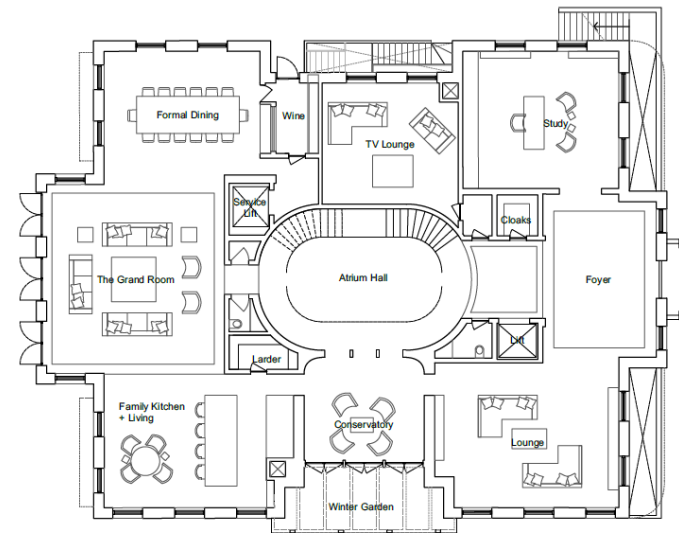


Fig 1c: Proposed development ground floor plan

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The Pre-Demolition Audit

Site visit

A site visit was undertaken on Tuesday 14th July 2023, consisting of a non-invasive visual survey of the site and buildings. Observations, measurements, and photographs were taken of key features and materials.

Access to all areas within the site proposed for redevelopment was provided by the current occupier.

Methodology

Based on information gathered and provided, a full analysis of materials arising from the redevelopment has been undertaken, with results reported in both weight and volume. The weight has been calculated using standard density figures for the materials identified.

Please note that as the survey was non-invasive, certain aspects have been assumed based on typical practice, including but not limited to the substructure design, cross-sectional area of structural elements and dimensions of hidden elements and features. The foundation and super structure design, wall build-up of both external and internal walls, upper floor slab and roof was assumed based on typical construction practices from the period of construction combined with onsite observations.

Waste Electrical and Electronic Equipment (WEEE) and MEP have been noted where visible, e.g., lighting; weight/volume figures are not included; however, items have been logged and any relevant reuse options suggested within the report.

Pre-Demolition Audit Report

Sproughton, 22 Courtenay Avenue

Results Summary

Total estimated waste arising

An overall total of 700 tonnes of construction material is predicted to arise as a result of the proposed redevelopment works, with an estimated volume of 434 cubic metres.

By material

The waste materials have been divided into Key Demolition Products (KDP).

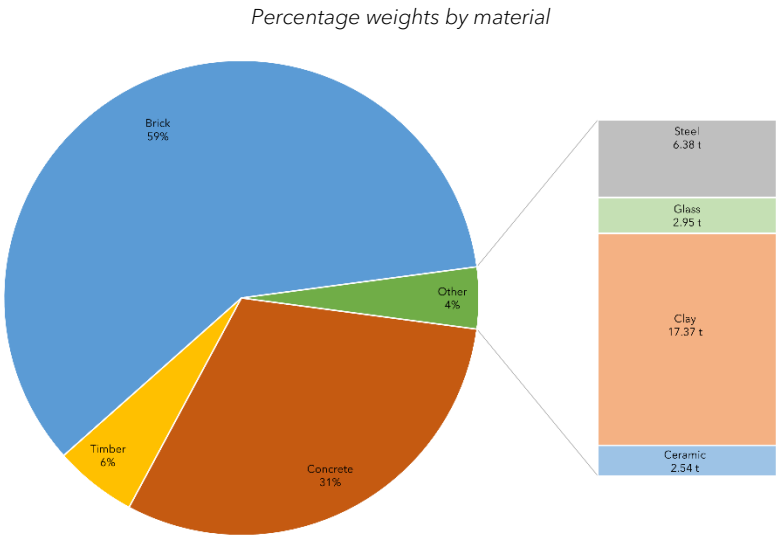
Brick is the largest KDP arising 415 tonnes, followed by concrete (214 tonnes), timber (40 tonnes), Clay roof tiles (17 tonnes), and steel (6 tonnes). There are also smaller amounts of ceramic, glass, carpet, and acrylics.

The KDP by weight and volume are shown with their associated European Waste Codes (EWC) in the table below.

KDP	Weight (t)	Volume (m³)	EWC
Brick	414.69	243.94	17 01 02
Concrete	214.41	93.22	17 01 01
Wood	39.17	82.85	17 02 01
Clay	17.37	5.79	17 01 03
Steel	6.38	0.81	17 04 05
Glass	2.95	1.18	17 02 02
Ceramics	2.54	1.04	17 01 03
Carpet	1.13	0.75	19 12 08
Acrylic	0.30	0.04	17 02 03
Vinyl	0.05	0.02	17 02 03
Gypsum/ plaster	0.04	4.40	17 08 01
Totals	699.03	434.04	

The percentage weights by material are shown in the chart below.

The individual KDPs are described in more detail within the following sections, along with associated management options and potential for reuse.



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Brick

Brick accounts for an estimated 415 tonnes and 244 m³ of waste arisings. This represents 59% of total waste arisings by weight, and 56% of total waste arisings by volume.

Material sources

The main source of red brick in the existing development is the external walls (one brick thick solid wall), internal walls (half brick walls), foundation (strip footing) and floor finishes (rear entrance area).

Item	Weight (t)	Reuse potential	Repurpose potential
External walls	237.75	60%	40%
Internal walls	162.47	60%	40%
Foundation	8.56	0%	95%
Floor finish	5.89	60%	40%
Totals	~ 415 tonnes	~ 244 tonnes	~ 170 tonnes

Potential for reuse

It is possible to reuse a certain proportion of the bricks, depending on the strength of the cement mortar they are bonded with. At present a nominal value of 60% has been provided for walls and floor finishes since the practicability is unknown – further investigation is recommended, after which the target may be revised.

