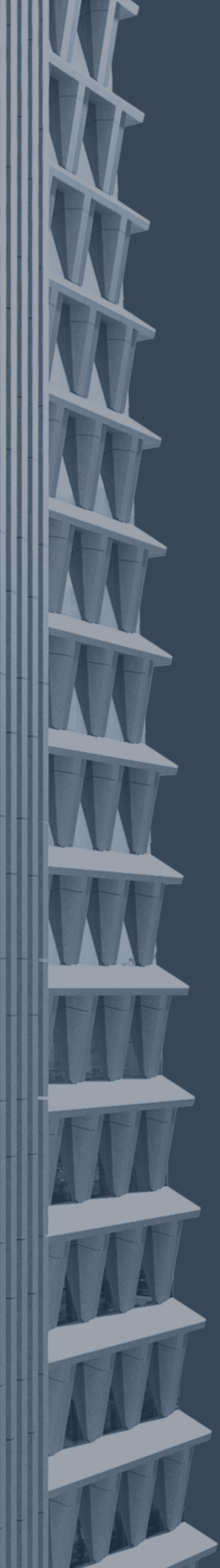

EUSTON TOWER

Circular Economy Statement

December 2023

British Land

Revision	Issued for	Date	Prepared by	Checked by
A	Planning Submission	05.12.2023	GXN	AOZ

Issue: 05 December 2023
Rev: A

Contents

Executive Summary

This Circular Economy Statement has been prepared by GXN, on behalf of British Land Property Management Limited (hereafter British Land), in support for planning permission for the redevelopment of Euston Tower. It summarises the circular economy approaches and strategies proposed for the development in response to the Greater London Authority's and London Borough of Camden's planning polices and guidance, as well as British Land's ambitious sustainability brief.

The application seeks permission for the redevelopment of Euston Tower, including the partial retention (retention of existing core, foundations and basement), disassembly, reuse and extension of the existing building, to provide a 32-storey building for use as offices and research and development floorspace (Class E(g)) and office, retail, café and restaurant space (Class E) and learning and community space (Class F) at ground, first and second floors, and associated external terraces. Provision of public realm enhancements, including new landscaping, and provision of new publicly accessible steps and ramp. Provision of short and long stay cycle storage, servicing, refuse storage, plant and other ancillary and associated works.

The proposed development creates a GIA of 77,542 m^2, comprising the following:

- Commercial office (Class E(g)) 46,465 m^2
- Lab-enabled workspace (Class E(g)) 21,603 m^2
- Accelerator lab workspace (Class E(g)) 2,893 m^2
- Lobby (Class E(g)) 3,830 m^2
- Retail (Class E) 748 m^2
- Retail/Community Space (Class E/F) 2,003 m^2.

The proposed development adopts the principles of the circular economy across all areas of design, construction, and operation. This will ensure that it delivers world leading sustainability performance that is fit for today and the future.

Wherever technically, practically, and economically feasible, the proposed development meets and exceeds the sustainability requirements of planning policy.

Special attention has been paid to the opportunities for retention of the existing building, and the reuse/recycling/upcycling of any materials from the deconstruction.

The proposed development includes a range of circular economy strategies and approaches, as detailed in this statement and its supporting documents, including:

- **Maximising utility of existing buildings**
  - Achieved by retaining as much as possible of the existing building, reducing waste and the need for new materials
  - A thorough and transparent Feasibility Study studying the condition of the existing building, and assessing options for redevelopment
  - Retention of 31% of the existing structure, the opportunities for which have been the subject of a thorough feasibility study which is submitted in support of the application (satisfying the GLA requirements for a pre-redevelopment audit).
- **Minimising waste in deconstruction and construction**
  - A pre-demolition audit has been undertaken and is included in Appendix A
  - A transparent approach to handling deconstructed materials and identifying opportunities to put them to best use
  - A detailed assessment of opportunities for on site and off site deconstruction waste reuse/upcycling/recycling are considered and captured in the material strategy as part of this statement
  - The proposed development is targeting 98% of the demolition waste to be diverted from landfill, 96% of the construction waste to be diverted from landfill, and 95% of excavation waste to be put to beneficial use
  - Prototyping innovative approaches for structural reuse of concrete and recycling of building glass at scale, with ambition to publish the findings
  - Designing a modular facade utilising off-site manufacturing to reduce waste.
- **Minimising waste in operation and end of life**
  - The overall strategic design approach is to design a building for adaptability and longevity, reducing waste and preventing premature obsolescence
  - Particular focus is applied to the structure as it is the most carbon-intensive element, and is seen as fundamental to long-term adaptability
  - Considering the different building elements in layers to enable maintenance and replacement that minimises destructive impacts on other building elements (especially structure)

  - Dedicated storage areas for waste recycling
  - The proposed development will contribute to achieving the GLA's municipal waste target of 65% recycling by 2030
  - Improving end of life reusability by committing to capture useful data for key building elements in material passports
  - Committing to submitting a post-construction report to report as-built circular economy performance.
- **Seeking to use reused/recycled materials**
  - Using reused and/or high recycled content materials where possible, targeting 25% recycled content (by value)
  - Driving innovation by upcycling/transforming materials from the deconstruction to reduce waste and the reliance on virgin materials, captured in the material strategy as part of this statement.

The Bill of Materials and Recycling and Waste Reporting Table has been summarised in this statement, with the full details and calculations included in the Circular Economy Statement Template which is located at Appendix C.

To ensure successful implementation, the key initiatives and commitments detailed in this statement, and its supporting documents, will be implemented, monitored, and/or reviewed as the design develops, and subsequently during the operational phase of the proposed development.

1

Euston Tower

Introduction

1.1 Introduction

1.1.1 General

Euston Tower is a 36-storey tall building standing on the northern edge of central London, situated in the south-west of the London Borough of Camden (LBC). The proposed redevelopment of Euston Tower aims to create a world leading science, technology and innovation building and public realm for Camden and the Knowledge Quarter that inspires, connects, and creates opportunities for local people and businesses.

This will vision be achieved by:

- Transforming the largely vacant Euston Tower ensuring it is fit for the future by adopting world leading sustainability targets and reusing, recycling, and offsetting where necessary, to reach net zero at completion and in operation.
- Putting social impact at the heart of the project from the start and ensuring that communities play a key role in shaping new spaces which meet local needs.
- Creating pioneering workspaces in the Knowledge Quarter for businesses of all sizes to prosper, including flexible incubator and accelerator spaces, to support start-ups and knowledge sharing.
- Ensuring that the future use of Euston Tower is built upon identified needs and contributes to a thriving local, regional and national economy for our ever-changing world.
- Reimagining the public spaces of Regent's Place, creating safe, inclusive, connected and sustainable spaces for Camden's communities.
- Contributing to meeting Camden's housing needs.

1.1.2 The applicant

British Land Property Management Limited (hereafter British Land).

1.1.3 Purpose of this document

This document is the Circular Economy Statement that has been prepared in support of an application for planning permission of the redevelopment of Euston Tower, 286 Euston Road, London, NW1 3DP. It outlines the circular economy strategy and circular economy commitments for the Proposed Development, in response to the Greater London Authority's (GLA's) and London Borough of Camden's planning polices and guidance.

This document accompanies the GLA Circular Economy Statement Assessment Template, which has been developed to meet London Plan 2021 Policy D3 and SI 7, and has been produced in line with the GLA Circular Economy Statement Guidance.

The document has been prepared by GXN on behalf of British Land.

1.1.4 The site

The site is situated within LBC, and the ward of Regent's Park. The site is bounded by Euston Road (south), Hampstead Road (east), Brock Street (north) and Regent's Place Plaza (west). The site covers an area of 8,079 m^2, comprising a single, ground plus an existing 36-storey tower. Comprising predominantly office uses on the upper floors, the tower has been fully vacant since April 2021, however there are still retail units currently in operation at ground floor level.

1.1.5 Summary of the proposed development

The proposal is for the redevelopment of Euston Tower, including the partial retention (retention of existing core, foundations and basement), disassembly, reuse and extension of the existing building, to provide a 32-storey building for use as offices and research and development floorspace (Class E(g)) and office, retail, café and restaurant space (Class E) and learning and community space (Class F) at ground, first and second floors, and associated external terraces. Provision of public realm enhancements, including new landscaping, and provision of new publicly accessible steps and ramp. Provision of short and long stay cycle storage, servicing, refuse storage, plant and other ancillary and associated works.

The proposed development creates a GIA of 77,542 m^2, comprising the following:

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Figure 1.1 Render of the proposed development as seen from Euston Road

1.1.6 Team

3XN is the architect and lead designer for the proposed development, and is supported by a team of key consultants:

Executive Architect & Principal Designer:	Adamson Associates
Landscape Architect:	DSDHA
Planning Consultant:	Gerald Eve
Services Engineer:	Arup
Structural Engineer:	Arup
Sustainability Consultant:	GXN & SWECO
Transport & Logistics:	Velocity
Visual Impact Assessment:	Cityscape Digital
Townscape Consultant:	Tavernor Consultancy
Public Use Consultant:	Forth
EIA Co-ordinator:	Trium Environmental
Ecological Consultant:	Greengage
Daylight Consultant:	Point2
Rights to Light Consultant:	Point2
Fire Engineering:	Arup
Access Consultant:	David Bonnett Assoc.
Security Consultant:	QCIC
Acoustic Consultant:	Hann Tucker
Wind Analysis:	Arup
Facade & Access & Maintenance Consultant:	Thornton Tomasetti
Cost Consultant:	Gardiner & Theobald
Planning Legal Advisors:	Herbert Smith Freehills
Community Consultation:	LCA
Project Manager:	Gardiner & Theobald
Construction & Logistics Consultant:	Lendlease
Employment & Training and Regeneration Advisor:	Volterra
Community Engagement & Social Impact Consultant:	Beyond The Box
Community Engagement Consultant:	Something Collective

Figure 1.2 Render of the proposed development

1.2 Planning Policy

1.2.1 General

The relevant documents setting out current and emerging planning policy on circular economy are the following:

- The National Planning Policy Framework, September 2023 (NPPF)
- The London Plan, March 2021 (LP)
- Circular Economy Statement Guidance, March 2022 (CESG)
- Camden Local Plan, 2017 (CLP)
- Camden Planning Guidance, Energy Efficiency and Adaptation, January 2021 (CPG).

1.2.2 National planning policy

National Planning Policy Framework (NPPF)
The National Planning Policy Framework (NPPF) sets out Government's planning policies for England and how these are expected to be applied to achieve "sustainable development".

The NPPF replaced the previous suite of national Planning Policy Statements, Planning Policy Guidance Notes and some Circulars in 2012. The 2023 revisions replaces the previous NPPF last revised in July 2021.

The NPPF Chapter 14 states how the planning system should support the transition to a low carbon future in a changing climate. It does not contain specific targets for sustainability or energy.

1.2.3 Regional planning policy

The London Plan (LP)
The London Plan (LP) (March 2021) sets out the spatial development strategy for Greater London. It is the overall strategic plan for London, setting out an integrated economic, environmental, transport and social framework for how London will develop over the next 20 - 25 years.

London Borough planning authorities' local plans need to be in general conformity with the LP, and its policies guide decisions on planning applications by the Borough Council's and the Mayor.

The LP contains several specific sustainability and energy targets, these are summarised below:

- Policy D3 Optimising site capacity through the design-led approach

  This key circular economy policy sets out key objectives to:
  - Create buildings that are high quality, with architecture that pays attention to detail and gives thorough consideration to the practicality of use, flexibility, safety and building lifespan, through appropriate construction methods and the use of attractive, robust materials which weather and mature well
  - Have high sustainability standards and take into account the principles of the circular economy.

- Policy SI 7 Reducing waste and supporting the circular economy

  This key circular economy policy sets out the key metrics used to address the circular economy policy objectives. It defines a circular economy as one where materials are retained in use at their highest value for as long as possible and are then reused or recycled, leaving a minimum residual waste. Policy SI 7 requires addressing the following:
  - A) Resource conservation, waste reduction, increases in material reuse and recycling, and reductions in waste going for disposal will be achieved by the Mayor, waste planning authorities and industry working in collaboration to:
    - Promote a more circular economy that improves resource efficiency and innovation to keep products and materials at their highest use for as long as possible
    - Encourage waste minimisation and waste prevention through the reuse of materials and using fewer resources in the production and distribution of products
    - Ensure that there is zero biodegradable or recyclable waste to landfill by 2026
    - Meet or exceed the municipal waste recycling target of 65% by 2030

- Meet or exceed the targets for each of the following waste and material streams: Construction and demolition – 95%; Excavation – 95 % beneficial use
- Design developments with adequate, flexible, and easily accessible storage space and collection systems that support, as a minimum, the separate collection of dry recyclables (at least card, paper, mixed plastics, metals, glass) and food

– B) Referable applications should promote circular economy outcomes and aim to be net zero-waste. A Circular Economy Statement should be submitted, to demonstrate:
  - How all materials arising from demolition and remediation works will be reused and/or recycled
  - How the proposal's design and construction will reduce material demands and enable building materials, components and products to be disassembled and reused at the end of their useful life
  - Opportunities for managing as much waste as possible on site
  - Adequate and easily accessible storage space and collection systems to support recycling and reuse
  - How much waste the proposal is expected to generate, and how and where the waste will be managed in accordance with the waste hierarchy
  - How performance will be monitored and reported

– C) Development plans that apply circular economy principles and set local lower thresholds for the application of Circular Economy Statements for development proposals are supported

– Further specific circular economy guidance is given in the Circular Economy Statements Guidance LPG.

Circular Economy Statement Guidance (CESG)
The Circular Economy Statement Guidance (CESG) provides guidance on how to prepare a CE Statement and demonstrate compliance with LP Policy SI 7.

All referable applications are required to submit a CE Statement demonstrating how the principles of the circular economy are being applied and how performance will be monitored and reported. The CESG details what should be included in the Circular Economy Statement at each RIBA Stage, and the requirements for the submission of the GLA Circular Economy Statement Spreadsheet which accompanies this statement.

1.2.4 Local planning policy

The Camden Local Plan 2017 (CLP)

The Camden Local Plan 2017 (CLP) sets out Camden's planning policies, ensuring Camden has robust planning policies that contribute to delivering the Camden Plan. The CLP covers the period from 2016 – 2031. The CLP focusses on creating the conditions for harnessing the benefits of economic growth, reducing inequality, and securing sustainable neighbourhoods.

Pre-dating the London Plan 2021, the CLP is less well harmonised with the LP on sustainability, but this has been improved with the publication of Camden Planning Guidance Energy Efficiency and Adaptation in January 2021 with the CPG on energy efficiency and adaptation.

The CLP contains several specific circular economy targets, these are summarised below:

- Policy D1 Design
  - Requires that development is sustainable in design and construction, incorporating best practice in resource management, and climate change mitigation and adaptation
  - Requires that development is of sustainable and durable construction and adaptable to different activities and land uses (no specific detail is provided in Policy D1, but specific detail is contained in the CC suite of policies and the CPG)

- Policy CC1 Climate change mitigation
  - Requires developments that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building, and proposals for substantial demolition should be fully justified in terms of the optimisation of resources and energy use
  - 85% construction, demolition, and excavation waste diversion from landfill
  - Expects developments to optimise resource efficiency by reducing waste, reducing energy and water use in construction and operation, minimising materials required, using low embodied carbon materials

- Policy CC5 Waste
  - Sets requirements for operational waste and an increase in recycling and reuse of materials
  - Developments required to include facilities for the storage and collection of waste and recycling
  - Encourages submission of site waste management plans.

Camden Planning Guidance Energy Efficiency and Adaptation (CPG)

The Camden Planning Guidance Energy Efficiency and Adaptation (CPG) supports the policies in the Camden Local Plan 2017 (CLP). It is a Supplementary Planning Document (SPD) which is a "material consideration" in planning decisions.

The January 2021 version of the CPG replaces the Energy Efficiency and Adaptation CPG (March 2019), which itself replaced the CPG3 Sustainability (July 2015).

The CPG contains several specific circular economy targets that build on the policies in the CLP, these are summarised below:

- (9) Reuse and optimising resource efficiency

  This key section sets out the Camden's requirements used to address the circular economy policy objectives.
  - Any developments proposing substantial demolition are required to submit an existing building condition and feasibility study, as well as an options appraisal with the aim of optimising resource efficiency
  - Any developments, where the chosen option is substantial demolition, are required to submit a Whole Life-cycle Carbon Assessment (WLCA) and Pre-demolition Audit (PDA)
  - Developments should meet the London Plan 2021 targets for construction and demolition waste diversion from landfill (95% reused/recycled/recovered), and 95% of excavation waste to be put to beneficial use
  - All major applications and new buildings are required to submit a Resource Efficiency Plan showing how resource efficiency has been optimised

- The following resource efficiencies are expected to be demonstrated:

Design stage

- ◦ Energy efficient building design
- ◦ Minimise the quantities of materials used
- ◦ Where demolition is involved, submission of a pre-demolition audit, implementing careful demolition strategies, segregating materials and conducting analysis to maximise reuse and reclamation
- ◦ Use of reclaimed / recycled content, and enabling reuse of building materials (local sourcing through material exchange portals)
- ◦ High durability materials and low maintenance requirements
- ◦ Design to allow for flexibility – reconfiguration/ remodelling
- ◦ Design to allow for easy repair/ replacement of components
- ◦ Design for deconstruction and reuse of materials

Construction stage

- ◦ Minimise the quantities of other resources used (energy, water, land)
- ◦ More efficient use of resources and materials including minimising waste generation
- ◦ Divert waste from landfill (via reuse, recycling or recovery)
- ◦ Demolition and construction waste - 95% to reuse, recycling, recovery (excavation 95% 'beneficial use')
- ◦ Use efficient demolition equipment
- ◦ More efficient modes of transporting materials
- ◦ Local sourcing of materials responsibly and sustainably
- ◦ Post completion bill of materials (including as a minimum the building layer, element, material and quantity)
- ◦ Efficient construction processes and machinery

Operation stage

- ◦ Use a soft landings approach to ensure the building is operating efficiently as designed
- ◦ Implement a good maintenance/ repair strategy to maximise life of materials
- ◦ Consider repair before replacement
- ◦ When replacements required select high durability materials with low maintenance requirements

Deconstruction/end of life, and managing waste

- ◦ Design for deconstruction and reuse of materials
- ◦ Divert waste from landfill (via reuse, recycling or recovery)
- ◦ Demolition and construction waste - 95% to reuse, recycling, recovery
- ◦ Excavation 95% 'beneficial use'
- ◦ Use efficient demolition equipment.

- (10) Sustainable design and construction measures
  - Developments of 500m^2 or larger are required to address sustainable design and construction measures in a Sustainability Statement
  - Developments are required to reduce overheating risk by following the cooling hierarchy.

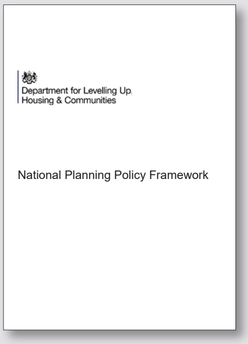
- (11) Sustainable Assessment Tools
  - Non-residential developments of 500 m^2 or larger are required to achieve BREEAM "Excellent", achieving 60% of all available Energy and Water credits and 40% of available Materials credits.

Camden's Climate Action Plan
In June 2020, Camden approved a 5 year "Climate Action Plan" which creates a framework for action across all aspects of the borough with the aim of achieving zero carbon by 2030.

Objectives and actions that affect the proposed development include:

- From 2020, all major developments in Camden are required to be zero carbon (as per the London Plan 2021 definition)
- From 2020, all major developments in Camden are required to calculate whole life-cycle carbon emissions to include all operational and embodied carbon
- Public spaces will encourage and enable healthy and sustainable travel choices and promote biodiversity.
- Enable electric transport with infrastructure and incentives.