Repurposing, recycling, and diversion from landfill

It is recommended that bricks that are unable to be reused are segregated onsite and crushed to produce recycled aggregate (RA) which can be used as fill material. Finished recycled aggregates should not contain more than 1% (by weight) of clay, soil, metals, wood, plastic, rubber, and gypsum plaster, in line with the limits set within the aggregate's standards. The Environment Agency Quality Protocol for inert materials should be followed.

Waste management options

Local waste management companies that could manage the waste arising include:

- Brewsters Waste - <https://brewsterswaste.co.uk/> - 020 7474 3535
- Ohara Bros - <http://oharabros.co.uk/services/aggregates-recycling> - 020 8424 2220
- RTS Waste - www.rtswaste.co.uk - 020 7232 1711
- Days Group - <http://www.daygroup.co.uk/> - 0845 065 4655

Alternatively, licensed waste management contractors/demolition contractors should be able to reprocess the brick waste into aggregates.

If any of the bricks are suitable for reclamation, then local reclamation companies that can be contacted with regard to reclaiming the bricks and the value in doing so include:

- London Reclaimed Brick Merchants - www.lrbm.com - 020 8452 1111
- Premier Reclaimed Bricks - <http://www.premierreclaimedbricks.co.uk/> - 020 8684 3537
- Salvo - <https://www.salvoweb.com/>

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Figure 2: Major brick elements on site

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Concrete

Concrete accounts for an estimated 214 tonnes and 93 m³ of waste arisings. This represents 31% of total waste arisings by weight, and 21% of total waste arisings by volume.

Material Sources

The main source of concrete is the ground floor slab of both the original construction and extension.

Item	Weight (t)	Reuse potential	Repurpose potential
Ground floor – Original	109.55	0%	95%
Ground floor – Extension	104.85	0%	95%
Totals	~ 214 tonnes	0 tonnes	~ 204 tonnes

Potential for reuse

Concrete foundation cannot be reused as a sub-base for the proposed development as two basements are planned for the new build and the entire foundation needs to be demolished to excavate the basements.

Repurposing, Recycling, and diversion from landfill

It is recommended that 95% of concrete from both the foundations be repurposed by segregation and crushing to produce recycled concrete aggregate (RCA) in accordance with the WRAP Quality Protocol for aggregates from inert waste (<https://www.gov.uk/government/publications/quality-protocol-production-of-aggregates-from-inert-waste>).

It can also be used for lower-value applications such as mats and temporary/permanent fill (infilling). The mortar will be bonded to the brickwork and as such is likely to be treated with the brick waste as RA. Recycled concrete aggregates can be used in:

1. Bitumen-bound materials – Recycled concrete aggregate can be used may be used in a variety of base course and binder course mixtures.
2. Concrete – Recycled concrete aggregate is permitted for use in certain grades of concrete. It is generally acknowledged that RCA can potentially be used to replace 20% of the coarse aggregate in concrete up to Grade 50.
3. Pipe bedding – suitably graded recycled concrete aggregate is used in pipe bedding.

4. Hydraulically bound mixtures (HBM) for subbase and base-recycled concrete aggregate can be suitable for use in HBMs. These can be used in the construction of car parks, estate/minor roads and hard standing.
5. Unbound mixtures for subbase – suitably graded recycled concrete aggregate is used as subbase.
6. Capping – Recycled concrete aggregate is suitable for capping applications.

Waste management options

Local waste management companies that could manage the waste arising include:

- Power day - <https://www.powerday.co.uk> - 020 3858 0504
- Norris Skips - <https://norriskips.co.uk/skip-hire/> - 020 8698 8000
- RTS Waste - www.rtswaste.co.uk - 020 7232 1711
- Days Group - <http://www.daygroup.co.uk/> - 0845 065 4655

Alternatively, licensed waste management contractors or demolition contractors should be able to reprocess concrete waste into aggregates.

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Figure 3: Major Concrete elements on site - Ground floor slab

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Timber

Timber accounts for an estimated 39 tonnes or 6% of total waste arisings by weight; this represents 19% of the total volume of waste arising.

Material Sources

The largest source is the upper floors construction and roof construction, which is assumed to be timber in the pitched roof of the main building (rafters, ridge board, purlins, wall plates, and battens) as well as in extensions. Other sources of timber include external and internal doors, staircases, and windows (including frames and sills).

Item	Weight (t)	Reuse potential	Repurpose potential
Upper floor structure	14.90	50%	45%
Roof structure	10.22	50%	45%
Staircases	6.75	10%	85%
Upper floorboards	2.97	50%	45%
Doors and windows	4.32	0%	95%
Totals	~ 39 tonnes	~15 tonnes	~ 22 tonnes

Potential for reuse

Although difficult to ascertain, some of the timber elements in the roof and floor structure may be reusable, however these were not visible during the site visit, so their quality, condition, and reversibility is not known. Therefore, 50% reusability potential is assumed at this stage for the structural elements and boards- further investigation is recommended, after which the target may be revised. Additionally, the solid timber balusters and handrails are reusable for the proposed development. The doors and windows are not reusable because of current fire safety standards and thermal performance requirements of the proposed development.

The estimated percentage of reusable material is shown by item in the table above and images of items for potential reuse are shown on the next page. Overall, approximately 15 tonnes of the timber is estimated to be reusable on and off site for other projects.

Recycling and diversion from landfill

Most of the solid timber can be recycled, usually into chipboard. For the panel-based products, these will be suitable for energy recovery. It is recommended that a local wood recycling organization is contacted to see what timber items are suitable for reclamation and reuse. Where reclamation is not possible the timber should be segregated on site if space permits, or offsite and sent to a licensed waste management contractor for recycling.

Due to the age of the building some of the timber may be hazardous. It is recommended that the Waste Wood Guide is followed.

<https://condemwaste.org/wp-content/uploads/2021/07/CIWM-CD-Waste-Wood-Guide-v1.0.pdf>

Reuse companies

Local companies that could assist with reuse include:

- Community Wood Recycling - www.communitywoodrecycling.org.uk - 01273 20 30 40
- Solo Wood Recycling - www.solowoodrecycling.co.uk - 07444 729 521
- LASSCO - www.lassco.co.uk/locations/brunswick-house/ - 020 7394 2100
- SALVO - www.salvo.co.uk lists details of architectural salvage and can list demolition projects.

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Figure 4: Major timber elements on site – Doors, upper floor and roof construction, staircases, and window frames

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Clay tiles

Clay tiles accounts for an estimated 17.37 tonnes and 5.79 m³ of waste arisings. This represents 2.48% of total waste arisings by weight, and 1.33% of total waste arisings by volume.

Material sources

The main source of clay on the site is the roof tiles of both the original house and extension.

Item	Weight (t)	Reuse potential	Repurpose potential
Clay roof tiles	17.37	95%	5%
Totals	~ 17.5 tonnes	~ 16.5 tonnes	~ 0.86 tonnes

Potential for reuse

Most of the clay tiles have potential for reuse on site for the proposed development or off site for other projects. The damaged quantities on site can be repurposed as fill material and crushed aggregate.

Where onsite opportunities are not identified with the design team and client, then local reclamation companies can be contacted for reclaiming the tiles, including Salvo (<https://www.salvoweb.com/>). Additionally, material marketplaces such as Globe chain (www.globechain.com) could be utilised.

Recycling and diversion from landfill

The damaged or broken tiles on site are also suitable for use as backfill, however based on the opportunity for reusing and upcycling this would be of relatively low value to the client and project.

Waste management options

Local waste management companies that could manage the waste arising include:

- Brewsters Waste - <https://brewsterswaste.co.uk/> - 020 7474 3535
- Ohara Bros - <http://oharabros.co.uk/services/aggregates-recycling> - 020 8424 2220
- RTS Waste - www.rtswaste.co.uk - 020 7232 1711
- Days Group - <http://www.daygroup.co.uk/> - 0845 065 4655

Alternatively, licensed waste management contractors/demolition contractors should be able to reprocess the tile waste into aggregates.

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Figure 4: Major clay elements on site – Roof tiles

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Steel

Metals account for an estimated 6.38 tonnes and 0.81 m³ of waste arisings. This represents 0.91% of total waste arisings by weight, and volume.

Material sources

The largest source of steel is present in the substructures (Ground floor slab of original house and extension).

Item	Weight (t)	Reuse potential	Recycle potential
Ground floor slab rebar	6.38	0%*	95%
Fencing and gates	To be retained	100%	0%
Totals	~ 6.4 tonnes	~ 17.8 tonnes	~ 17.8 tonnes

The rebar in ground floor slab cannot be reused as the slab needs to be demolished to accommodate two basement floors.

Potential for reuse

There is no potential to reuse rebar from the existing buildings on site as the limited quantity in foundation will be demolished to accommodate the basements.

Recycling and diversion from landfill

Any metal items including rebars that are unsuitable for reuse should be segregated on site and sent for recycling.

Reuse companies

The following companies are active in sourcing steel for reuse, as long as it meets the Steel Construction Institute Protocol for Reuse

- Cleveland Steel and Tubes - <https://cleveland-steel.com/sustainability> 01845 577789
- EMR Group - <http://www.emrgroup.com/>

Waste management options

Local waste management companies that could manage the waste arising include:

- Capital Metal Recycling - <http://capitalmetalrecycling.co.uk/> - 0208 964 2120
- London Scrap Metal Recycling - <http://www.londonscrapmetalrecycling.com> - 0208 809 1019

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Other Materials

Any material that accounts for less than 1% by weight of the total construction materials resulting from the proposed demolition has been covered in this section. These materials have limited potential to be reused on site and options to repurpose and recycle are discussed below.

Ceramic

Ceramics accounts for an estimated 2.54 tonnes of total waste arisings by weight. Major source of ceramics is the floor finishes and sanitary fittings. These materials are at the end of their service life and cannot be reused in their current condition on the future development. However, they have the potential to be reused off site. These materials can be donated to organizations that reuse them or waste processors. Some of the tiles have potential to be damaged based on the bond that they are set in, in case of damage these tiles can be repurposed on site as recycled aggregate or fill material.

Glass

Glass accounts for an estimated 2.95 tonnes of total waste arisings by weight, all within the windows and conservatory. These windows cannot be reused in their entirety because their thermal performance would not permit reuse on site or elsewhere without upgrades e.g., secondary glazing. However, the glazing itself could be reused as secondary glazing off site.

There are some schemes that will take back flat glass for recycling. If some of the glass is damaged during the deconstruction process it is recommended to be crushed into aggregate with the other inert waste. If it is to be segregated on site for reuse/recycling, there is a health and safety consideration for the workforce as it needs to be handled carefully and have no contamination from other materials. Glass recyclers are:

- RTS Waste - www.rtswaste.co.uk - 020 7232 1711 (note they may require the glass to be removed and stacked as panels)
- Berryman Glass Recycling - www.berrymanglassrecycling.com - info@berryman-uk.co.uk
- Viridor www.viridor.co.uk/siteassets/document-repository/brochures/glass-recycling-ukviridor-low-res.pdf

Carpet

Carpet accounts for an estimated 1.13 tonnes of total waste arisings by weight, in the form of carpet flooring which is in poor condition and at the end of its service life.

Carpet cannot be reused on site or off site in their entirety but there are some schemes that will take back carpet for recycling. It is recommendation that every possible effort is made to divert this waste from sending it to landfill.

Carpet recyclers are:

- Enviro cycle London Ltd - www.envirocyclelondon.com - 07549 448123
- Carpet Recycling London - www.surreywasteremoval.co.uk - Info@surreywasteremoval.co.uk
- Carpet tile recycling - www.carpettilerecycling.co.uk

WEEE

Several WEEE items, including radiators, space heaters, and lighting (bulkhead and strip lighting) were observed during the site visit, however their weight was too small to include in overall quantifications. There may be scope for reuse of some items dependent on their condition, performance, and potential value, however options are few.

Furniture

The house is currently fully furnished with excessive amount of wooden furniture including sofas, bed, wardrobes, and cupboards. These materials are not part of the building and loose fittings are not part of pre demolition audit. However, every effort should be made to divert them from being sent to waste management facilities or landfill as these can be donated to people in need and the furniture is in good condition to be reused offsite.