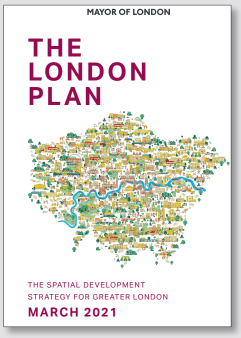
NATIONAL PLANNING POLICY



National Planning Policy Framework

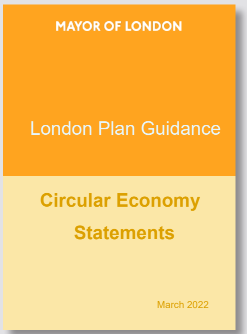
Sets out Government's planning policies for England and how these are expected to be applied.

REGIONAL PLANNING POLICY



The London Plan

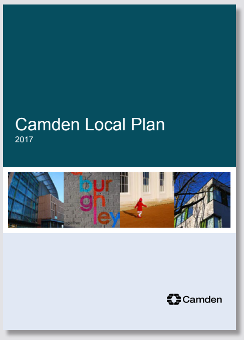
Sets out the spatial development strategy for Greater London



Circular Economy Statement Guidance

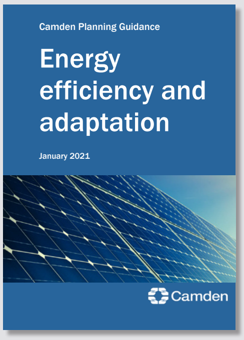
Provides guidance on how to prepare a CE Statement and demonstrate compliance with LP Policy SI 7

LOCAL PLANNING POLICY



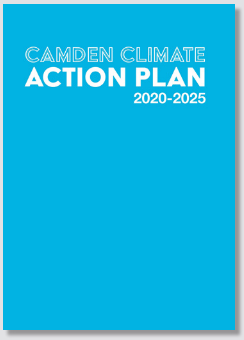
The Camden Local Plan 2017

Sets out Camden's planning policies, ensuring Camden has robust planning policies that contribute to delivering the Camden Plan



Camden Planning Guidance Energy Efficiency and Adaptation

Supports the policies in the Camden Local Plan 2017 (CLP)



Camden's Climate Action Plan

Creates a framework for action across all aspects of the borough with the aim of achieving zero carbon by 2030

Figure 1.3 Overview of key planning documents and guidance relating to circular economy

1.3 British Land Sustainability Brief

British Land is committed to sustainability leadership across the development and operation of its buildings. The British Land Sustainability Brief 2030 sets out its ambitions across a range of topics that impact environmental sustainability, including the circular economy, many of which go beyond standard practice and/or policy requirements.

Chief amongst these ambitions, British Land is focussed on making the whole portfolio net zero carbon by 2030. This starts with reducing embodied and operational carbon in design by:

- Prioritising retrofit above new build
- Employing circular economy principles in design and construction
- Being innovative in the use of sustainable materials
- Prioritising energy efficiency and renewable energy sources.

Figure 1.4 The British Land Sustainability Brief goes beyond planning policy in several areas

1.4 Ambitions and Response to Planning Requirements

The proposed development has high aspirations regarding the circular economy.

Accelerating the transition towards a circular economy is a core parameter when evaluating solutions for the proposed development, both regarding how the existing disused materials are handled, and ensuring the future building minimises waste during construction, during operation, and at end of life. The end of life strategies consider solutions for maximising value when the building, or parts of the building, is no longer required.

In response the planning policy and the strategic objectives of the London Borough of Camden and the Greater London Authority, the following strategies are employed in the proposed development.

1.4.1 Maximising utility of existing buildings

- Achieved by strategically retaining as much as possible of the existing building, reducing waste and the need for new materials
- A thorough and transparent Feasibility Study studying the condition of the existing building, and assessing options for redevelopment.

1.4.2 Minimise waste in deconstruction and construction

- A pre-demolition audit has been undertaken and is included in Appendix A
- Zero biodegradable waste to landfill
- Targeting 98% of demolition waste to be upcycled, recycled, or downcycled
- Targeting 96% of construction waste to be upcycled, recycled, or downcycled
- Targeting 95% of excavation waste to beneficial use
- A detailed assessment of opportunities for on site and off site deconstruction waste reuse/upcycling/recycling are considered and captured in the material strategy as part of this statement
- Prototyping innovative approaches for structural reuse of concrete and recycling of building glass at scale, with ambition to publish the findings
- Designing a modular facade utilising off-site manufacturing to reduce waste.

1.4.3 Minimise waste in operation and end of life

- End of life considers solutions for maximising value when the building is no longer required
- Designing a structure that is long-lasting and adaptable, with elements designed to be disassembled and recovered for reuse
- Considering the different building elements in layers to enable maintenance and replacement that minimises destructive impacts on other building elements (especially structure)
- Dedicated storage areas for waste recycling
- Contributing to the GLA's municipal waste target of 65% recycling by 2030
- Contributing to the London Environment Strategy's business waste target of 75% recycling by 2030
- Improving end of life reusability by committing to capture useful data for key building elements in material passports.

1.4.4 Seek to use reused/recycled materials

- Using reused (both from the existing tower and elsewhere) and/or high recycled content materials where possible, targeting 25% recycled content (by value)
- Driving innovation by upcycling/transforming materials from the deconstruction to reduce waste and the reliance on virgin materials, captured in the material strategy as part of this statement.

1.4.5 High-quality certification

- Targeting BREEAM NC 2018 Shell & Core "Outstanding" for Office with Research and Development Areas
- Targeting BREEAM NC 2018 Shell Only "Excellent" for retail areas.

Figure 1.5 Render of the proposed development

1.5 Method Statement

1.5.1 General

This Circular Economy Statement has been prepared as a response to the GLA and London Borough of Camden requirements, and carried out in line with the GLA Circular Economy Statement Guidance from March 2022.

The Circular Economy statement is a result of a collaborative effort across the design team, through fortnightly sustainability meetings. A number of specific workshops were conducted with a focus on the material strategy, and future-proofing of the proposed design.

In addition to a rigorous approach to avoiding waste through the reuse and recycling of the disused materials, a key focus for the project team has been how to avoid many of the limitations inherent in the existing building in the design of the new development.

The circular economy approach proposed in this statement is split into two categories: the approach to the existing building, and the approach to the new development. The approach is shown diagrammatically in Figure 1.6.

1.5.2 Circular economy approach to existing building

The approach to the existing building proposed in this statement is a result of the following documents:

- **Feasibility Study**
  A detailed, three-part feasibility study to assess, in detail and transparently, the opportunities for reuse, degrees of retention and refurbishment of the existing tower following the principles set out in the CPG Energy Efficiency and Adaptation
- **Pre-demolition Audit**
  Conducted to identify the types and amounts of products and materials arising from the deconstruction of the existing tower, and outlines the reuse and recycle potential from a 'standard' and 'best practice' scenario
- **Material Recovery Strategy**
  Building on the Pre-demolition Audit, the strategy lays out the holistic overview of material waste routes, presents innovative approaches to treating the larger, challenging material fractions and identifies key recycling/upcycling opportunities
- **Circular Economy Principles**
  An overview of how the GLA's circular economy principles are applied in the proposed development.

Section 2 provides a more comprehensive summary of the individual documents, and outlines overall commitments and suggestions on how materials arising from deconstruction works will be reused/upcycled/recycled.

1.5.3 Circular economy approach to new development

The circular economy approach to the new development addresses the following:

- Strategies incorporated or considered for reducing material intensity, and increasing the use of reused and high recycled content materials
- Opportunities to reduce on site waste
- Details on strategies for designing out waste in production, in use and at end of life
- Details on strategies for design for future flexibility, adaptability, longevity and reusability
- Current considerations on an end of life strategy including developing of material passports for key materials/products
- Strategies for how circular economy performance will be monitored and reported.

These strategies are detailed in Section 3 of this statement.

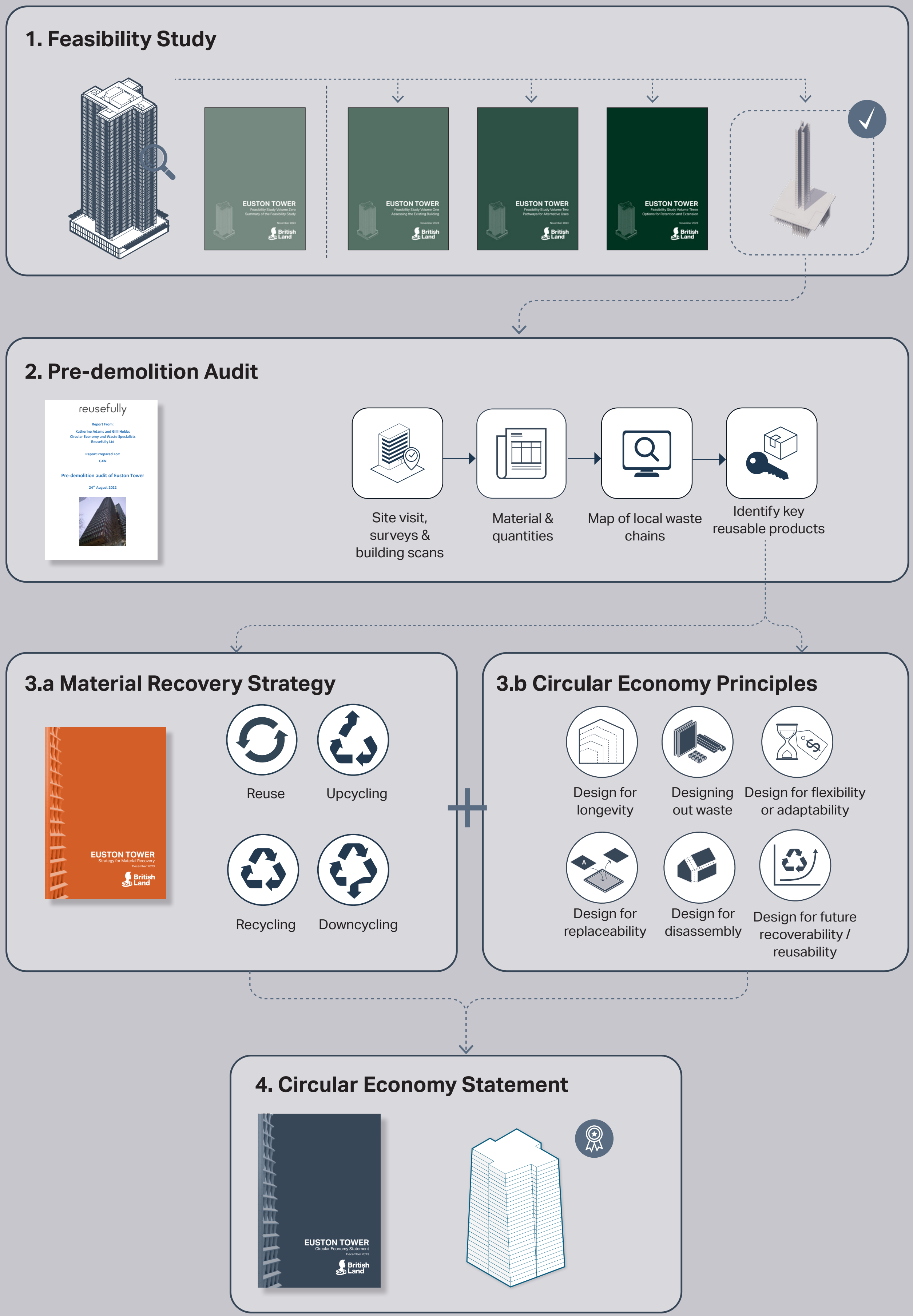


Figure 1.6 The structure of this Circular Economy Statement

1.6 Supporting Information

This Circular Economy Statement should be read in conjunction with the documentation forming the full planning application, and in particular:

- Design & Access Statement prepared by 3XN dated December 2023
- Planning Statement prepared by Gerald Eve dated December 2023
- Feasibility Study[1] prepared by GXN dated November 2023
- Sustainability Statement prepared by GXN dated December 2023
- GLA Whole Life-cycle Carbon Assessment Template prepared by Sweco dated December 2023
- Operational Waste Management Plan prepared by Velocity Transport Planning dated December 2023
- Outline Site Waste Management Plan prepared by Velocity Transport Planning dated December 2023
- Construction Management Plan prepared by Velocity Transport Planning dated December 2023.

[1] In response to London Plan Policies D3 and SI 7 for a pre-redevelopment audit and Camden Local Plan Policy CC1 to justify proposals with significant demolition

Figure 1.7 Model of the proposed development

2

Euston Tower

Strategy for the Existing Building

2.1 Circular Economy Approach

2.1.1 Working with existing buildings

The circular economy decision tree for developments with an existing building on site has been used to assist the design team in choosing the most appropriate design approach for the existing scheme. Refer to Figure 2.1.

An extensive feasibility study has been carried out, to evaluate the technical feasibility and practicality of retaining the existing building on site, and to which degree the existing building can be retained and still suit modern requirements for the proposed development. This has been independently reviewed by a third-party.

Feasibility Study Volume One, supported by a number of both intrusive and non-intrusive surveys, concludes that the existing services and facade system are no longer fit for purpose in line with current guidelines. It furthermore establishes that, despite the superstructure being in good condition, the extent of the upgrades that are required to bring the existing tower up to current building regulations and standards are extensive. The extent of upgrades required, and the quality and quantum of compromised office space delivered, would make the resulting product challenging in the leasing market and it identified that refurbishing the existing building is not a feasible option.

Feasibility Study Volume Two concludes that in order for the existing tower to support alternative uses (those other than office use) substantial structural alterations are required to deliver the necessary upgrades to accommodate modern services and lift requirements. Considering the technical challenges in providing the necessary upgrades, as well as the resulting compromised space, low quality units, and policy non-conformance, the existing tower was shown not be appropriate for alternative uses.

From the two studies it is concluded that a full retention and retrofit is not considered feasible either for continued office use or alternative uses, but that the existing substructure and parts of the superstructure could be retained.

A range of options for re-purposing and retaining the existing tower has been considered in Feasibility Study Volume Three. It has been shown that an option that retains the existing foundation and basement, as well as the central core, provides the best balance of structural retention and quality, flexibility, adaptability and buildability.

A more detailed summary of the Feasibility Study is presented in Section 2.2. The full Feasibility Study forms part of this planning application. Refer to the *Feasibility Study prepared by GXN dated November 2023*.

2.1.2 Working with disused materials

The materials that will be removed as part of the deconstruction process are captured in the Pre-demolition Audit.

The Pre-demolition Audit maps the materials' condition, and provides the business as usual and best practice recycling routes for the key deconstruction products.

The interior fit-out and finishes have already been stripped from the existing building. The Pre-demolition Audit provides details on where the stripped out materials were sent for recovery.

A detailed summary of the Pre-demolition Audit is presented in Section 2.3. The full Pre-demolition Audit forms part of this planning application and is included in Appendix A.

A material strategy has been developed to ensure that the deconstructed materials and products are retained at the highest possible value. This includes identifying materials that could be suited for direct reuse, and where this is not possible, ensuring that the materials are carefully separated and recycled at the highest value possible. It also includes several design ideas for creative upcycling of materials from the deconstruction, for use in the new development or elsewhere.

A detailed summary of the overall strategy to treating the deconstructed materials is presented in Section 2.4. The full Material Recovery Strategy forms part of this planning application and is included in Appendix B.

GLA Circular Economy Decision Tree for Existing Buildings

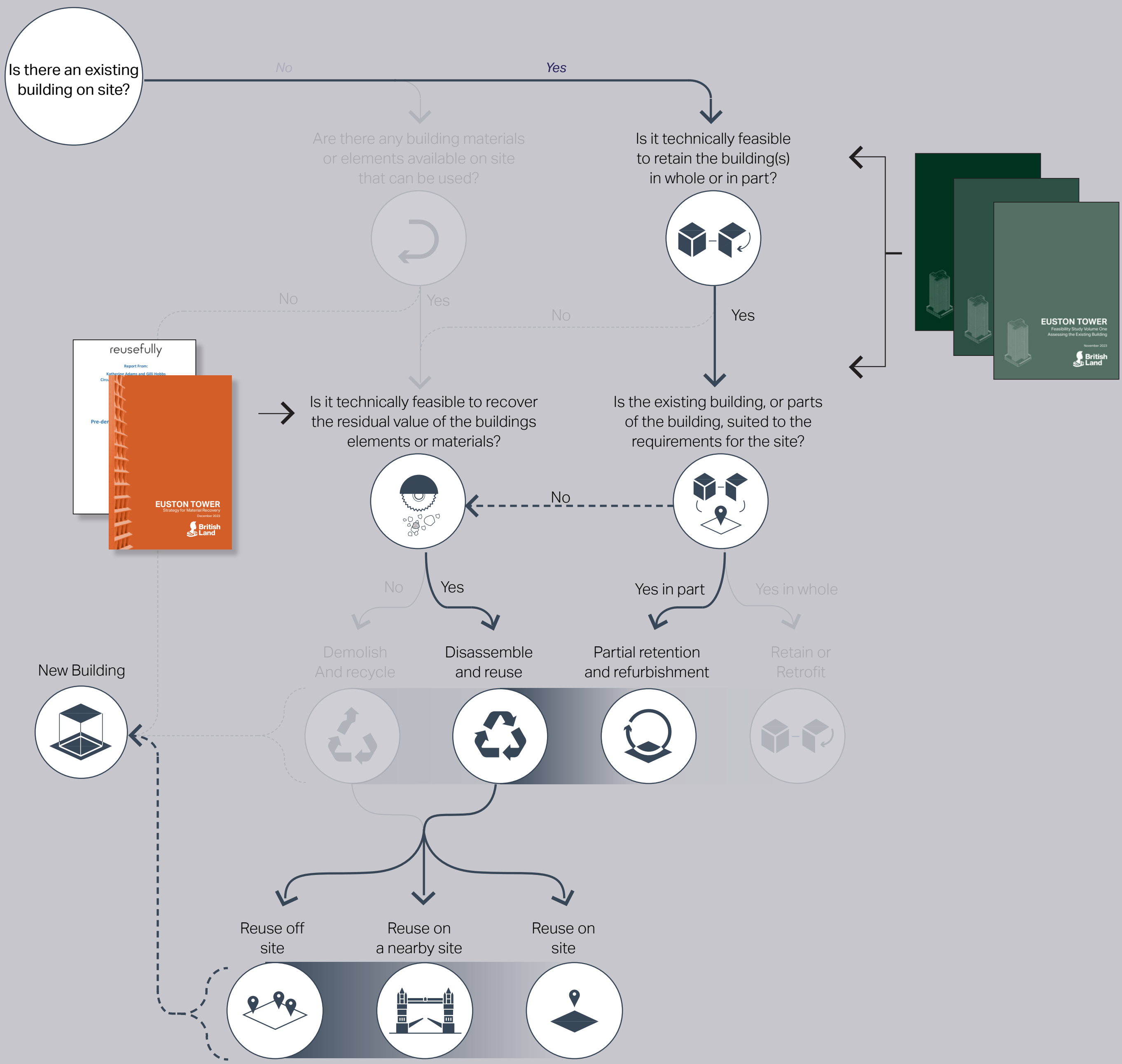


Figure 2.1 The circular economy decision tree for developments with an existing building on site from the GLA Circular Economy Guidance

2.2 Feasibility Study Summary

The feasibility study into the condition of the existing Euston Tower and opportunities for retention was prepared in response to London Plan Policies D3 and SI 7 and Camden Local Plan Policy CC1.

In the context of London Plan Policy SI 7, it satisfies the requirement for a pre-redevelopment audit that demonstrates that options for retention are fully explored before considering any demolition. In the context of Camden Local Plan Policy CC1, it satisfies the requirement for a condition and feasibility study, and options appraisal for any development proposal proposing substantial demolition.

The full feasibility study comprises three volumes (in addition to a summary known as Volume Zero), and has been third-party, independently reviewed on behalf of London Borough of Camden. The process is shown in Figure 2.2. The full feasibility study is included as part of this planning application (refer to *Feasibility Study prepared by GXN dated November 2023*), and the following provides a summary for reference.