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Maximising Reuse

General guidance

Experts advise that a long lead-in time and maximum exposure are required to enable the reuse of products and components. The best chances for reuse, with the best environmental and economic benefits, are as near to site as possible:

- Used by the same client locally.
- Sold or given away locally.

Specific recommendations

The following recommendations may assist in maximising the reclamation potential of KDPs identified:

- Consult the design team for the new project to consider any options for onsite re-use as recommended in this report.
- Consider setting aside storage on site for segregation of salvage items.
- Advertise specific salvage items for free on www.salvo.co.uk or low value materials or use companies such as Globe Chain (www.globechain.com); Reyooz (www.reyooz.com/about/clients) and Collect eco: <https://www.collecteco.co.uk/> Salvo also operate a demolition/refurbishment alert service on their website which serves to bring forthcoming demolition products to the attention of potential buyers or users.
- For smaller items e.g. white goods, fans etc, use local organisations such as the Reuse Network: <https://reuse-network.org.uk/donate-items/#/>
- Contact local architectural salvage merchants about specific items. Salvo publish a directory on their website (<https://www.salvoweb.com/>). Ensure that salvaged items are removed and stored in such a way that all components remain together, e.g. hinges and fixings with doors, etc.
- Material exchange websites can be searched at https://www.supplychainschool.co.uk/log-in/?redirect_url=https%3A%2F%2Flearn.supplychainschool.co.uk%2Flocal%2Ftactionplans%2Fresource_intro.php%3Fid%3D4291%26amp%3Bmodtype%3Durl (Note, you will need to create a log in but there is no charge to use the site).

Key items for reuse/upcycling

There are several items potentially suitable for reuse, as discussed in the individual KDP sections above:

- Red brick
- Concrete
- Timber
- Lampposts
- Fencing/gate
- Some furniture

Pre-Demolition Audit Report

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Targets

Material reuse

Reuse, rather than recycling, of items should always be prioritised. It is believed that approximately 275 tonnes of material could potentially be reused, representing around 40% of total weight of arisings. Whilst this is an apparently high figure, it is justified for several reasons. There are large quantities of weighty materials – such as red brick and concrete that the design team has already expressed an interest in reusing/ downcycling, and which can be relatively easily incorporated into the new development.

A reuse target of 40% by weight is therefore recommended, this is twice as high as the 20% aspirational target set by GLA.

Material repurposing - Diversion from landfill

It is recommended that an overall repurposing and recycling target is set prior to the project commencing based on the recommendations of this report and liaison with the selected contractor(s).

An estimate of the total percentage of waste materials that can be repurposed or recycled is 58% by weight.

A total diversion from landfill target of 95% (Reuse + Recycle) by weight is therefore achieved.

Note that BREEAM also sets an ambitious target of 95% diversion from landfill representing an exemplary level practice.

Minutes of meeting

Subject: Circular Economy Workshop

Place: Eight Versa London Office, Date 08 August 2023 15:00-17:00

Present:

Hesham Ahmad (Eight Versa)

Brigitte Clements (LOKI - architecture and development)

Objective of meeting: Circular Economy Statement: Establish Strategies for circular economy

Item	Action
1.0 INTRODUCTION Eight Versa provided background to CE statement and requirements. CE statement over three stages - Step 1 Draft Statement (Outline planning application) sets out strategic approach. - Step 2 - Detailed Statement Full Application (RIBA 2/3) addresses CE through detailed design - Step 3 Post Planning Statement during construction and occupant (RIBA 5 and 7) provides updates against targets. Compliant CES Cover core information and inform project proposals. Make project relevant commitments. Pioneering CES Depth of targets.	Eight Versa
2.0 CIRCULAR ECONOMY PRINCIPLES Strategic approach exiting development and new development. Decision tree for selection of strategic approach.	Eight Versa and design team
3.0 PROJECT CE PRINCIPLES Circular economy principles regarding exiting development and new development.	Eight Versa and design team
4.0 NEXT STEPS Draft circular economy to be issued for review by design team members.	Eight Versa and design team



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Circularity workshop

Why are we here?

Aim: Increase circular economy performance and reduce embodied carbon emissions from the scheme

This workshop...

- Presentation on CE background and principles, as well as the client's related requirements
- Review the pre-refurbishment audit outcomes and recommendations
- Walkthrough the current design to identify existing CE/carbon reduction aspects and further opportunities and actions

Circular economy background



Introduction to the Circular Economy

A circular economy is

- Minimal extraction of virgin finite resources
- Almost total reuse and recycling of resources, without loss of value
- No resources are disposed of, or value lost

In contrast, the current take-make-waste linear economy is

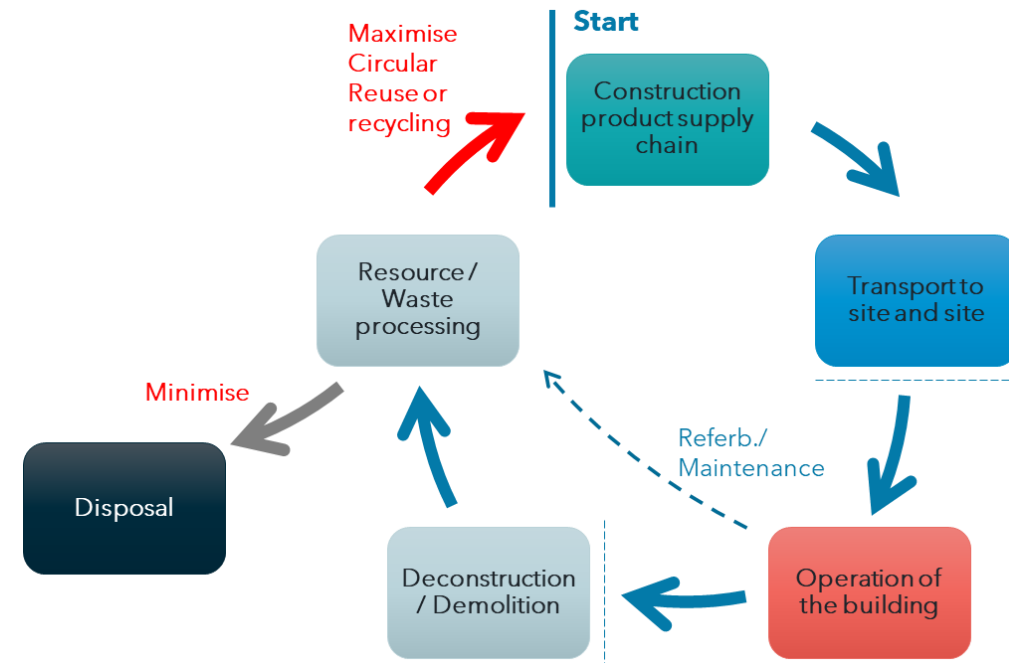
- Extraction of vast amounts of finite virgin resources
- Mostly single use products
- Disposal of most resources (or downcycling)
- Colossal waste of value in the resources and energy used

For the construction industry, the onus is currently on sustainable resource use and less on economic value

Standards now in development for CE

Now entering 'regulation'

08/09/2023



Relationship of CE to LCA and WLC

- **LCA and Whole life carbon**

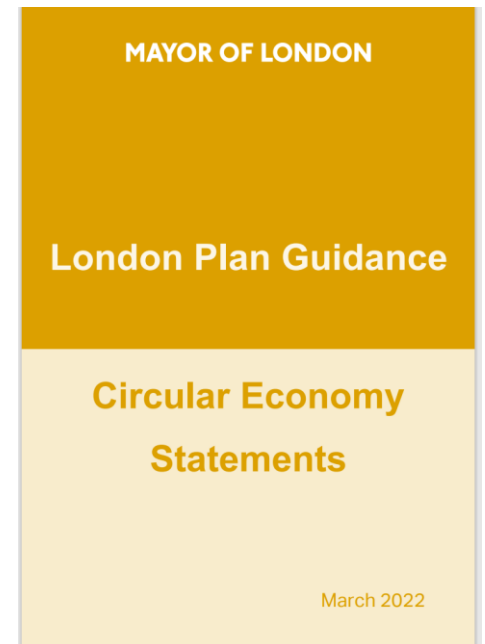
- How embodied and whole life carbon impacts are *measured*
- Allows for numerical analysis of different design options, iterations etc.
- Developed ISO, EN and BS standards
- No prescribed impact reduction principles and solutions, left to users

- **Circular economy**

- A newer concept for the construction industry, but has gained traction
- CE principles are not new and are reasonably straightforward, but have been amplified by the promotion and clear message of CE
- CE principles guide projects on how to reduce impacts through **practical solutions**
- But **quantitative LCA results are needed to make robust decision-making**
 - e.g. What does reusing 10t of material mean in terms of carbon emissions? How does it compare with using an alternative new product or reducing operational energy demand?
- Emerging standards

Key drivers

- BREEAM
- GLA Whole Life Carbon and Circular economy statements
- Project/client led sustainability and net zero carbon



Drivers: BREEAM (NC & RFO)

BREEAM has many CE credits, they just aren't signposted and are scattered!

- **Reuse of resources**

- Materials efficiency (Mat 06)
- Recycled aggregates / Recycled and sustainable aggregates (Wst 02)
- Previously occupied land (use of) and decontamination (NC only) (LE 01)

- **Durable design**

- Designing for durability & resilience (Mat 05)
- Flood resilience (Pol 03)

- **Resource consumption efficiency**

- Monitoring of construction site impacts (Man 03)
- Sustainable procurement (Mat 03)
- Materials efficiency (Mat 06)
- Construction waste reduction / construction resource efficiency (Wst 01)
- Diversion of resources from landfill (Wst 01)
- Recycled aggregates / Recycled and sustainable aggregates (Wst 02)
- Operational waste (facilitating reuse/recycling) (Wst 03)
- Speculative finishes (minimisation) (Wst 04)
- Building LCA (Mat 01)