Feasibility Study Process

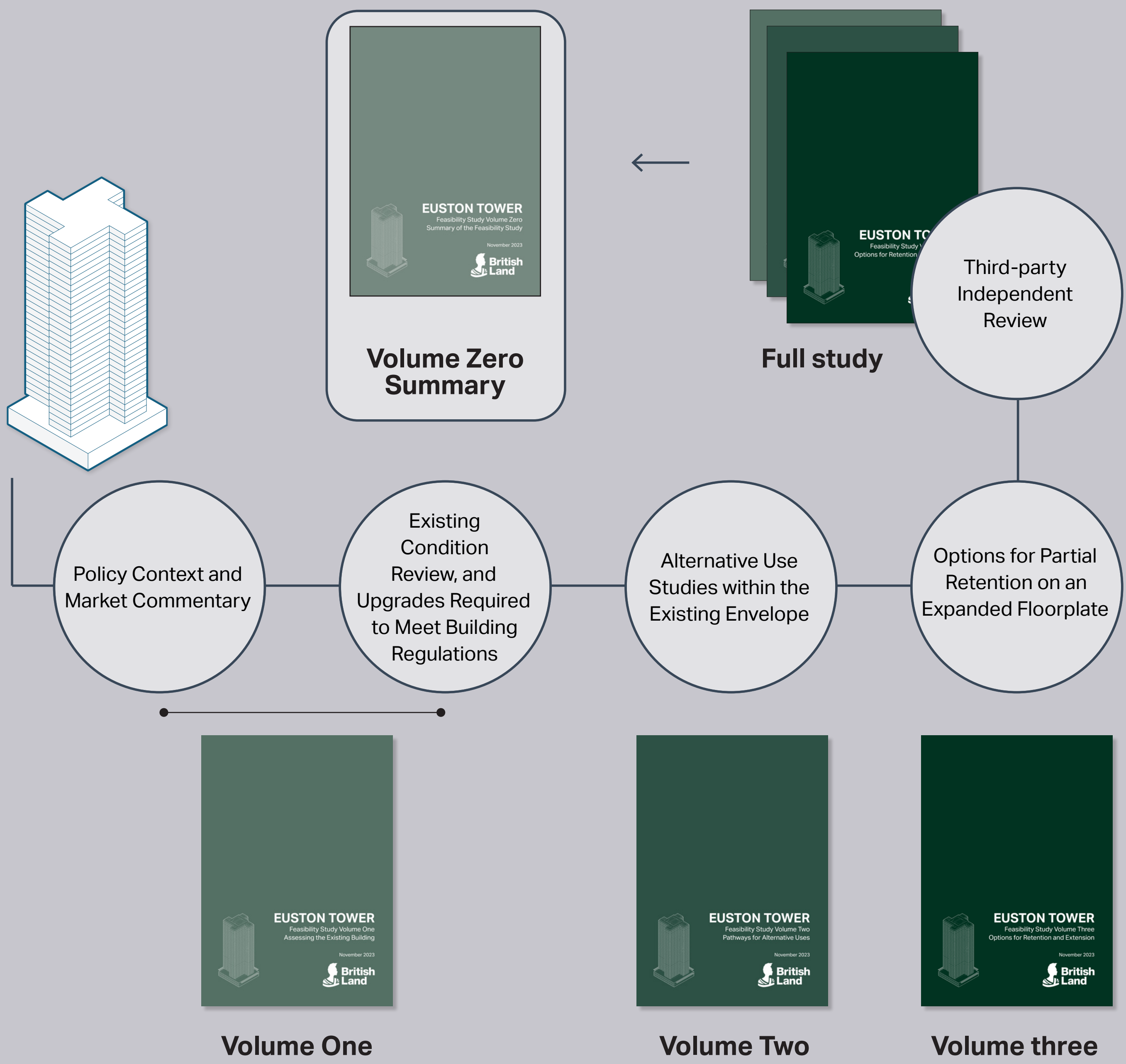


Figure 2.2 Overview of the feasibility study process

2.2.1 Volume One - Assessing the Existing Building

Volume One explored, in detail, the condition of the existing tower. It considered the planning policy relating to the future use of Euston Tower, as well as market requirements for continued commercial use of the tower. It presented an appraisal of the operation of the existing building, including an assessment of the building services. Finally, it sets out the upgrades required to comply with current legislation, based on a technical review looking at the condition of the architecture, structures, and facade.

The assessment identified the following primary points about the existing building:

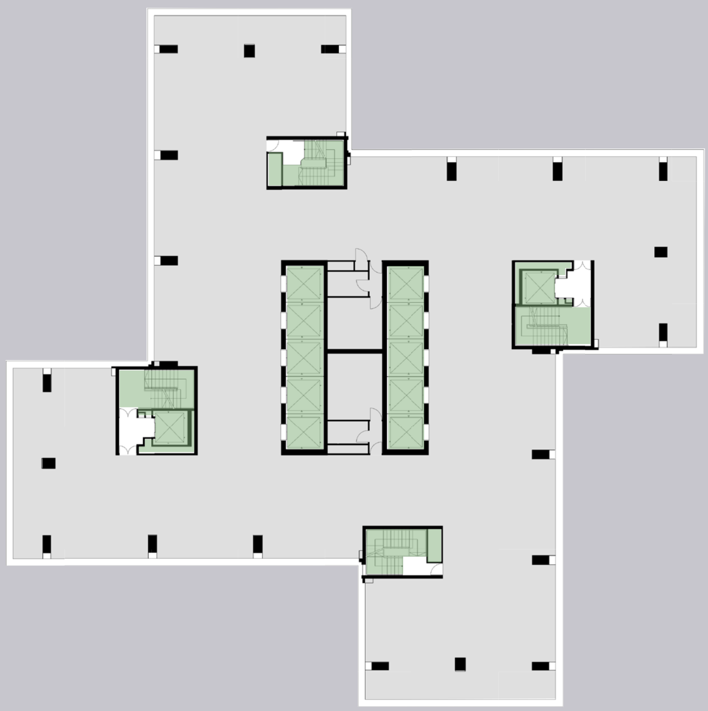
- Concrete structure is generally in a reasonable condition and able to support the current building loads
- The layout of the floorplates is disconnected meaning that the existing space hard to navigate for modern open-plan offices
- Uninviting and closed-off building with a reflective glass facade
- A facade that does not meet modern fire or energy performance requirements
- No current connection or use to local residents or the wider community
- A challenging structure to adapt and improve through minor refurbishment, due to the ribbed slab structure resulting in service penetrations being larger than they need (see Figure 2.3)
- Unattractive and undesirable to modern occupiers, and has been challenging to let since the early 2010s, and vacant since 2021
- Low floor to ceiling heights (2.38 – 2.48m depending on the upgrade strategy pursued), meaning that it would be challenging to accommodate modern occupiers' needs and servicing requirements (floor to ceiling heights of 2.6m and above) and lab-enabled commercial space fit for the future
- Services equipment is beyond its serviceable life
- Building doesn't comply with current Building Regulations and would need significant changes to make it safe and suitable for modern occupiers including fire safety measures such as sprinklers, mechanical smoke ventilation and dedicated fire fighting lifts.

Options were studied for how to address the Building Regulation non-compliances, and bring the building back into use. Where structural interventions would be required, the resulting impact on the structure is exaggerated because entire slab zones need to be removed if any portion of the existing ribbed system is overlapped by new vertical penetrations. Refer to Figure 2.3.

Ultimately, the building does not support the level of services required for a modern commercial development, particularly with regards to fire, ventilation and energy performance (Approved Documents B, F, and L respectively).

Volume One concluded that the extent of upgrades required for continued office use, and the quality and quantum of compromised space delivered, would make the resulting product challenging in the leasing market and confirmed that the refurbishment of the existing Euston Tower for commercial use was not a feasible option.

Existing Floorplan



Upgraded Floorplan

Figure 2.3 Diagram showing erosion of floor slab and exaggerated penetrations due to upgrades to meet current Building Regulations

2.2.2 Volume Two - Pathways for Alternative Uses

Notwithstanding the strong policy position which protects against losing existing office space, the following alternative uses were studied for the existing building, refer to Figure 2.4:

- **Commercial developments**
  - Commercial office only (Volume One)
  - Commercial office with laboratory (life sciences / innovation)
- **Residential-led mixed use**
  - Residential with commercial office
  - Residential with laboratory
  - Residential with hotel
- **Hotel/Student Housing developments**
  - Hotel only
  - Hotel with student housing.

For each use a thorough technical assessment was undertaken, and regardless of use, the same primary issues identified in the existing building assessment (building regulations, fire safety, performance) need to be addressed before the building can be brought back to life.

As for offices, the existing structural loading capacity was shown to be sufficient for any of the alternative uses, with the exception of laboratories which require more extensive structure. However, the dynamic response of the structure (how much it vibrates at a microscopic scale) was shown to be more challenging, especially for uses with bedrooms where users are more likely to be sensitive to vibrations.

Fire safety was identified as a challenge for mixed-uses. In addition to providing dual fire escapes, each separate use requires independent firefighting provisions and fire escape routes. Practically this precludes combining more than two distinct uses, as the efficiency of the floor layout would be severely eroded with the additional space required for the independent fire safety requirements.

The ceiling zone required to accommodate modern, energy-efficient building services for residential use was challenging to fit within the height between the existing storeys of 3.2m, while delivering the clear ceiling heights recommended by The London Plan Policy D6, and the Mayor of London's Housing Design Standards published in June 2023.

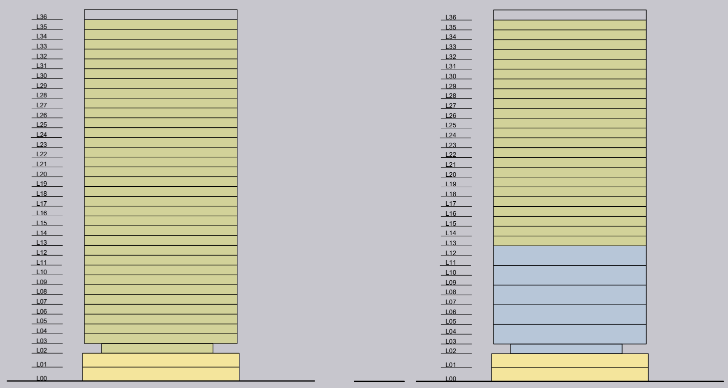
It was shown that this junction of Euston Road and Hampstead Road is also not ideal for residential accommodation, due to the relatively poor air quality and the noisy environment on the junction. An Air Quality Assessment was undertaken and recommended against having openable windows in the lower portion of the tower, which further makes delivering good quality residential apartments in this area difficult. Similarly, the noisy environment due to the 24-hour road noise and the nearby A&E department are not ideal for noise sensitive uses like residential, hotel, and student accommodation.

In addition to the issues outlined above, the resulting floor layouts for residential, hotel, and student accommodation are compromised due to the following:

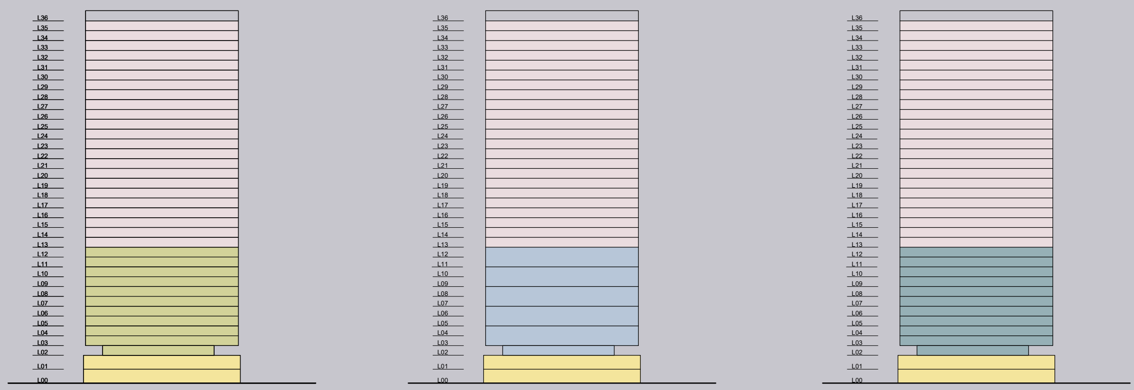
- Several single-aspect units (and some north-only facing meaning they never get direct sun)
- Some self-shaded units due to overshadowing from the shape of the existing building
- Several narrow inefficient units with lots of wasteful circulation space
- In some cases, long corridors with no daylight
- No outdoor private amenity due to wind conditions.

Notwithstanding the policy protection for commercial land use within the Central Activities Zone and the Knowledge Quarter, none of these options were ideal, and if pursued, would generally result in low quality, compromised accommodation that doesn't meet current GLA guidelines, and would be challenging to deliver cost-effectively.

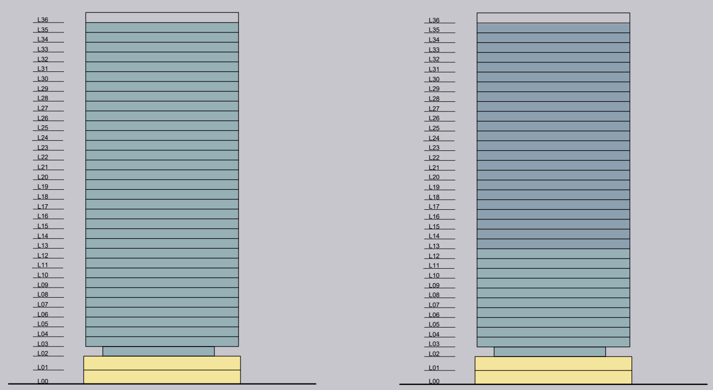
COMMERCIAL-LED DEVELOPMENTS



RESIDENTIAL-LED DEVELOPMENTS



HOTEL / STUDENT HOUSING DEVELOPMENTS



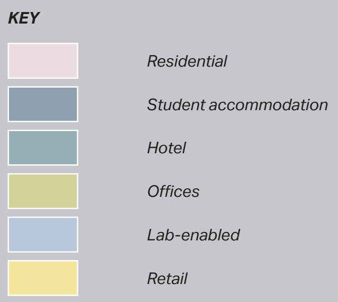


Figure 2.4 Stacking diagrams for use cases explored in Volume Two of the feasibility study

2.2.3 Volume Three - Options for Retention and Extension

It was agreed that the best use of the existing building was continued commercial use, based on the findings of Volume Two of the Feasibility Study.

The following options were studied for delivering the project vision, generating additional value, while retaining as much of the existing building as possible, refer to Figure 2.5:

- **Major Refurbishment**
- **Retention and Partial Extension (Max Retention)**
- **Retention and Extension ("Full" Retention)**
- **Partial Retention and Extension (Disassemble and Reuse)**
  - Retain consecutive slabs (office)
  - Retain consecutive slabs (office and lab-enabled)
  - Retain interstitial slabs (office)
  - Retain interstitial slabs (office and lab-enabled)
  - Retain the core
- **New Build.**

For each option a thorough technical and design assessment was undertaken. The assessments considered: how much of the existing building could be retained (in terms of material and carbon emissions), the quality of the resulting floor layouts (to be attractive to a modern user), future flexibility and adaptability (the tower must be fit for the future), and health & safety (it must be buildable in the safest way possible).

Daylighting levels were assessed, and it was shown that the areas of well-daylit space reduce materially when the size of the floor is extended, even by a small amount. The reduction in well-daylit space is alleviated by increasing the floor to floor height. Increasing the existing floor to floor height to deliver more well-daylit space is necessary to create the high quality spaces that are attractive to large tenants, who are essential to a successful letting strategy for a building of this scale, and to deliver on the environment the Knowledge Quarter is seeking to foster.

Whole Life-cycle Carbon Assessments (WLCAs) were conducted for selected options with varying degrees of existing building retention. For each option, these assessments estimated the total carbon emissions (considering deconstruction, construction, and operation of the buildings) anticipated to be emitted over the building's lifetime, assuming all office use so as to provide a clear comparative assessment. The Retain the Core option has the lowest estimated whole life-cycle carbon emissions when compared with the other options that resolve the floor to floor height issues previously described. This is in spite of the Retain the Core Option retaining 31% (by volume) of the existing structure compared to 42% (by volume) for the Retain Interstitial Slabs option.

On balance, the Retain the Core option is identified to be preferable. This is because it offers the best balance of structural retention, quality, flexibility (it does not inherit many of the limitations of the existing building risking premature obsolescence), and adaptability (a floor system that could be adapted over time and disassembled easily at its eventual end of life). And it does so with a whole life-cycle carbon position that is the lowest of the options that deliver the quality of space which is necessary for the redevelopment of Euston Tower to be successful.

2.2.4 Third-party Independent Review

Throughout the pre-application process, which began in February 2022, there has been constant dialogue and review with the London Borough of Camden.

In April 2023, Camden Council appointed third-party experts to conduct a technical review on their behalf. The full study has undergone review by the appointed third-party assessor, and their report has been issued to Camden.

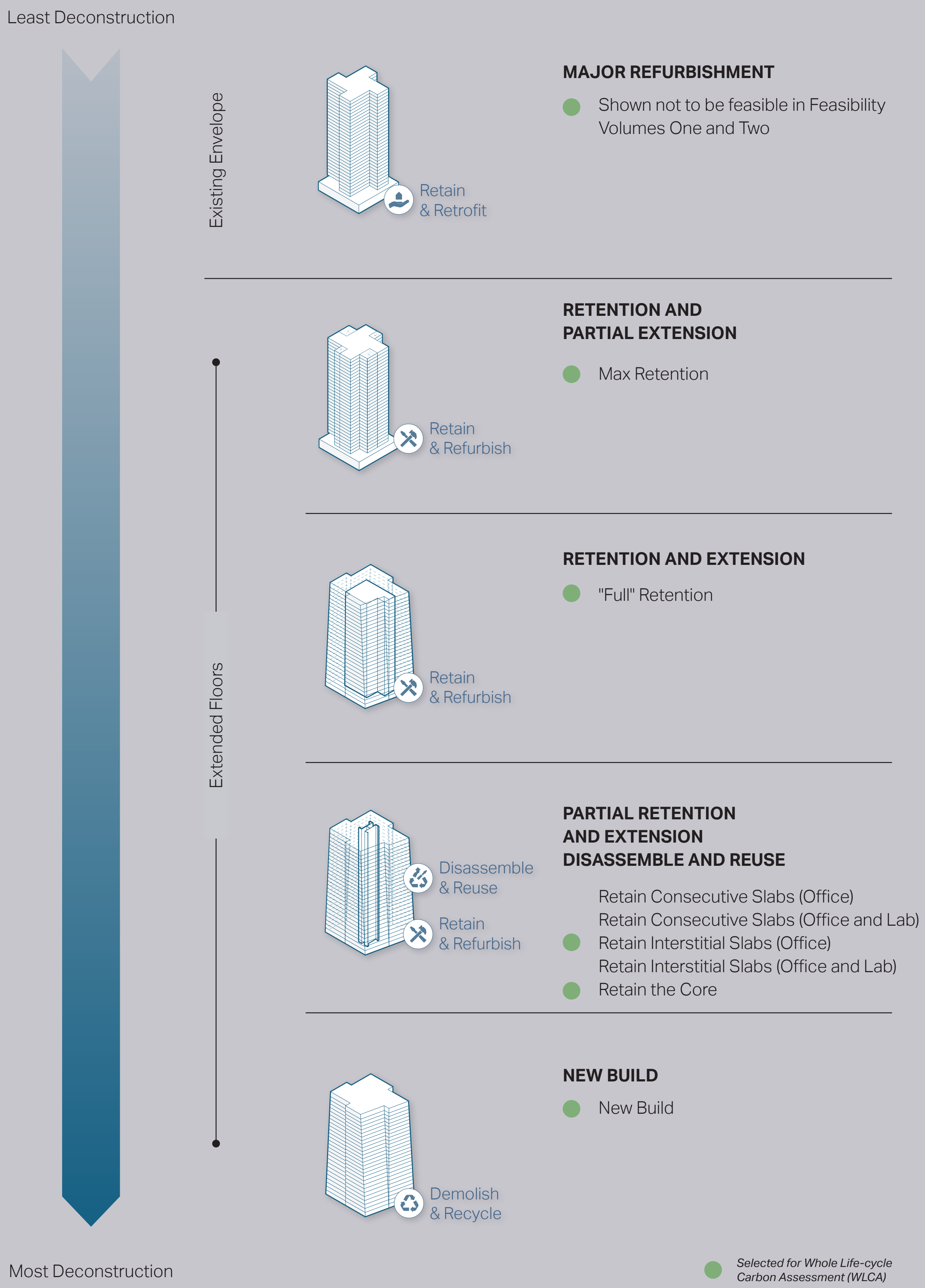


Figure 2.5 Overview of options studied

2.3 Pre-demolition Audit Summary

A Pre-demolition Audit was conducted for Euston Tower in accordance with GLA CE Statement Guidance. It details the quantities and quality of the materials in the building.