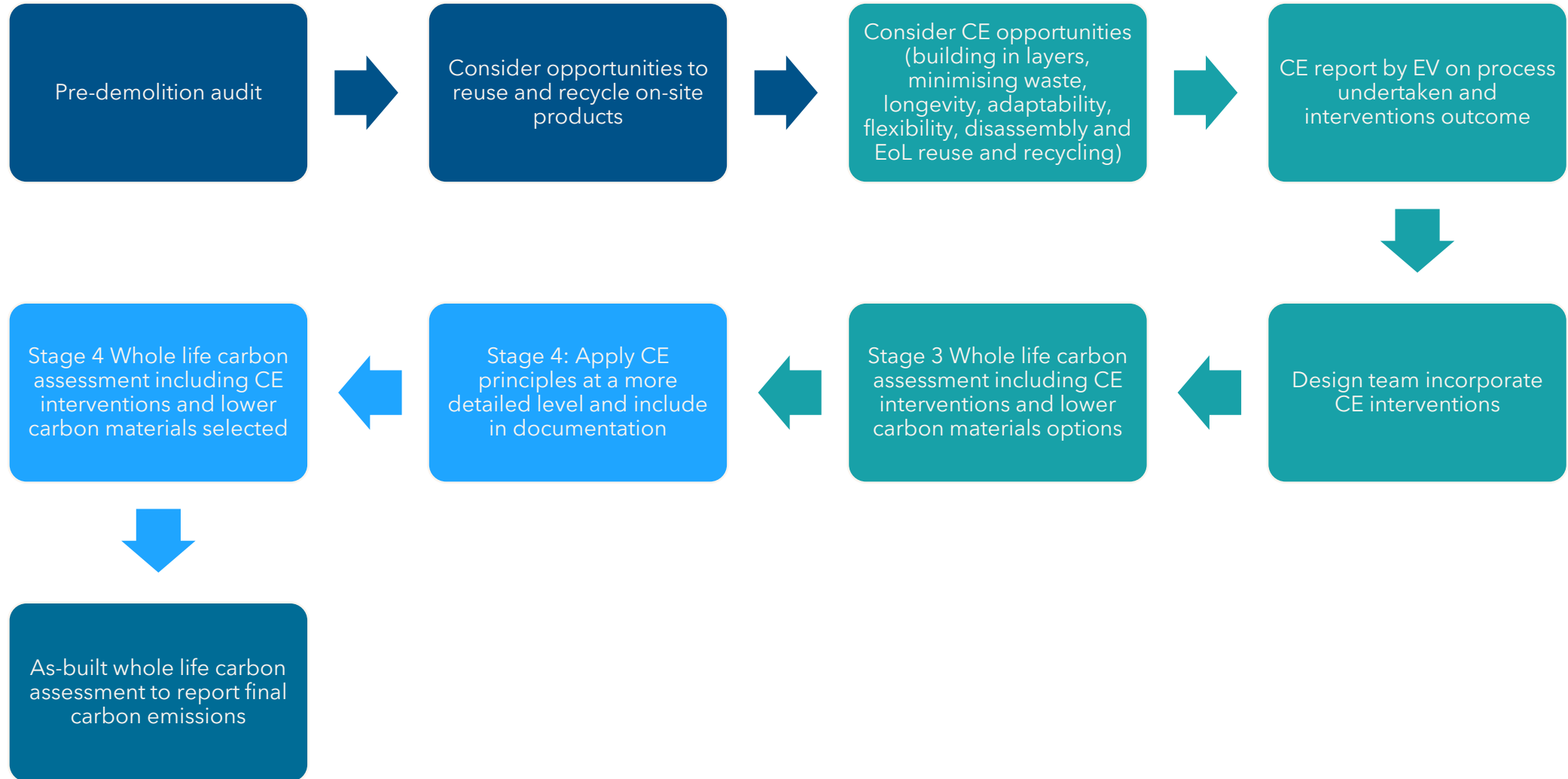


Drivers: Future proofing - value through CE

Beyond compliance and ESG

- Reducing building value risk from
 - Early obsolescence
 - Inability to adapt to new uses
 - Inability to adapt to climate change
 - Excessive in-use costs and disruption
 - Excessive end of life costs
 - Poor product/material retained value (materials banking)

CE example outline workflow



Circular economy principles



CE design approaches

Decision tree - Existing structures

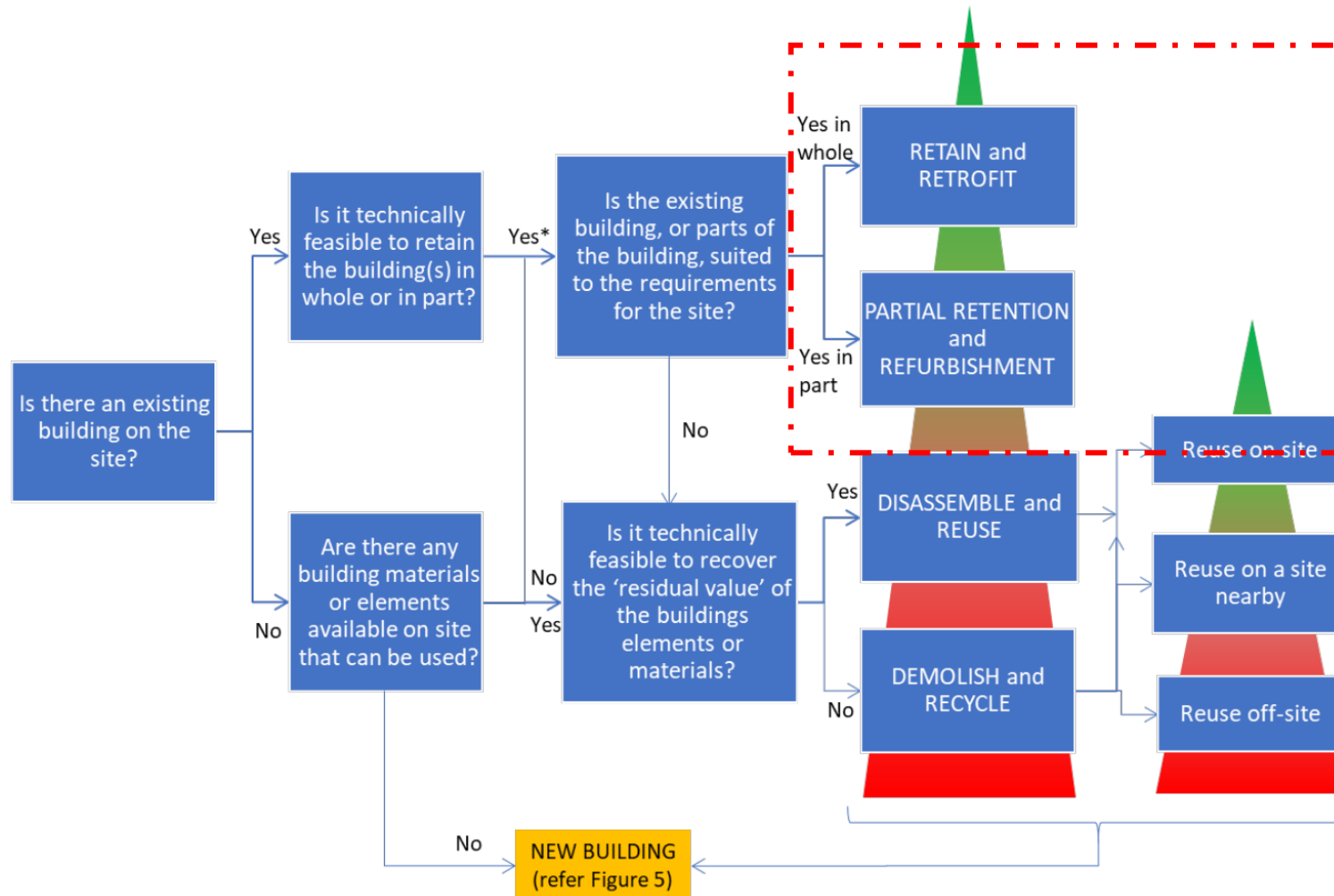


Table 2: CE design approaches for existing structures

Existing structures approaches	Definition
Retain and retrofit	The vast majority of the building's fabric is retained, with the building refurbished for the same or new uses through restoring, refinishing and future-proofing. This also encompasses retrofitting, where new technology or features are added to existing buildings to make them more efficient and to reduce their environmental impacts.
Partial retention and refurbishment	Significant quantities of carbon-heavy aspects of the building are retained in place, such as the floors and substructure, with replacement of some elements of the building, such as walls or roofing. More significant refurbishment can involve adding floors or extensions.
Disassemble and reuse	Disassemble sections of a building and enable their direct reuse ideally on the site or, where this is not possible, off site (with nearby sites preferred). This approach also includes careful selective deconstruction of the building and material types i.e. taking apart each layer and material type as much as possible, minimising damage to parts and maintaining their value, and then reusing those elements and materials. If reuse is not possible, materials may be carefully and selectively separated for processing and recycling into new elements, materials and objects.
Demolish and recycle	Traditional demolition, with elements and materials processed into new elements, materials and objects for use on the site or on another site.

CE design approaches

Decision tree - New structures

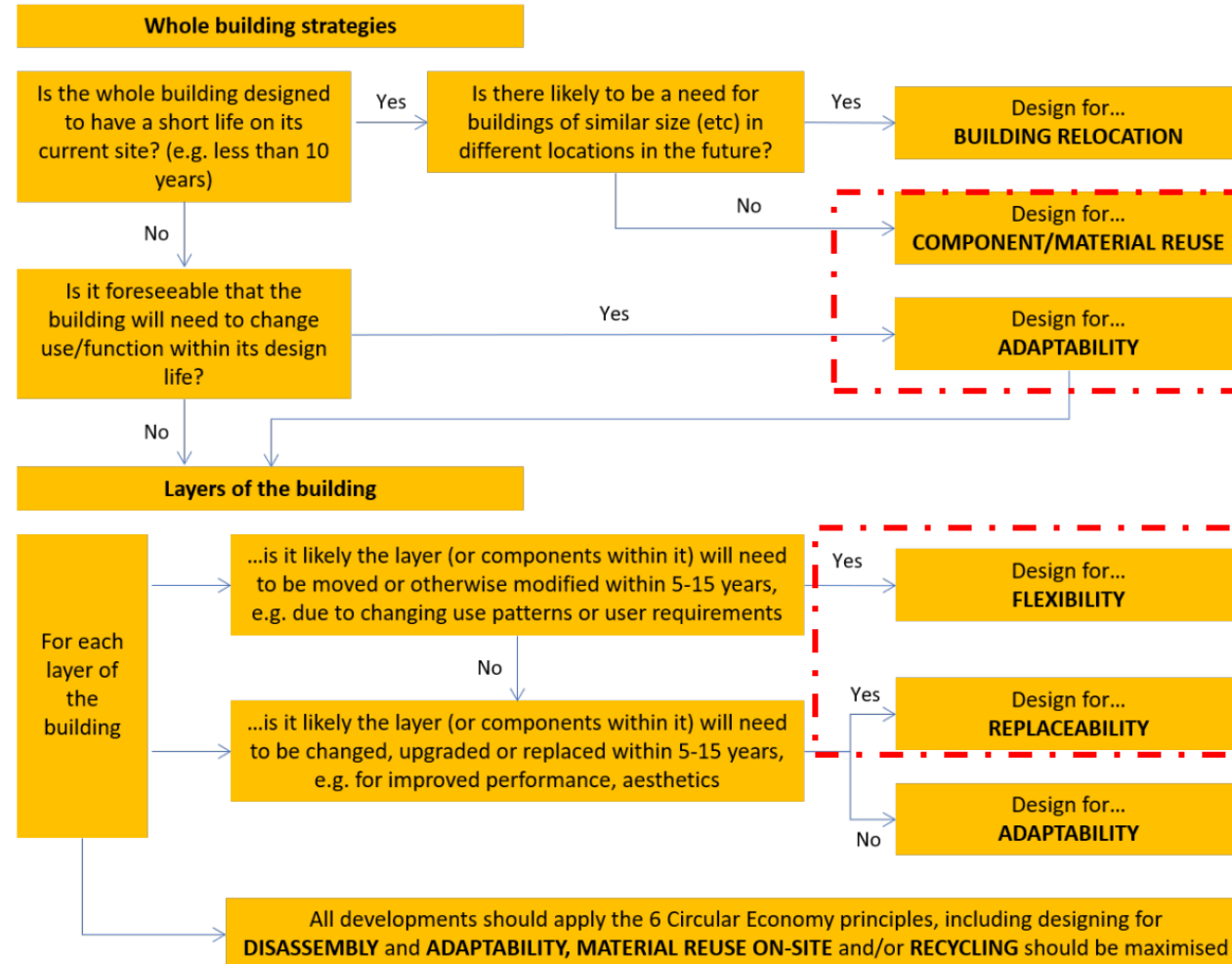


Table 3: CE design approaches for new buildings and definitions

New building CE design approaches	Definition
Building relocation	Designing to allow the whole building to be used on a different site, either by moving as a whole or disassembling into large modules.
Component or material reuse	The use of a product in its original form with minimal reprocessing. Preparation for reuse involves checking, cleaning or repairing materials so that they can be used again for their original purpose. Materials can be reused as a whole; redeployed as modules; or reused as a kit of parts on one or more different sites.
Adaptability	A building that has been designed with thought of how it might be easily altered to prolong its life, for instance by alteration, addition, or contraction, to suit new uses or patterns of use. ¹³ Often used interchangeably with flexibility; however, it relates more to building structural changes.
Flexibility	A building that has been designed to allow easy rearrangement of its internal fit-out and arrangement to suit the changing needs of occupants. ¹⁴ Often relates to floorplates rather than structural changes (see Adaptability).
Replaceability	Designing to facilitate easy removal and upgrade, and ideally to be reused, remanufactured or recycled on a part-by-part basis.
Disassembly	Designed to allow the building and its components to be taken apart with minimal damage to facilitate reuse or recycling. If designed well, it should be possible to replace any component.
Longevity	Designing to avoid a premature end of life for all components through considering maintenance and durability.