Figure 2.6 illustrates the quantity in tonnage of the various materials in the tower. The largest material quantities are concrete, steel, glass, aluminium. Concrete makes up 91% of the total 37,420 tonnes.

The majority of the interior finishes and services have already been stripped out of the existing Euston Tower. These materials are captured in the Pre-demolition Audit showing the route of treatment that the materials have taken.

The four materials in the existing building make up over 98% of all existing materials (by mass). A short description of each of these materials is provided in Figure 2.7.

The remaining materials are quantified, and a recovery route is suggested for each of the materials. From the Pre-demolition Audit it is stated that overall an estimated 98% could be diverted from landfill.

The full Pre-demolition Audit forms part of this planning application and is included in Appendix A.

Material Quantities in Existing Building (tonnes)

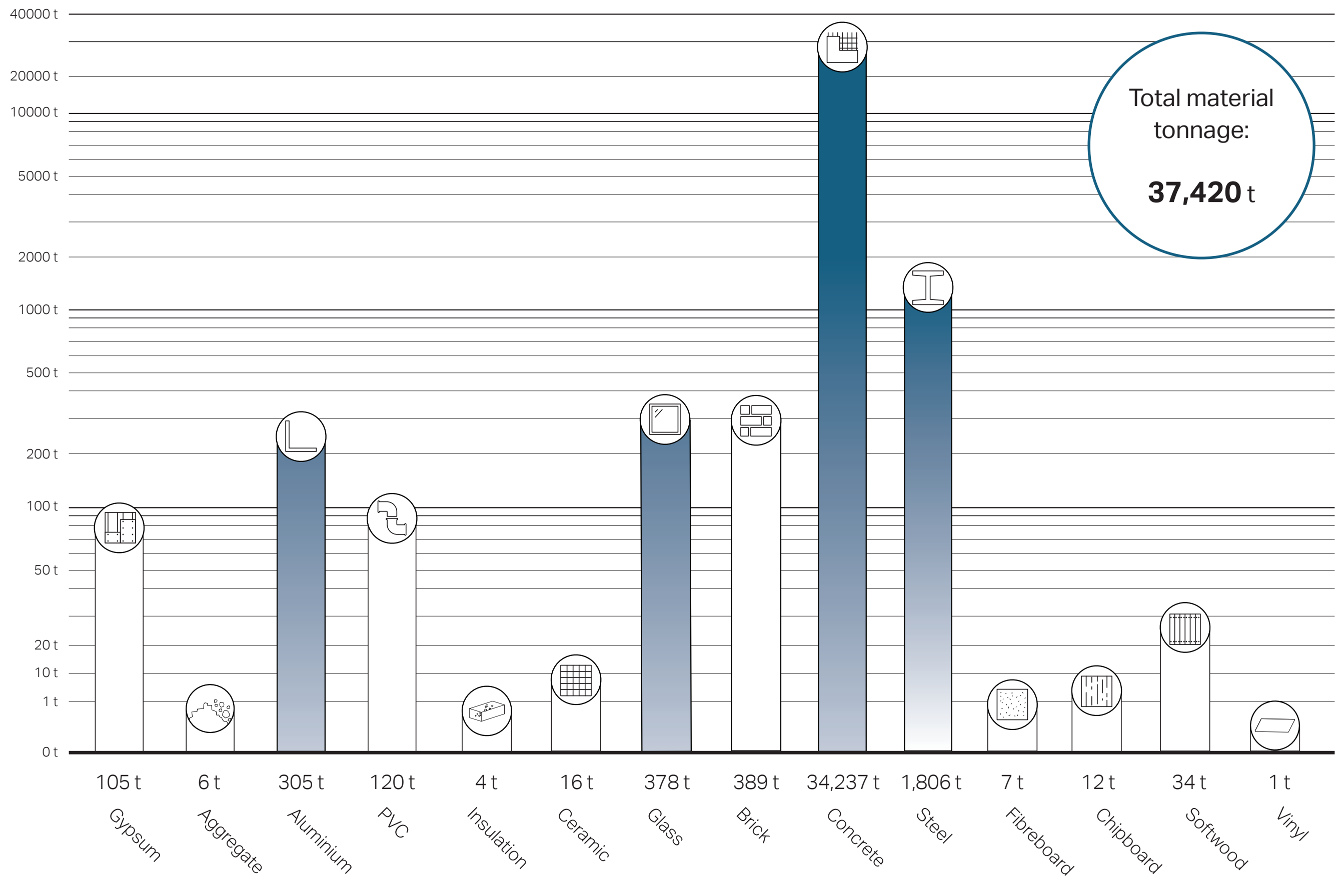


Figure 2.6 Material quantities in the existing building

Main Material Fractions from Pre-demolition Audit

Concrete

Concrete is the largest key demolition product (KDP) identified, estimated to be approximately 34,237 tonnes, equivalent to 3,534 tonnes of CO_2e. This is from a number of sources, primarily from the concrete floor slabs (16,922 tonnes), walls (6,744 tonnes), the columns (4,355 tonnes), and the beams (4,043 tonnes).

Steel

Steel accounts for 1,806 tonnes of material arising from the deconstruction. This comes from a variety of sources, the majority is as reinforcement in the concrete structure (1,717 tonnes). Reinforcing bar is difficult to reuse as it is embedded within the concrete, but it can be effectively recycled.

Glass

Glass is estimated to be 378 tonnes, the majority arising from the external facade (169 tonnes) in the tower, and the associated secondary glazing (161 tonnes). Even though glass is recyclable, current standard practice is to downcycle it to insulation or road paint.

Aluminium

There is an estimated 305 tonnes of aluminium. The mullions and transoms in the facade system make up the largest quantity of aluminium in the building. Aluminium should be prioritised as it is a carbon intensive material, and effectively recycled when segregated appropriately.

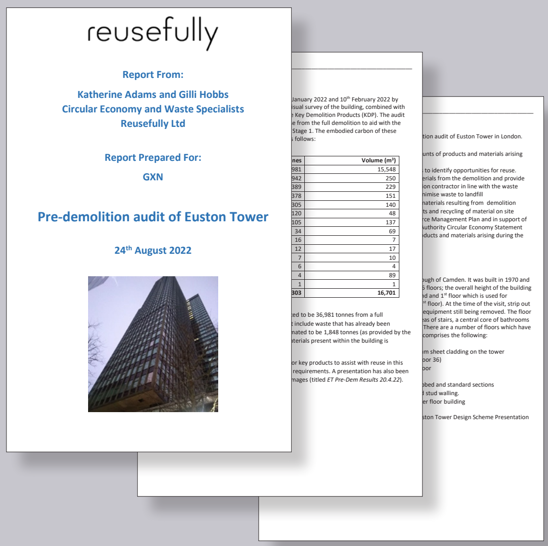


Figure 2.7 Summary of main key demolition products from the Pre-demolition Audit

2.4 Strategy for Material Recovery

2.4.1 General

A detailed existing materials strategy has been produced to compliment the Pre-demolition Audit with the intention of further investigating the implementation of listed "best practice" management of the identified materials.

The purpose of the strategy is to:

- Identify the materials in the existing building quantitatively and qualitatively
- Develop solutions that minimise waste, reduce carbon, and generally maintain or increase the value/utility of materials
- Tell a circular economy story through the reuse and upcycling of materials from the existing tower
- Establish best in class routes for handling the deconstruction materials.

The material strategy hierarchy adopted for the proposed development can be seen in Figure 2.8. Here the “Reuse some stuff” is included to specify how best to take advantage of the existing resources on site. The key deconstruction products identified in the Pre-demolition Audit are described along with potential pathways across the categories of Reuse, Recycling, Upcycling and Downcycling.

As noted in Section 2.3, most of the existing interior fitout, finishes and services have already been stripped out of the building. This has been logged on to BRE’s SmartWaste system and this is captured in the pre-demolition audit. The materials remaining in the building are therefore mainly in the substructure, structure and the facade. Accordingly, the main materials are concrete and steel in the structure, and aluminium and glass in the facade.

By focussing on the key material hotspots, those that are either large in carbon or quantity (or both, see Figure 2.9), the strategy is to move as many of these key materials up the hierarchy, as is technically, practically, and economically possible. This will ensure that the historical carbon emissions associated with these materials is not wasted, and is instead, used beneficially elsewhere.

For more information refer to the full Material Recovery Strategy which forms part of this planning application, and is included in Appendix B.

Material Reuse and Recycling Hierarchy

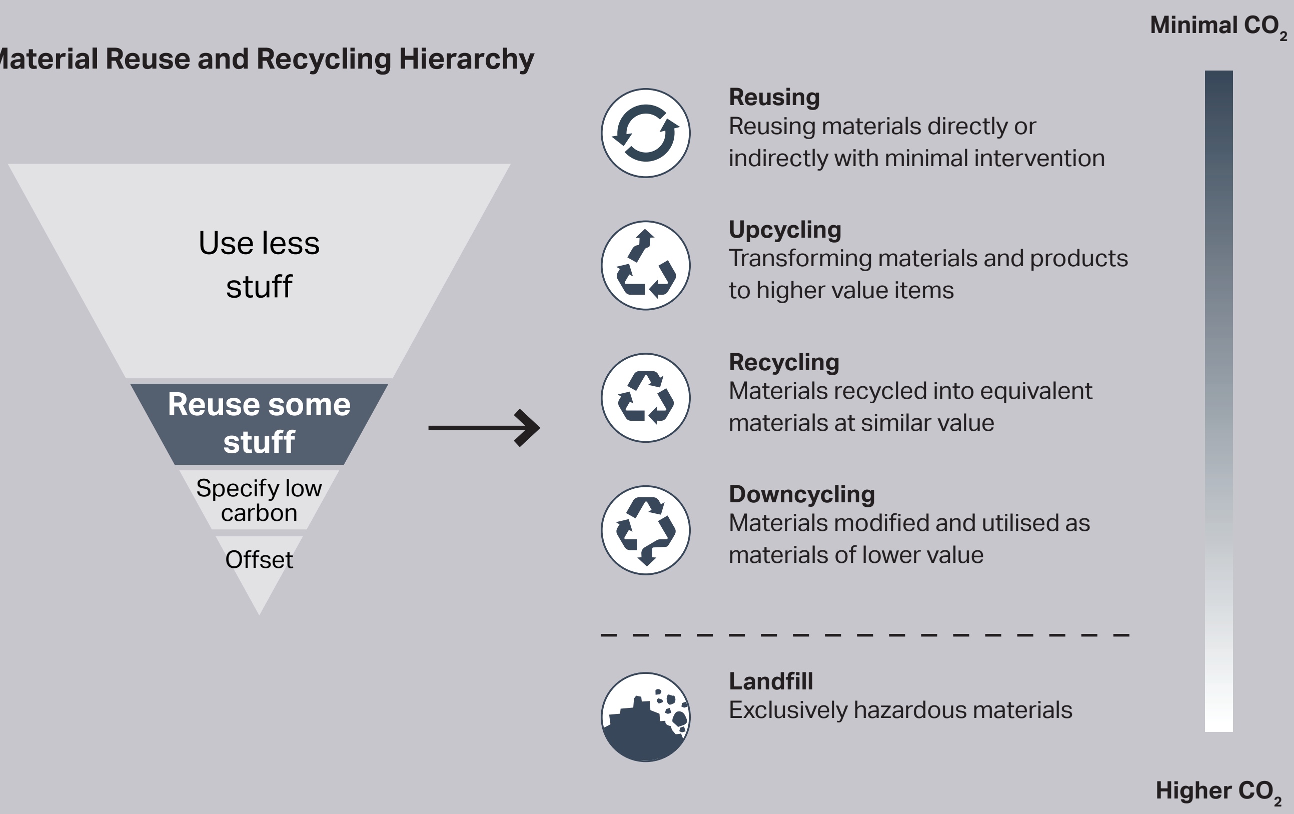


Figure 2.8 *Hierarchy for material reuse and recycling*

Most Impactful Materials for Reuse and Recycling

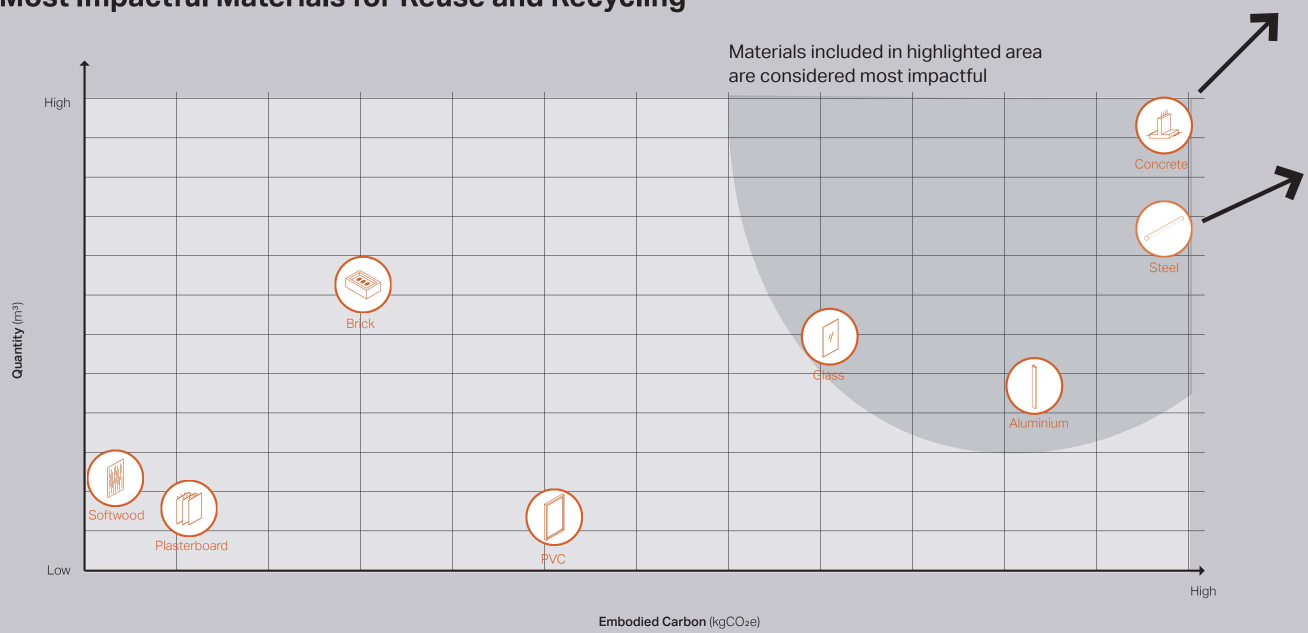


Figure 2.9 *Diagram for identifying key material recovery hotspots*

2.4.2 Prototyping innovative reuse/recycling methods

The proposed development has a pioneering approach to circular economy through prototyping innovative approaches for reuse/recycling of difficult-to-handle materials like concrete and glass from the deconstruction. The proposals are market-leading, having not been conducted previously at this scale, and aim to advance current best-practice. The proposals are in line with the proposed development's ambitions, and will be progressed as far as technically, practically, and economically possible, subject to considerations on project risks, cost and programme.

Concrete
To get the most out of the existing in-situ concrete, the ambition is to test the feasibility of cutting out and reusing the existing concrete slabs in a structural application. Physical tests will be conducted with the University of Surrey to test the feasibility of reusing the mined pieces from the ribbed floorslabs in a new structure.

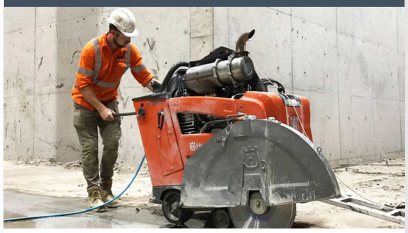
A roadmap has been laid out of the steps required to enable reuse back into the structure, see Figure 2.10. Current progress is preparing the first specimen for removal and transport to the University.

Glass
It is the ambition to get higher value out of the existing facade glass than what is standard practice (downcycling to road paint or insulation). Being the original glazing, the facade glass is unfit for direct reuse. There is an industry demand for high quality cullet (crushed glass that is used as feedstock in glass making) but almost no post consumer recovery is currently undertaken.

Based on the material quantity estimations of the glass materials at Euston Tower, there is a potential to re-manufacture up to 376 tonnes of glass back into the glass float line for use within new flat glass products. This would avoid more than 218 tonnes of CO_2e. The additional carbon implication associated with transport from a regional material dismantler is approximately 13 tonnes of CO_2e resulting in a net avoidance of 205 tonnes of CO_2e. Figure 2.10 presents the roadmap for recovering the existing facade glass.

For more information refer to Appendix B.

Concrete Reuse



Cutting out and reusing in-situ concrete ribbed slabs (reference image)

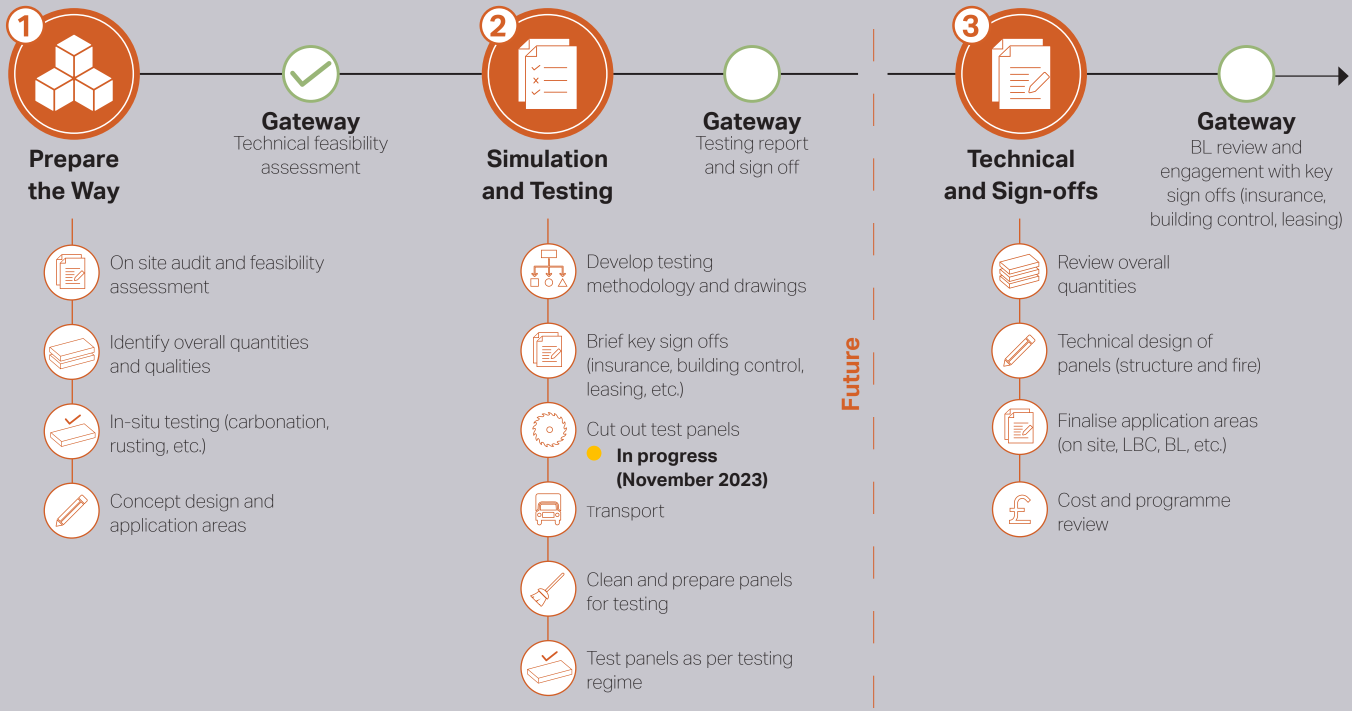
Specimen cut out for testing

Glass Recycling

Class A – clean clear glass cullet with no contamination which can be used back in the float line by re-melting.