CE principles

• Reusing existing resources

- Existing buildings or structures (pre-redevelopment plan)
- Existing materials on-site (pre-demolition audit)
- Existing materials from off-site
- Materials with high recycled content

• Minimise resource consumption

- Avoid over design
- Material efficiency (more with less)
- Use abundant resources

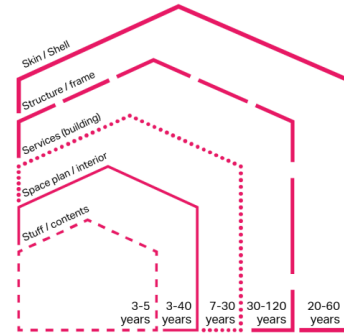
• Building in layers

- Ensuring that different parts of the building are accessible
- Easily maintained and replaced without affecting deeper layers

Related specific client requirements

- 10% of demo materials (by value and quantity) should be reused either on-site or offsite
- Demo and construction waste (non-hazardous)
 - 100% diverted from landfill
 - 90% reuse or recycled
 - $\leq 2.1\text{t}/100\text{m}^2$ GIA (1.4t aspirational)

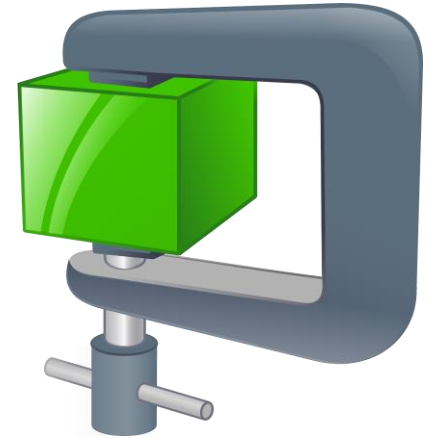
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Building layer	Summary and constituent elements	RICS reference
Site	The geographical location, context, external works, earth works and landscaping.	NRM 8 – External works
Skin/shell e.g. façade	The layer keeping out water, wind, heat, cold, direct sunlight and noise. Includes exterior surfaces such as the roof, siding, sheathing and windows. This layer includes the façade (front or face of a building). This layer often has biggest impact on long-term durability, occupant comfort and building-energy performance.	NRM 2.3, 2.5, 2.6 – Superstructure (roofs, external walls, windows and external doors)
Structure/ structural frame/ superstructure	Load-bearing elements above plinth including roof-supporting structure. Generally, it is the longest-lasting building element. Insulation and services may be embedded here.	NRM 2.1, 2.2 and 2.4 and 7 – Frame, upper floors, stairs and ramps, work to existing building
Substructure	Excavations, foundations, basements and ground floors.	NRM 1 Substructure
Services (building)	Installations to ensure comfort, practicality, accessibility and safety, including plumbing, heating, cooling, ventilation and electrics. Distribution systems can be hard to change.	NRM 5 Services (MEP)
Space/space plan/interior/ interior space	The layout, internal walls and partitions, ceilings, floors, surface finishes, fixtures, doors, fitted furniture. Changeable without changing structure, services or skin.	NRM 2.7, 2.8 and NRM 3 (Finishes, superstructure – internal walls and partitions, internal doors)
Stuff/contents	Anything that could fall if the building was turned upside down. Not permanent, easily movable, most frequently changed by occupant, e.g., appliances, lamps, electronics, furniture, art.	Fittings, furnishings and equipment
Construction materials	Any temporary installations/works/materials, packaging and equipment.	NRM 0

CE principles

- **Designing out waste**
 - Waste reduction is planned in from the start
 - Standardised components
 - Modular building
 - Off-site construction
- **Designing for longevity**
 - High quality beautiful buildings people love and want to keep
 - Long service lives of systems and products to avoid excessive maintenance and replacement
 - Design to avoid excess wear and weathering, include appropriate material selection and protection where required
 - Simple maintenance and information e.g. material passports, BIM
- **Designing for adaptability or flexibility**
 - Resilience and adaption for future effects of climate change
 - Building is flexible to accommodate several uses, with only simple adaptations

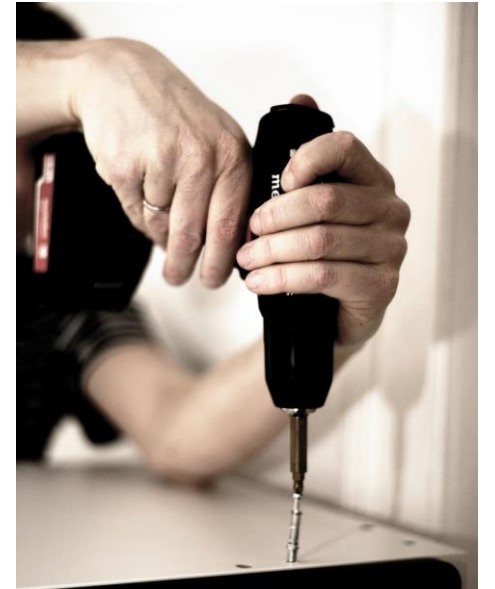


CE principles

- **Designing for disassembly**
 - Systems and materials easily dismantled and separated
 - Mechanical fixings not bonded
 - Material passports, BIM
 - Avoid composite materials
- **Design for reuse and recycling**
 - Take-back / buy-back
 - Servitisation
 - Materials banking
 - Avoid hazardous ingredients
 - Standard and/or modular sizes
 - Standard performance e.g. structural, fire
 - Material passports, BIM

Related specific client requirements

- Design for disassembly (e.g. mechanical fixings)
- Modular design for reuse



Design review workshop



Review of current design

- **Today**

1. Walk through current design drawings
 - Led by architect, all contribute
 - Keep in mind CE principles and client requirements
2. Identify CE related aspects already included, particularly non-business as usual
3. Identify further CE/carbon reduction opportunities and actions

- **After the workshop**

- EV report back on the CE actions identified
- Design team aim to incorporate CE actions
- Design team share the final stage 3 design information
- EV carry out whole life carbon modelling and report back