Panels dismantled for testing

Roadmap for Reuse of Concrete Slabs



Roadmap for Recycling Facade Glass

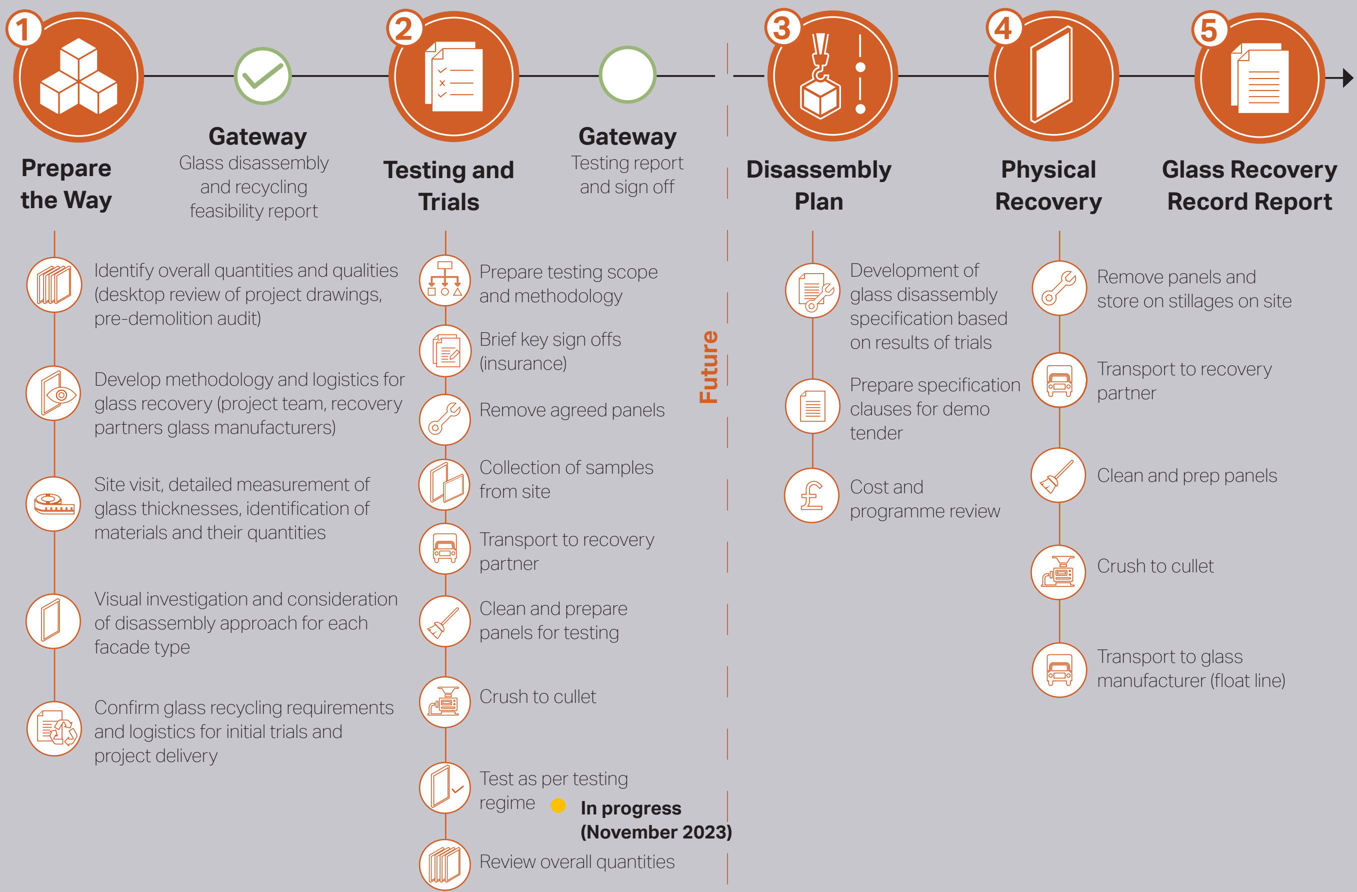


Figure 2.10 Roadmap for reuse of concrete slab (above) and glass recycling (below)

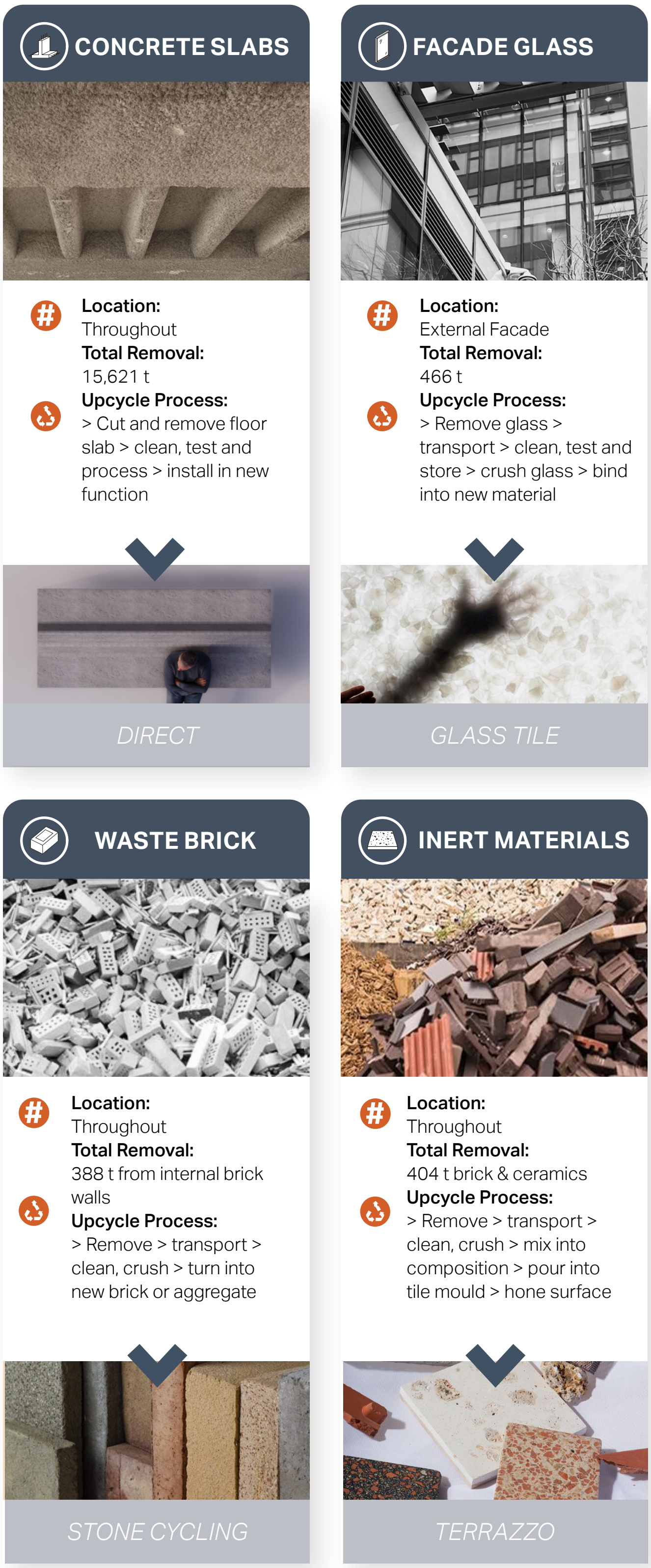
2.4.3 Upcycling opportunities

Upcycling is a strategy for recycling which entails transforming products and materials into higher quality and/or higher value products and materials. The final aim is to convert waste into new materials and products by re-manufacturing in ways that reduce demand for extracting raw materials from the natural environment.

As noted in Section 2.3, most of the existing interior fitout, finishes and services have already been stripped out of the building. The materials remaining in the building therefore mainly comprise the big material fractions such as concrete, steel, aluminium and glass.

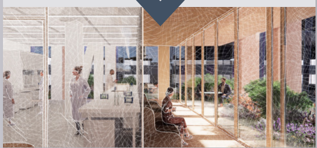
The upcycling opportunities focus on the few items still left in the building that have a potential for being reused either directly or with re-manufacturing, as well as presenting opportunities for products that can provide storytelling around the circular economy.

An overview of select upcycling opportunities are presented in Figure 2.11. For more details refer to the Material Recovery Strategy in Appendix B.



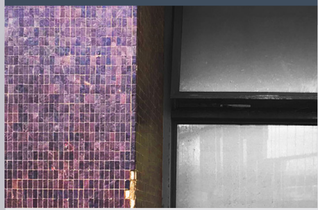
INTERNAL GLASS

Location:
Ground Floor Level
Total Removal:
831 m²
Upcycle Process:
> Remove glass > clean, test and store > sell to external buyer or re-install as glass partitions



GLASS PARTITIONS

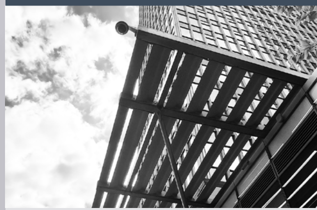
PODIUM TILES



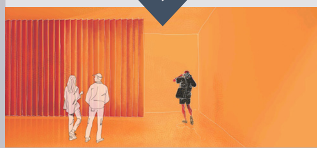
Location:
Podium Exterior Columns
Total Removal:
131 m²
Upcycle Process:
> Remove from columns > clean, test and process > install in new function

REPURPOSED TILE

WIND CANOPIES



Location:
Wind Canopy
Total Removal:
16 t
Upcycle Process:
> Cut and remove canopy > clean and cut into fins > install in new function



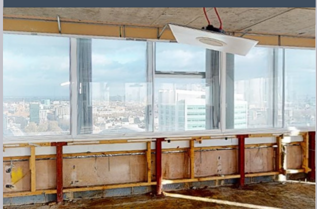
CLADDING

SPRINKLER PIPES

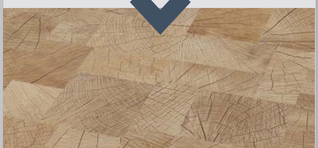
Location:
Levels 1 and 2
Total Removal:
TBC
Upcycle Process:
> Cut and pipes > clean, test and bend > bend and fix into bike racks

BIKE RACKS

TIMBER STRUTS



Location:
Levels 3 - 34
Total Removal:
26 t
Upcycle Process:
> Remove > clean, cut, layout in tiles > fix and sand > install



END GRAIN TIMBER

TIMBER DOORS

Location:
Throughout
Total Removal:
4 t
Upcycle Process:
Direct reuse with reuse partner

TIMBER DOORS

SOFTWOOD

Location:
Timber joinery & doors
Total Removal:
4 t
Upcycle Process:
> Remove and clean > reform into furniture > deliver to user

TIMBER FURNITURE

Figure 2.11 Select upcycling opportunities for products and materials from the existing building

3

Euston Tower

Strategy for the New Development

3.1 Circular Economy Approach

3.1.1 Design approaches for new buildings

The circular economy decision tree for design approaches for new buildings described in the GLA Circular Economy Statement Guidance has been used to assist the design team in choosing the most appropriate design approach for the new building. Refer to Figure 3.1.

One of the main circular economy drivers for the design of the proposed development is to ensure that the proposed development will not suffer the premature obsolescence experienced in the existing tower, and others of its time. The overall aim is therefore to design a tower that responds to today's demands, and can flex and be adapted to remain fit for purpose long into the future.

The proposed development is designed to deliver best-in-class office space, including the Level 03 - 11 lab-enabled storeys that can accommodate a wide range of future workspace fit-outs depending on occupier demands.

It is unlikely that the building would need to accommodate a significant future change in use/function given its location, however to ensure a tower fit for purpose for an extended lifespan, design considerations have been made to best accommodate uncertainty in the future requirements to the functionality of the proposed development.

This is primarily accounted for by incorporating adaptability and longevity principles in the design. More specifically, the substructure and superstructure are designed to allow for a range of loading regimes, and can be adapted to accommodate future changes in loading and spatial requirements in a non-destructive manner.

The remaining building layers are designed to be generally independent from the primary structure, facilitating their respective maintenance and/or replacement that does not result in damage to the structure.

GLA Circular Economy Decision Tree for New Buildings

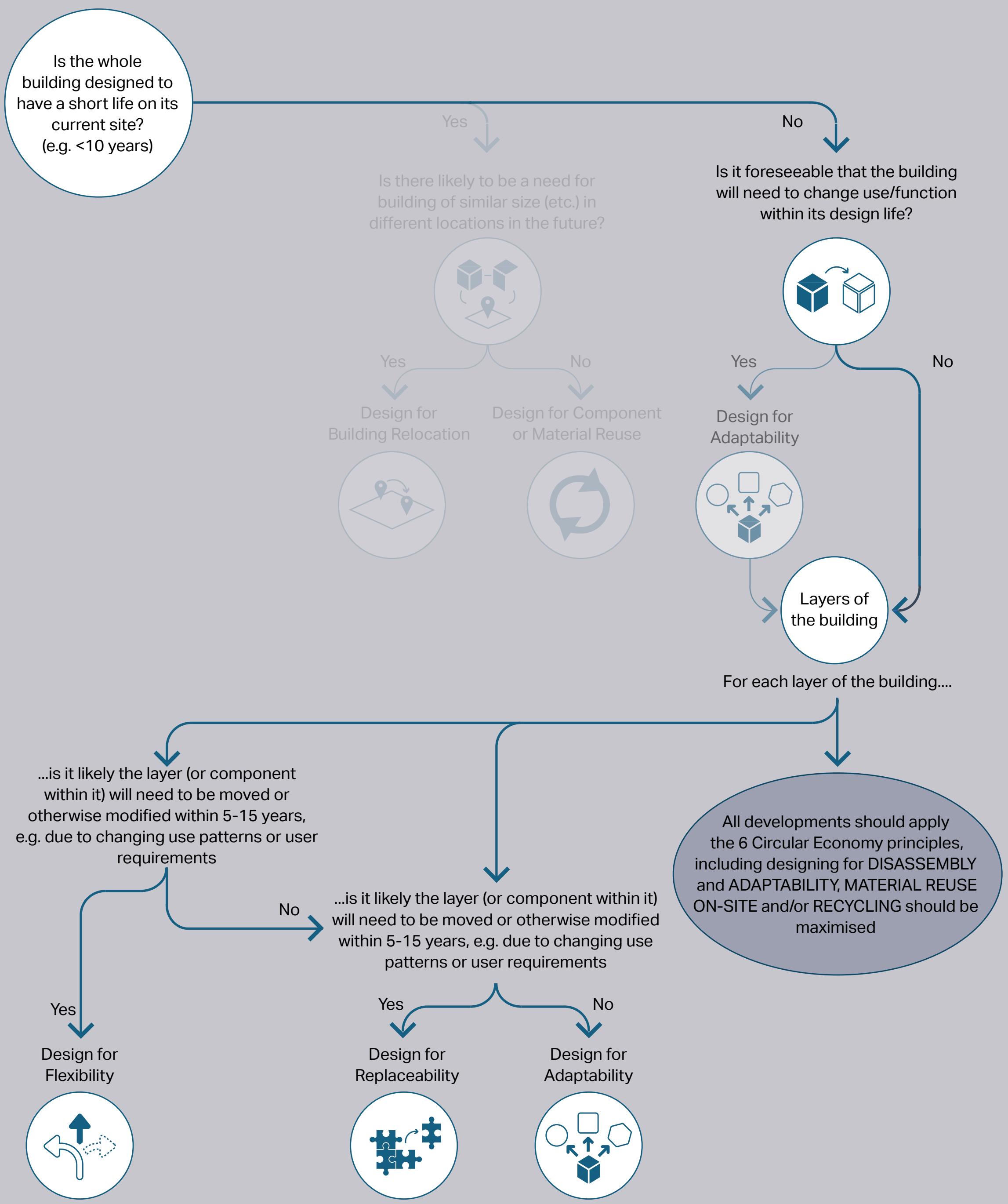


Figure 3.1 The circular economy decision approach decision tree for new buildings from the GLA Circular Economy Guidance

3.1.2 Ensuring "good bones"

The circular economy principles are considered across all of the building layers, and a particular focus has been put on ensuring "good bones" for the proposed development.

"Good bones" describes a building where the core foundational elements are well-designed, high-quality, long-lasting, and flexible.

The overall strategic design approach, as described in 3.1.1, is to design a tower for adaptability and longevity.

The longevity of the other building layers (facade, services, etc.) is predicated on the longevity of the structure. If the structure cannot be easily adapted to changing requirements, the strategies employed for the other building elements are unlikely to mitigate significant waste and avoid premature obsolescence. Therefore designing in principles for longevity and adaptability are particularly impactful in the structure.

Accordingly, the structure (and site) may be considered foundational in the circular economy approach, while the other building elements may be considered as operational.

Ensuring "good bones" gets the foundational elements right. It is clear that an adaptable structure is key to minimising waste and avoiding premature obsolescence across all building layers.

This foundational and operational approach is shown diagrammatically in Figure 3.2.

3.1.3 Structural adaptation approach

As with any change, different time horizons demand different responses for how to accommodate change. This is because we are less able to predict requirements and demands the further they are in the future. The structure has been analysed across three distinct time horizons:

- Short term <25 years
- Medium-long term 25 - 100+ years
- End of life 100+ years.

This approach is shown diagrammatically in Figure 3.2.

Short term changes are those that respond to relatively small, and possibly relatively frequent, occupier demands. These changes can occur during leases, or in between leases of different occupiers, such that they may occur several times throughout a building's lifespan, often less than 25 years. These types of changes are considered more invasive than allowing for layout flexibility, and should be accommodated in a way that minimises waste, but do not interfere with the overall building operation. These changes are likely to include structural adaptations such as:

- New double height spaces
- New stairs or other vertical connectivity
- New risers.

Medium-long term changes are those that respond to relatively major, and less frequent, geometric changes. These are unlikely to occur at a cadence of less than 25 years, and possibly only once or twice during a building's lifetime. Accommodating such change is key to preventing premature obsolescence and minimising waste. These types of changes are considered as invasive, and are likely to occur with a period of interference to the overall building operation. These changes are likely to include structural adaptations such as:

- Adding/removing terraces
- Adjusting floor to floor heights
- Change of use
- New lifts or central risers.

Strategies to address this type of change are described in under the longevity principles, see Section 3.2.4.

End of life considers solutions for maximising value when the building is no longer required. This is addressed through design for disassembly principles, see Section 3.2.6.

Designing for "Good Bones" by Enabling Structural Change

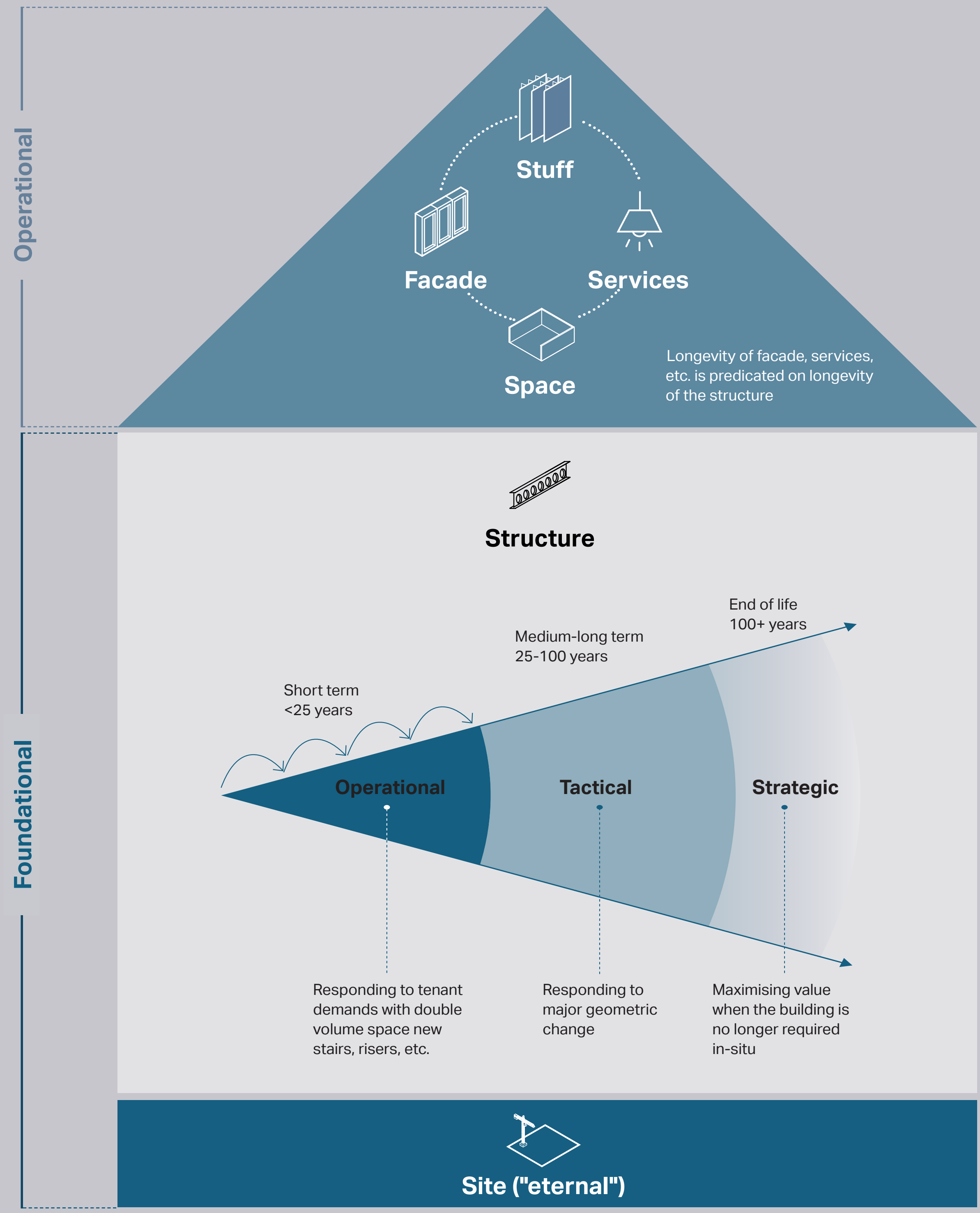


Figure 3.2   Foundational and operational adaptability and timeline for structural change

3.2 Design Principles by Building Layer

3.2.1 Building in layers

The proposed development considers the inherent properties of the building's different layers, as described by Stuart Brand in *How Buildings Learn*.

Figure 3.3 shows the defined building layers with approximate lifespans and associated whole life-cycle embodied carbon emissions percentages based on current estimates (refer to the *GLA Whole Life-cycle Carbon Assessment Template prepared by Sweco dated December 2023*).

This is used to determine the focus areas of the various design principles, both in terms of relevance for the principles regarding lifespan, as well as the degree of impact in the related embodied carbon emissions.

3.2.2 Circular economy design principles

The circular economy design principles are considered across all building layers. As shown in Figure 3.3, some principles are only addressed with solutions in some of the building layers, as appropriate.

Designing out waste is addressed with solutions across all layers.

Adaptability is considered in the design of the superstructure, facade, and services. The structural system aims to allow for future adaptability, both regarding short term changes such as vertical connectivity, as well as medium-long term changes such as changes in building geometry or functionality. This is achieved with a soft core, regular structural grid, and an adaptable floorplate system. The facade enables this adaptability through a component-based construction with mechanical fasteners that can be non-destructively decoupled from the structure.

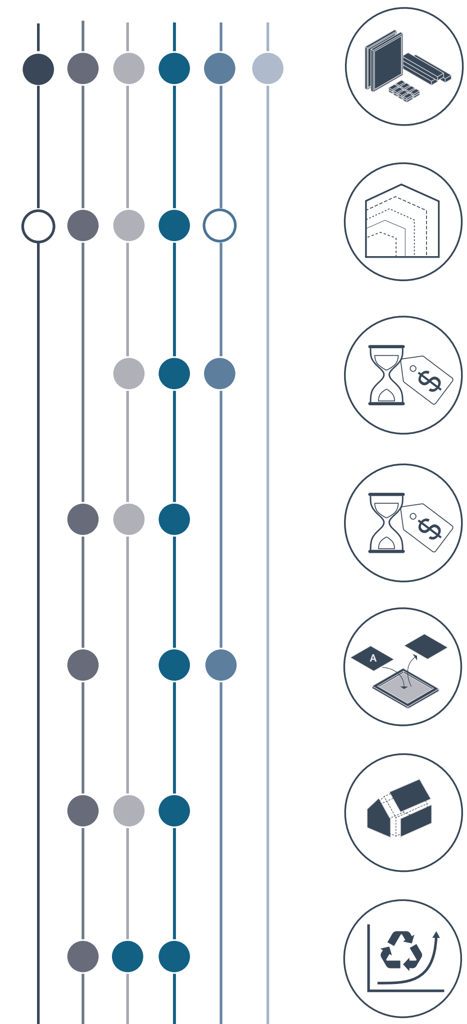
Design strategies that enable in-use flexibility are included in the superstructure, services, and space. This is addressed through structural uniformity (generous and regular structural grids), an all-air ventilation system without ductwork, and minimal high-level servicing, enabling changeable layouts depending on tenant needs. The services also provide flexibility for future changing requirements with on-floor air handling units that enable the ability to locally turn down and/or shut-off unoccupied floors.

Design for replaceability is relevant for the services, facade, and space, where upgrades may be required for the sub-elements of a system or module with shorter technical lifespans than the whole. The services and space plan are designed with exposed and independent layers enabling easy access for maintenance or replacement. A unitised facade composed of discrete elements enables replacement of individual elements (e.g. re-glazing of insulated glazed units).

In all layers of the building expected to be partly, or fully, deconstructed at the end of the building's lifespan, design for disassembly principles should be considered. Particularly for the building layers with the potentially greatest material intensity and highest impacts (superstructure and facade), disassembly strategies are embedded in the design. A unitised facade design with mechanical connections, and one that is decoupled from the primary structure, allows for future non-destructive disassembly. The steel frame is designed with bolted connections to facilitate disassembly, and it is an ambition contingent on the structural floor system progressed, that the floor system is designed with an aim of minimal wet works to further aid disassembly and recovery at end of life. On-floor ventilation enables ease of replacement and disassembly of ventilation plant without impacting the remainder of the building.

In the building layers with the longest anticipated lifespans (substructure and superstructure), design for longevity strategies are addressed, aiming to avoid future obsolescence through enabling adaptations to changes in future functionality or use with minimal damage. In the building layers with shorter lifespans (facade, services, and space), there will be a focus on specifying durable materials and enabling ease of access for maintenance to prolong lifespans where possible.

Sections 3.2.3 - 3.2.7 outline in further detail the integration of the circular economy design principles in the proposed development.



Designing out waste (Section 3.2.3)
Ensuring that waste reduction is planned in from project inception to completion, including consideration of standardised components, modular build, reuse of buildings, secondary products and materials

Designing for longevity (Section 3.2.4)
Ensuring that different parts of the building are accessible and can be maintained and replaced where necessary

Designing for flexibility (Section 3.2.5)
Designing to allow easy rearrangement of internal fit-out and arrangement to suit the changing needs of occupants

Designing for adaptability (Section 3.2.5)
Designing with thought of how a building would be easily altered to prolong its life

Designing for replaceability (Section 3.2.5)
Facilitating easy removal and upgrade, and ideally to be reused, re-manufactured or recycled on a part-by-part basis

Designing for disassembly (Section 3.2.6)
Designed to allow the building its components to be taken apart with minimal damage

Designing for recoverability and reusability (Section 3.2.7)
Designing so that disused components can be (ideally) reused as is, or recycled (useful recovery)

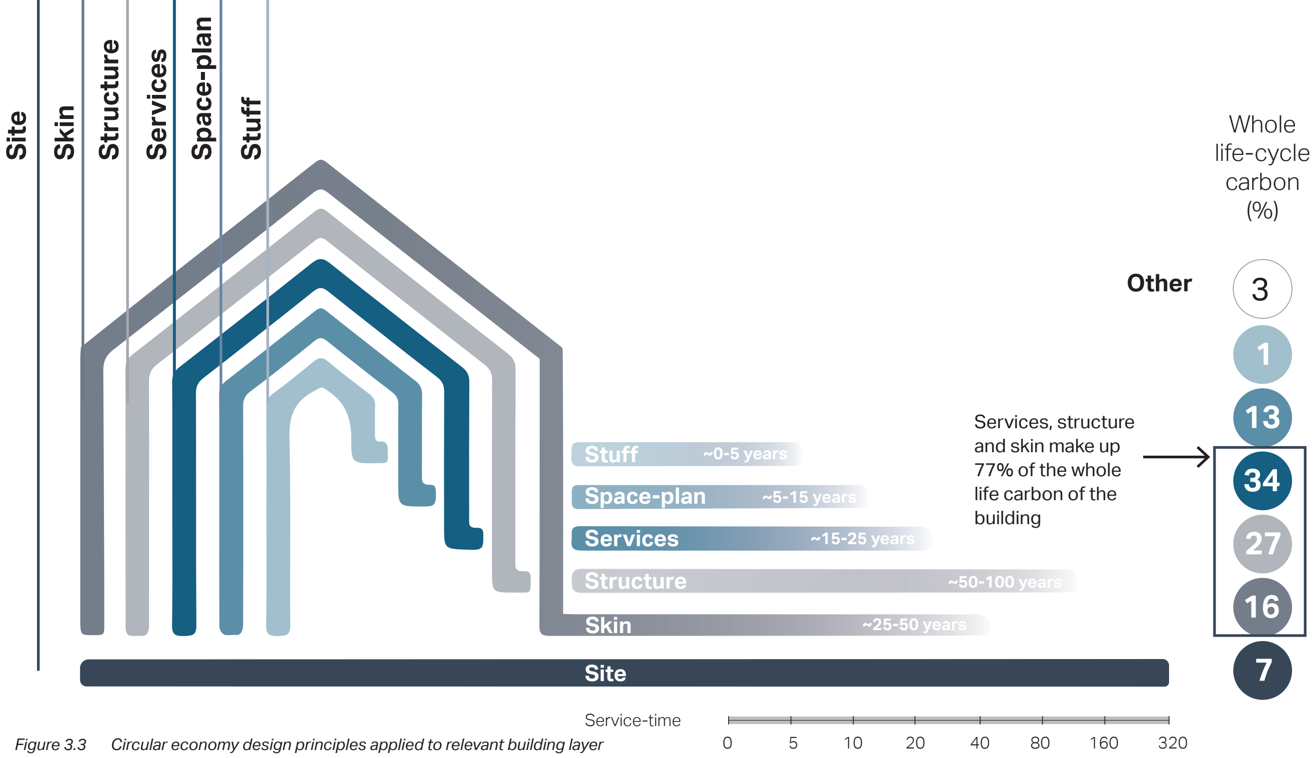


Figure 3.3 Circular economy design principles applied to relevant building layer

3.2.3 Designing out waste

The principle of designing out waste is applied to all building layers in the proposed development. It also covers all stages of the building's life-cycle. For the site, substructure, and superstructure, the effort lies in designing out waste at production and construction (though it is inherently considered in structural adaptability), whereas for the services, facade, and interiors, the in-use waste is equally addressed.

Site
Excavation work will be carried out for part of a new basement, however the retention of the foundations and basement will reduce the total amount of excavation work needed on site. In total approximately 15,204 m^3 of material is anticipated to be generated in the excavation. Out of this, the target is to ensure 95% will be put to beneficial use in line with the London Plan Policy SI 7.

Opportunities for reducing waste in the design of the public realm and landscape are being considered through reuse of the deconstruction waste in landscaping items (e.g. mounds, street furniture, etc.).

Substructure
The existing foundation and basement will be retained in the proposed development so far as possible, and the extent of new basement minimised. This will significantly reduce the amount of new material required for the substructure, as well as the amount of deconstruction waste.

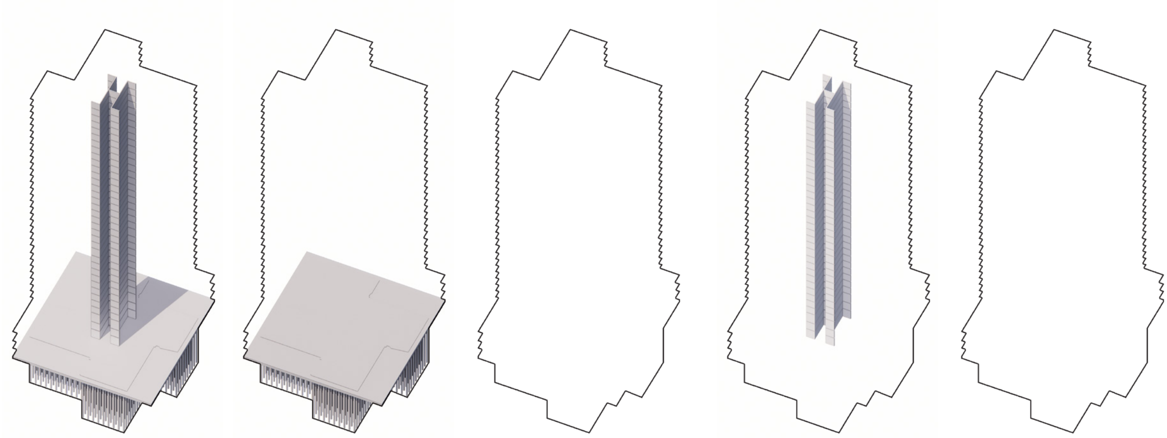
In the same way that the existing foundation and basement are being reused, the foundation and basement in the redevelopment are expected to last beyond the lifespan of the proposed development. This unlocks the potential for repeated direct reuse, providing benefits beyond the system boundary.

Superstructure
The retention of the existing central core reduces some of the waste related to the deconstruction of the existing superstructure. The proposed superstructure is designed as a lightweight steel structure, with a focus on rationalisation and material use reduction. The relatively lightweight steel construction minimises loads on the existing (and new) foundations, and is so designed to ensure compatibility with the existing foundation design.

All reinforcement bar contained in the superstructure concrete elements will contain high proportions of recycled content (ca. 98% recycled content). It is also the ambition that all structural steel elements, except connections, plate, and any fabricated elements, are to be procured as Electric Arc Furnace (EAF) steel with high recycled content (above 90%). In areas where the structural spans allow for it, the aim is to procure reused steel elements. This is however subject to availability of supply and will have to be procured on a just-in-time basis. Actions to implement these measures will include early engagement with the supply chains to mitigate procurement risks so far as possible.

The steel frame is designed to use elements of standard dimensions, and with bolted connections to enable future disassembly. In the design of the structural floor system, and contingent on the structural floor system progressed, there is an ambition to minimise wet works for ease of disassembly, and to allow for future recovery and reuse, reducing waste at deconstruction (see Section 3.2.6).

Structural Retention of Existing Building Elements (By Volume)



	OVERALL	FOUNDATION	SLAB	CORES	COLUMNS
Material Volume	**7,583** m^3	**6,000** m^3	**0** m^3	**1,583** m^3	**0** m^3
Ratio by Volume	**31** %	**24** %	**-** %	**6** %	**-** %

Figure 3.4 *Retention of structure broken down by structural element (by volume)*

Temporary Propping of Retained Core

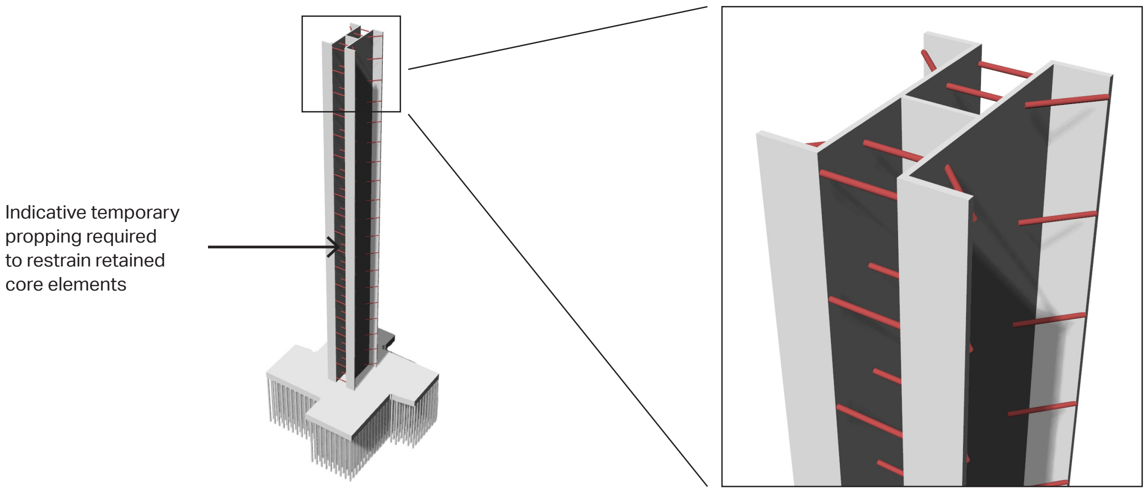


Figure 3.5 *Early sketch of temporary propping to enable retention of the existing core*

Shell/skin
The facade is designed with standard dimensions and modularity, to enable off-site pre-fabrication of repetitive elements. This minimises construction waste, as well as improves health and safety on site. These standardised facade components will aid in-use upgrades and reuse.

The facade system is designed with mechanical fasteners (between elements), and bolted connections to the structure to minimise waste during deconstruction. This optimises the potential for future reuse and recycling (see Section 3.2.6).

Material selection is carried out with a focus on high reusability/recyclability.

Services
The ventilation system consists of an all-air system and on-floor air handling units (AHUs). The number of AHUs is chosen to obviate the need for underfloor ventilation ductwork (the raised floor acts as a pressurised plenum), thereby minimising ductwork throughout the building.

No terminal units are needed in the servicing design since the all-air system provides both ventilation, and heating and cooling. This reduces waste as terminal units are often replaced during fit-outs.

The absence of on-floor ductwork and minimal high-level servicing, enables changeable layouts without generating MEP waste (where services are reconfigured), and reduces the number of in-use replacements and maintenance required.

The soffit is designed to be visible, enabling exposed services to ease access for removal and replacements of the minimal high-level services (limited to lighting, detection, etc.).

Space
The floor system is designed with a good quality flat soffit to avoid the need for ceilings. Subject to availability, the proposed development will aim to procure reused raised access flooring where there is no need for a pressurised floor plenum. The risk on availability of supply of the quantum of reused raised access flooring will be mitigated through early engagement with supply chain.

In highly trafficked areas, such as lobbies, publicly available space, and amenity spaces there will be an enhanced focus on robust and durable materials.

Stuff
Opportunities for omitting/minimising Cat A will be explored in future stages to minimise potential future waste.

Construction stuff
The strategy for construction waste management will involve methods of waste elimination and reduction. These construction waste materials may have alternative uses elsewhere on the site and will mostly be inert or environmentally benign. Any opportunities to maximise the recycling potential of construction materials will be investigated.

A Construction Management Plan (CMP) has been prepared to help minimise construction impacts (refer to *Construction Management Plan prepared by Velocity Transport Planning dated December 2023*). A Resource Management Plan (RMP) will be prepared to set resource efficiency targets in line with BREEAM Wst 01.

Plans to prove and quantify
A thorough feasibility assessment, including Pre-demolition Audit, has been produced to quantify options for existing building retention and the materials arising from the deconstruction.

Waste targets will be included as a contractual requirement in the Contractor Preliminaries. This includes requirement to record and report construction waste arisings in the Resource Management Plan (RMP).

New materials to be tracked as part of BREEAM sustainable procurement process. A BREEAM-compliant Sustainable Procurement Plan will be produced before the end of RIBA Stage 2.

Material strategies will be tracked as part of the BREEAM Mat 06 process.

Early identification of potential end of life routes for key reusable materials will be captured in Material Passports. The data for key reusable products will be collected and stored in a Material Passport.

Process for Fabrication and Assembly of Facade Modules

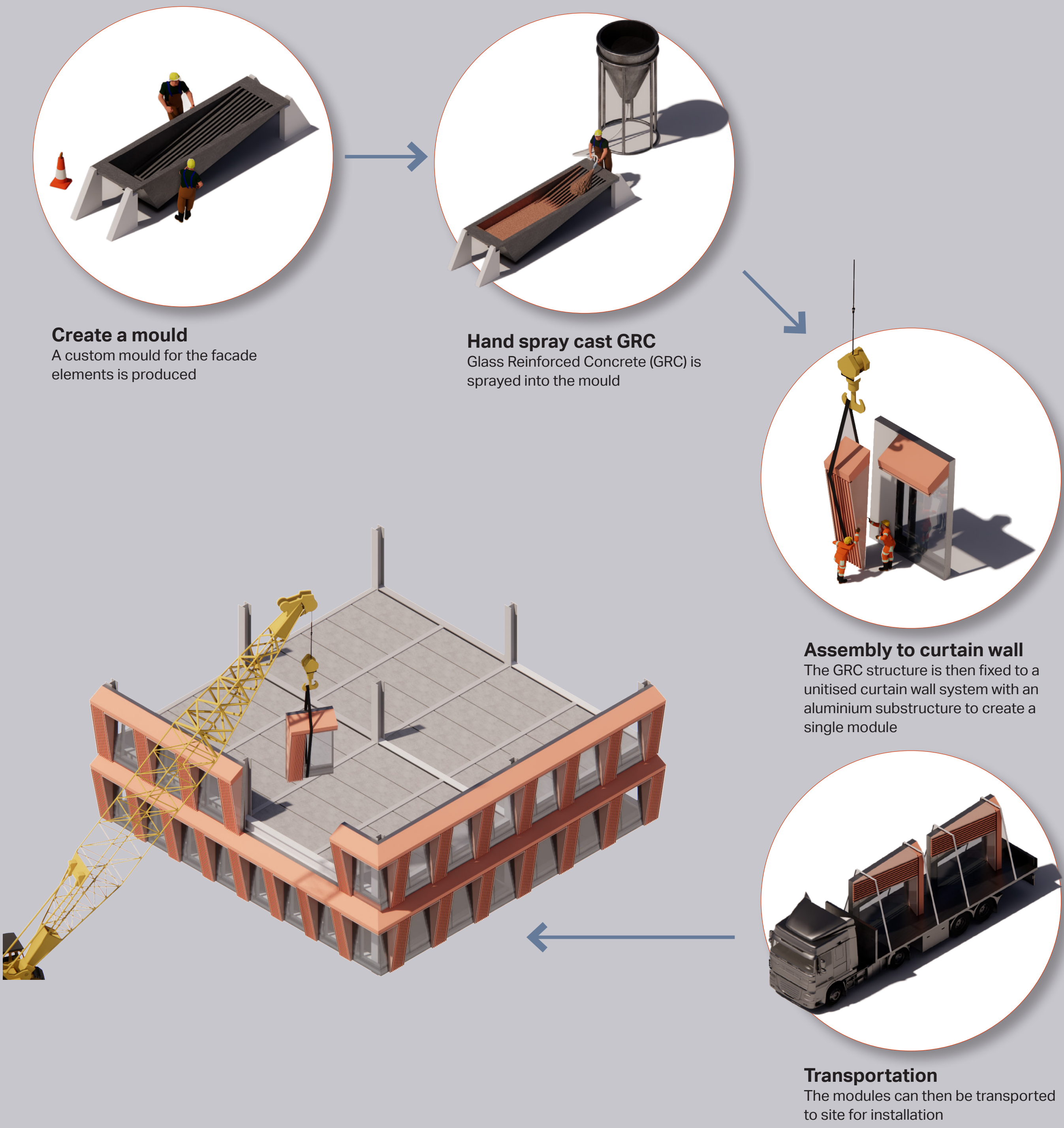


Figure 3.6 Process for fabrication and assembly of facade modules

3.2.4 Designing for Longevity

The principle of designing for longevity is a key principle for the proposed development, and is informed by the learnings from the challenges found in preventing the premature obsolescence of the existing tower.

Design considerations have been focused on the building layers that have an impact on the long-term functionality of the building (the structure, skin/shell, and building services), and which contribute to most to the whole life-cycle embodied carbon.

Structure
The structure has been designed to provide high flexibility in-use and potential for adaptations through a soft core, regular structural grid, an adaptable floorplate system, and a generous floor to floor height.

In order to minimise the load on the existing foundation, and thereby prolong its lifespan, a load-balancing approach has been adopted. The superstructure is designed to be relatively lightweight with most of the additional structural loads landing outside the footprint of the existing foundation. The new substructure is furthermore designed to ensure compatibility with the existing foundation design.

The global stability system is based a soft core approach (see Figure 3.8) that enables future adaptations (e.g. introduction of new risers at the central core) without compromising the global structural integrity.

The structure is designed to adapt to short term and medium-long term changes (see Section 3.2.6) in a non-destructive way and without compromising the structural integrity in order to prevent premature obsolescence.

Shell/skin
The modularity of the facade design (as discrete elements) allows for replacement of individual units, avoiding extensive demolition of the facade where replacement is required. The facade materials will furthermore be specified with a focus on high durability and robustness e.g. glass reinforced concrete (GRC) is currently considered as a durable solution for the facade cladding. Different facade elements have different lifespans and it should be possible to replace shorter lifespan elements (e.g. re-glazing of insulated glazing units) in-situ to extend the overall lifespan of the facade.

Services
Building services generally have a shorter lifespan than the structure and the facade, both due to durability of materials and systems, but also due to technical and regulatory development which may require upgrades to systems.

To optimise the longevity of the building services in the proposed development, accessibility to aid maintenance and replacement of certain components is promoted. This is achieved through a soffit design that allows for exposed services, and adequate maintenance space in plant rooms.

The longevity of the overall systems is also being considered. The ventilation system is designed with fresh air rates exceeding statutory requirements, thereby including capacity for future change of use or need. The heating and cooling systems, as well as stormwater drainage, are designed with an allowance for future climate change.

Space/Site
In highly trafficked areas, such as lobbies, publicly accessible space, and amenity spaces, there will be an enhanced focus on robust and durable materials. Likewise, in the design of the public realm there is a focus on selecting materials with high durability.

Plans to prove and quantify
New materials to be tracked as part of BREEAM sustainable procurement process. A BREEAM-compliant Sustainable Procurement Plan will be produced before the end of RIBA Stage 2.

Material strategies will be tracked as part of the BREEAM Mat 06 process.

Designing a Tower for Future Uncertainties

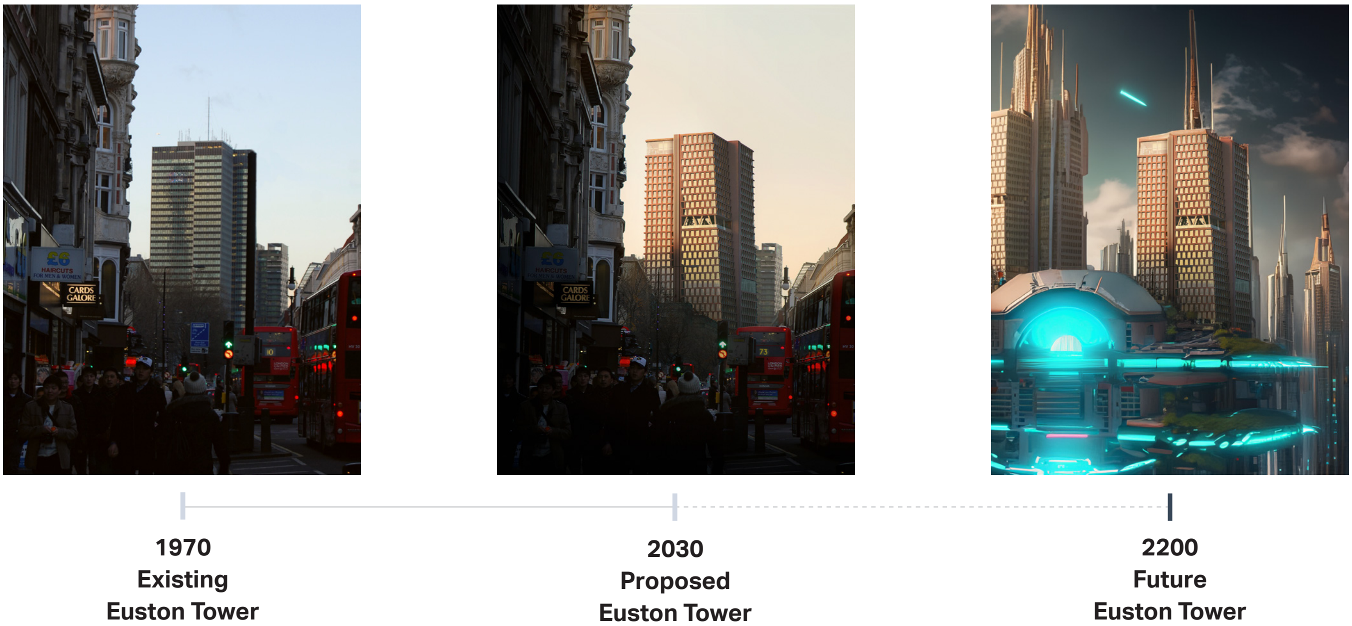
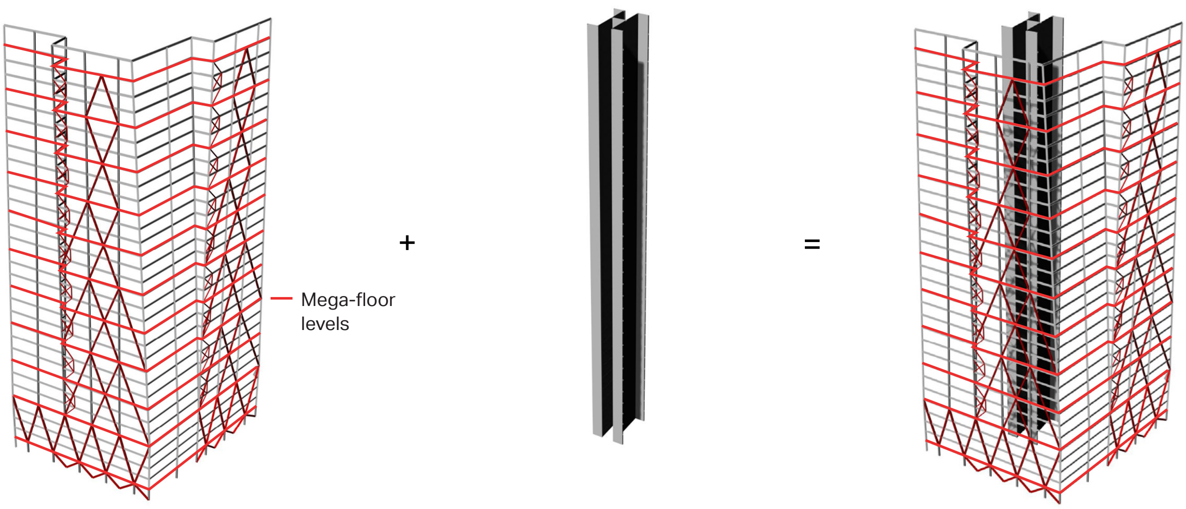


Figure 3.7 *The aim with the proposed development is to consider future uncertainties to prevent premature obsolescence*

Global Stability System and Soft Core Approach



Perimeter braced frame

The perimeter braced frame is designed to limit deflection due to wind and to resist the global overturning moment in the ultimate limit state.

Existing central core

The existing central core works to transfer lateral loads from interstitial floors to the perimeter bracing through the mega-floors

Global stability system

The existing core elements contribute to local stability by transferring loads to mega-floor levels

Figure 3.8 *Perimeter braced frame enables the soft core approach*

3.2.5 Designing for Flexibility and/or Adaptability

The principles of designing for adaptability and/or flexibility have been applied to multiple layers of the proposed development, and are key drivers to ensure that the building is fit for purpose and can be easily adapted to prevent premature obsolescence.

Superstructure
The structure is designed with a regular structural grid and open floorplates to accommodate short term flexibility in the layout such as changing tenant workplace fit-outs.

The central core is designed as a soft core that is not part of the global stability system. It therefore enables future changes such as additional lifts, risers, etc. without impacting on the global structural stability system.

Levels 03 - 11 are designed as lab-enabled spaces, which is achieved through a structural design that allows for the heightened vibration criteria, and an increased floor to floor height to accommodate required servicing provisions. These floors are flexible and can equally function as standard commercial office.

The proposed development aims to adopt adaptable floorplates in the structural design, that enable local changes in connectivity such as double height spaces, as well as more significant geometric or spatial changes such as new terraces or changes in future building use, while minimising waste. Refer to Section 3.2.6 for details.

Shell/skin
The facade is designed with operable vents to enable natural ventilation, making it adaptable to changing patterns of use. The modular design of the facade, and its ability for being decoupled from the structure (see design for disassembly description), enables future spatial adaptations to the perimeter of the tower, such as adding terraces.

Services
The ventilation system provides flexibility for future changing requirements with fresh air rates exceeding statutory requirements. The heating and cooling systems, as well as stormwater drainage, are designed with an allowance for future climate change.

The on-floor air handling units (AHUs) add to flexibility in use, as they enable occupiers to locally turn down and shut-off unoccupied floors. The system is designed as an all-air system without ductwork and, in addition to the minimal high-level servicing, enables changeable layouts without significant reconfiguration and waste.

Space
Levels 03 - 11 are designed as lab-enabled spaces. The core and floor layouts, as well as the all-air ventilation system, minimises coordination and allows for various tenant scenarios with potential for a wide range of current and future workplace fit outs.

Raised access flooring is proposed throughout, which allows a flexible "plug and play" approach to workplace deigns.

The design for exposed soffits with minimal high-level servicing allows for flexibility in lighting layouts, and easy reconfiguration with minimal impact on services.

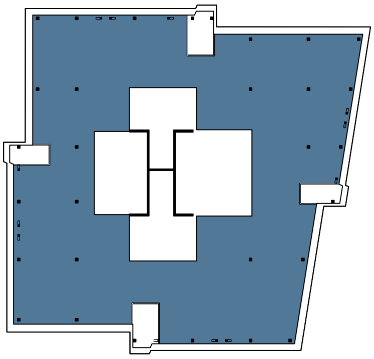
Plans to prove and quantify
Studies have been conducted to understand how flexibility and adaptability are delivered as part of the pre-application process, in addition to the Functional Adaptation study conducted as part of BREEAM Wst 06. Refer to the Functional Adaptation study BREEAM Wst 06 in Appendix D.

O&M manuals will capture the adaptation principles so that they are recorded.

End of life routes (reuse, adaptability, disassembly, etc.) will be captured as part of Material Passporting process.

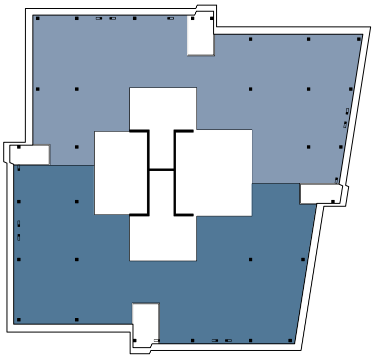
Requirements for LCAs and Material Passporting will be included in Contractor Preliminaries.

Floor Layout Flexibility for Various Tenant Scenarios



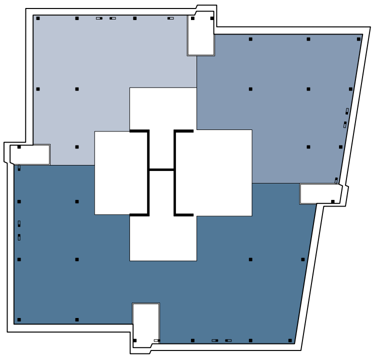
Single Tenant

Allows a single tenant use of the entire floor plate.



Two Tenants

It is possible to split office levels into two tenant spaces taking advantage of the central elevator lobby and escapes that provides direct access for both tenants

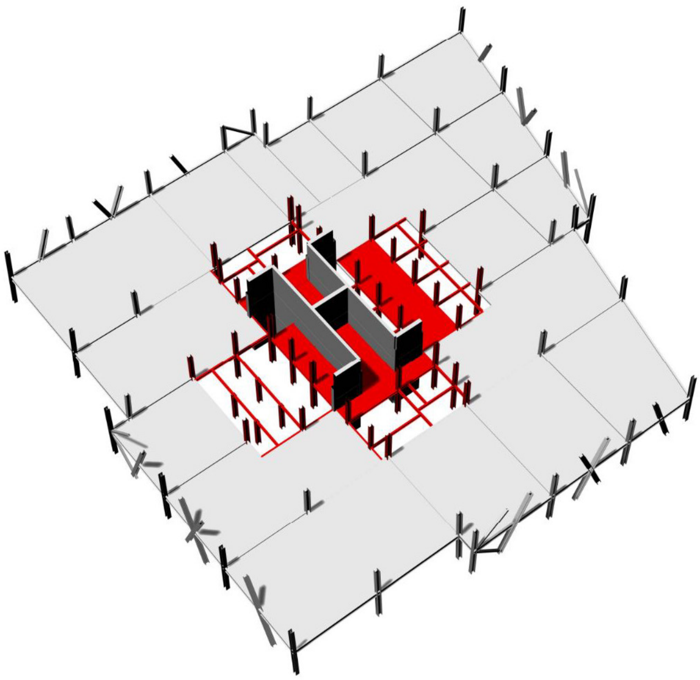


Multiple Tenants

It is proposed to limit the office floor stack to three tenant spaces per storey, given the smaller footprint of the upper portion of the tower

Figure 3.9 Internal layout allowing for several flexible tenant scenarios

Soft Core Approach



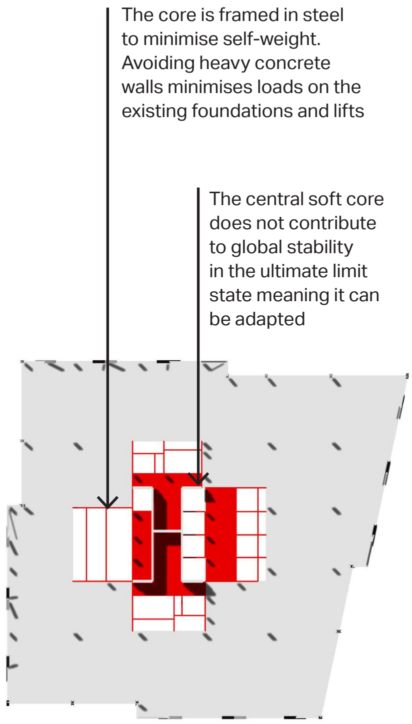


Figure 3.10 The core is designed as a soft core that accommodates riser expansion or contraction

3.2.6 Designing for Disassembly

The principle of design for disassembly has been considered for the superstructure, facade, and building services. These will be further investigated through detailing of the building elements in the following project stages.

Similarly the use of mechanical connections in the interior finishes and fitout will also be investigated at a later project stage.

Superstructure

In order to better enable future adaptations and design for disassembly for the high impact elements in the building, it has been prioritised to use a steel frame in the proposed development. The steel frame will be designed with bolted connections to allow for separation of the elements for future high value reuse.

Beyond the frame, the structural floor system design has been an area of focus, with the aim of best enabling its disassembly, and crucially reusability, where adaptations are made to the structure or at end of life.

Three different floor systems are currently being considered as potential options, as shown in Figure 3.11. Key in these studies is to balance the impacts of upfront embodied carbon, technical feasibility, disassembly and reusability, cost, risk, and programme. Other options may be explored as appropriate.

Option1: Precast Solid Planks

The precast solid plank system comprises 150mm thick, solid precast planks, dropped directly onto steel beams with shelf angles. Diaphragm demand and robustness is provided through the shelf plates and threaded bar. The aim in this option is to minimise the extent of wet works as far as technically and economically possible, to aid non-destructive disassembly.

This option provides the best result in terms of disassembly and reusability. The detail would allow the planks to be pried apart, such that the steel beams and precast planks could be recovered whole for reuse elsewhere. A proposed process for recovering the elements at end-of-life with this system can be seen in Figure 3.12.

Option 2: Precast Hollowcore Planks

The precast hollowcore plank system comprises 250mm thick, solid precast planks, dropped directly onto steel beams with shelf angles. In this case a rebar tie is required to provide the necessary robustness and diaphragm demand. The aim in this option is to minimise the extent of wet works as far as technically and economically possible, to aid non-destructive disassembly.

This option provides a good result in terms of disassembly and reusability. The detail would allow the planks to be pried apart, but unlike the precast solid plank option, the hollowcore planks would need to be cut during disassembly. This would still allow the steel beams and planks to be recovered for reuse elsewhere, noting a shortening of the hollowcore planks.

Option 3: Composite In-situ with Demountable Connection

The composite metal deck option comprises a typical metal deck with in-situ concrete topping. It is similar to a conventional system of this type, with the addition of a sacrificial steel plate bolted to the top flange of the beam, which aids separation of the decks from the steel beams.

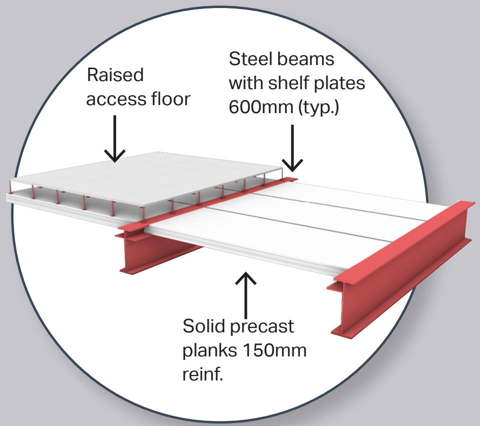
This option would allow recovery of the steel beams for use elsewhere, but the decks would need to be cut, and even if done so strategically, they are unlikely to be useful elsewhere. This may be possible in future with advancing technologies and techniques. The process for recovering the steel beams is shown in Figure 3.12. Composite action between the steel an concrete would be leveraged in this option, to reduce the amount of steel required.

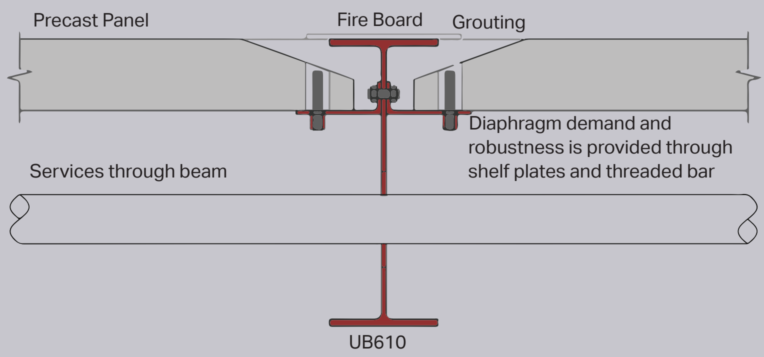
Across all options, one of the main challenges of enabling disassembly and reusability in the structural design is balancing demountability with upfront embodied carbon, since generally the reversible connections require additional material (in this case steel elements). Each option also has a different impact on cost and programme, especially the pre-cast options which demand significant hook time during construction.

To address these challenges, the connection details will have to be further developed along with embodied carbon emissions studies and reduction scenarios. Cost and programme implications will be tracked along with the options studies.

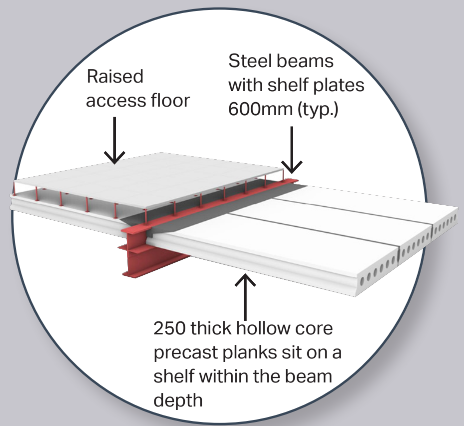
Structural Floor System Options

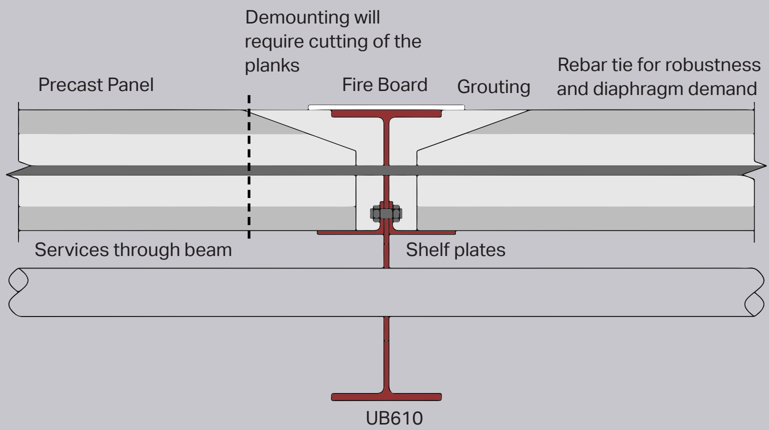
Option 1: Precast Solid Planks



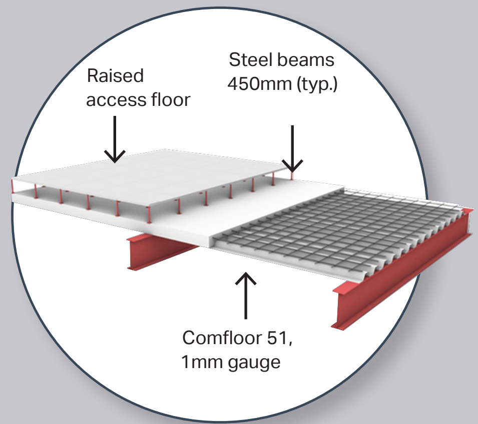


Option 2: Precast Hollowcore Planks





Option 3: Composite In-situ with Demountable Connection



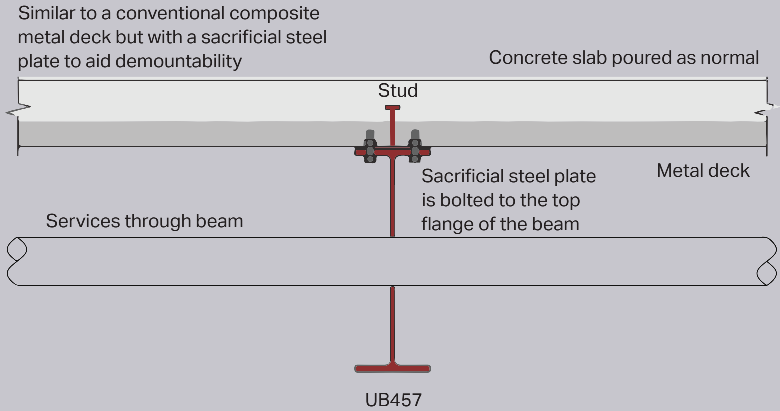


Figure 3.11 Potential structural floor systems evaluated in terms of disassembly and reusability

Shell/skin
The unitised facade is designed to be manufactured using component-based construction and combined using mechanical fasteners. The facade system is connected to the primary structure by a bolted connection to a cast-in channel, meaning the facade can be decoupled without impacting the primary structure.

Services
The clear soffit is designed to enable exposed services, easing access for maintenance and replacement. On-floor ventilation enables ease of replacement and disassembly without impacting the remainder of the proposed development.

Plans to prove and quantify
Studies have been conducted to understand how flexibility and adaptability are delivered as part of the pre-application process, in addition to the Functional Adaptation study conducted as part of BREEAM Wst 06. Refer to the Functional Adaptation study in BREEAM Wst 06 in Appendix D.

O&M manuals will capture the adaptation principles so that they are recorded.

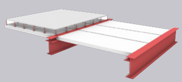
End of life routes (reuse, adaptability, disassembly, etc.) will be captured as part of Material Passporting process.

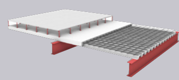
Requirements for LCAs and Material Passporting will be included in Contractor Preliminaries.

Sketch Process for Disassembling Structural Floor Systems

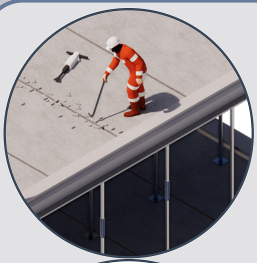
1 **Remove facade**

Dismantle facade and remove in modules



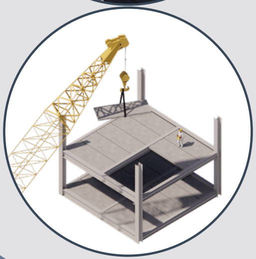


Pre-cast floor systems (options 1& 2)



2a **Dismantle precast planks**

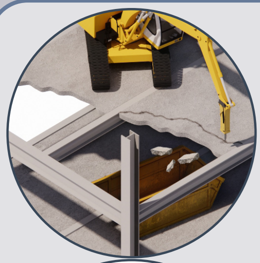
Secure area, prop from below, pry precast planks apart and remove loose grout between planks



3a **Remove planks**

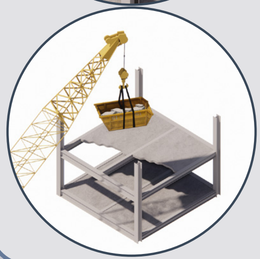
Lift planks from existing position using crane and store for reuse

Composite in-situ floor system (option 3)



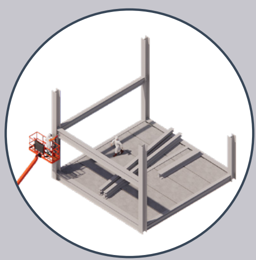
2b **Deconstruct in-situ composite decks**

Secure area, break away concrete slab into skips, remove debris



3b **Remove concrete rubble**

Skip lifted from existing position using crane, crushed concrete to be recycled



4 **Dismantle steel frame**

Unbolt and remove steel framing elements and store for reuse

5 **Prepare elements for future reuse**

Make good steel elements (remove old grout, adjust geometry where required, reapply protective coatings, etc.)

Figure 3.12 Sketch process for disassembly for pre-cast floor systems (Options 1 & 2) and composite in-situ floor system (Option 3)

3.2.7 Designing for recoverability and reusability

Superstructure
As detailed in Section 3.2.6, the principle of disassembly, specifically to allow for recoverability and reusability during deconstruction, has been embedded within the design of superstructure. This was outlined in Section 3.2.6 as it is clear that effective recovery is predicated on non-destructive disassembly, so the principles are inextricably linked.

The steel frame will be designed with bolted connections to allow for separation of the elements for future high value reuse, and is furthermore designed with sections in standardised dimensions to enhance the reusability of the elements for future buildings.

Enabling the future reuse of the structural floor system has been a special focus. Optioneering studies were conducted for three floor system solutions, as described in Section 3.2.6. As evidenced in the existing building, in-situ concrete is typically difficult to reuse in structural applications (its highest value application) and has not been achieved at scale. There exists precedent for recovering and reusing pre-cast concrete elements, and accordingly, two of the floor system option studied in Section 3.2.6, use pre-cast concrete planks, noting the caveats of cost, programme, risk, etc.

Figure 3.13 shows a hierarchy of the structural floor system options in terms of disassembly and reusability. Lowest in the hierarchy is the composite in-situ floor system with conventional connections (typical practice). This system would not allow for the decks to be recovered in a state fit for reuse (they would be broken down and torn from the shear studs). It is possible that the steel beams would be recoverable for reuse, though they may be damaged when the decks are removed.

The same system, with the addition of a demountable connection as in Section 3.2.6, would facilitate improved recovery of the steel beams (the beams and decks would be easier to separate due to the sacrificial plate). Again, the composite in-situ decks are unlikely recoverable for reuse, though this may be possible in future with advancing technologies and techniques.

For the pre-cast hollowcore plank system, the connection between planks would allow the planks to be pried apart, but the planks would need to be cut during disassembly. This would allow the steel beams and planks to be recovered for reuse elsewhere, though the planks would be shortened somewhat.

The pre-cast solid plank system would provide the best result in terms of disassembly and reusability. Like the pre-cast hollowcore planks, the connection between the planks would allow the planks to be pried apart, but without the need to cut the planks, the steel beams and precast planks could be recovered whole for reuse elsewhere

These options will be further explored as the design develops, along with embodied carbon, cost, risk, and programme implications.

Shell/skin
The component-based construction and mechanical fasteners allow for future separation of materials for potential reuse or recycling. The process of testing the existing facade glass for recycling back into the flat glass manufacturing, can inform the recyclability of the new glass applied in the project. The discrete layers in the modules allow for separation of constituent material parts to avoid contamination that could prevent future recyclability.

Services
The clear soffit is designed to enable exposed services, easing access for maintenance and replacement. Services can be removed for recovery and reuse generally without impacting the primary structure.

Plans to prove and quantify
O&M manuals will capture the adaptation principles so that they are recorded.

End of life routes (reuse, adaptability, disassembly, etc.) will be captured as part of Material Passporting process.

Potential end of life routes for key reusable materials will be identified early on. The data for these key reusable products will be collected and stored in a Material Passport. For more information on the strategy for applying material passports in the proposed development, see Section 3.5.1.

Structural floor system hierarchy of disassembly and reusability

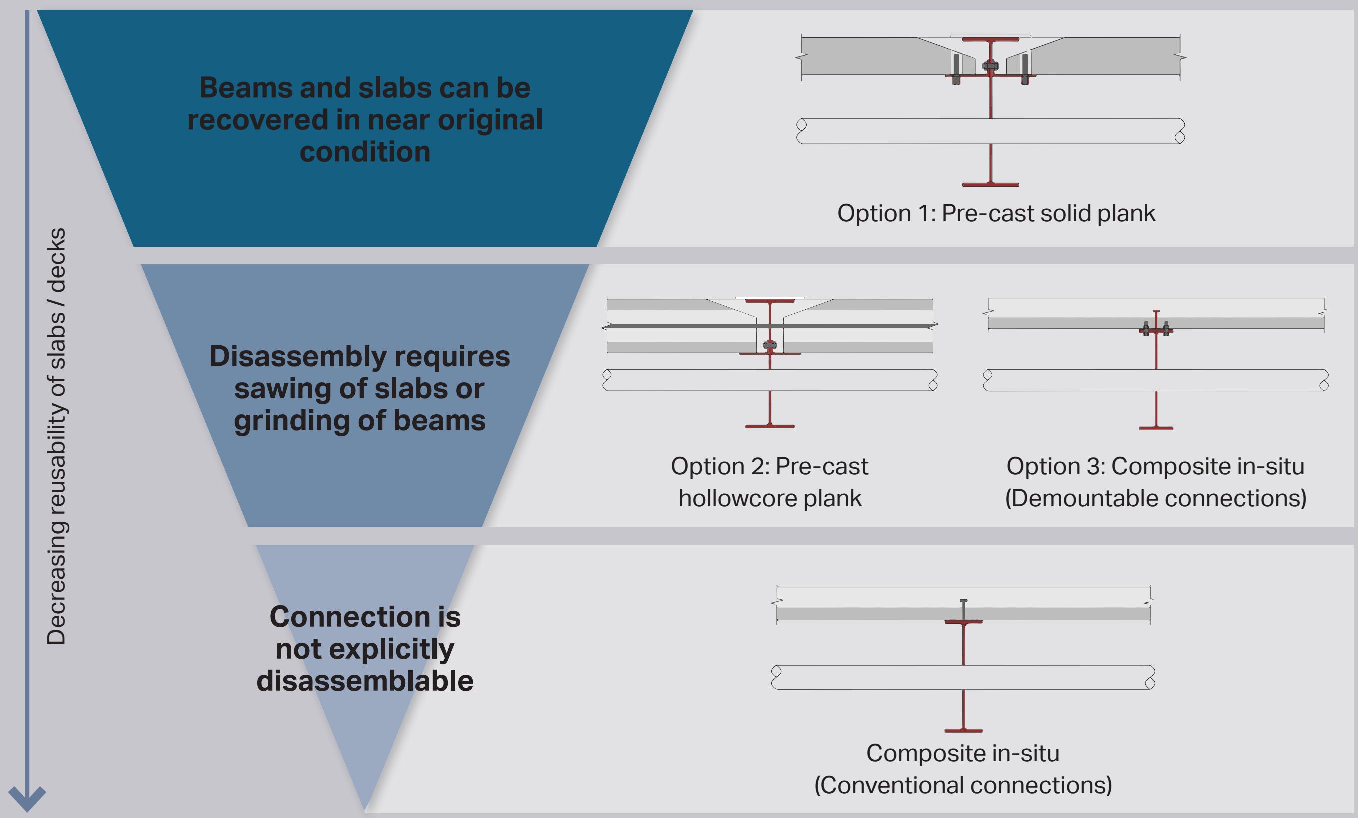


Figure 3.13 Hierarchy for disassembly and reusability of different structural floor systems

3.3 Bill of Materials & Recycled Content

3.3.1 Material intensity

The Bill of Materials has been completed based on information provided by the design team. The proposed development's overall mass of raw materials during the construction stage (A1-A3) is 72,452 tonnes (new material only, not including material retained in-situ from the existing building (foundations and central core)). A summary of the quantities across the building element categories is shown in Figure 3.14.

The Bill of Materials is aligned with the current cost plan and the submitted Whole Life-cycle Carbon Assessment (WLCA).

The quantities captured in this Bill of Materials reflect the items that are currently quantifiable in the WLCA. Material element categories that are currently (either fully or partly) included as benchmark values or cost coverage factors in the WLCA are not captured in the Bill of Materials. This concerns the external works and parts of the building services.

The Bill of Materials performance indicators can be seen in Figure 3.15. For all the building element groups, the material intensity performs within the second quartile, in line with the GLA's expectation that applications "will tend towards the median and lower quartile figures in the future".

3.3.2 Recycled content by value

Of the 72,452 tonnes of materials, 13,517 tonnes are of recycled content. This makes up 26% recycled content by value. This does not include material retained in-situ from the existing building (foundations and central core).

The primary items with recycled content in the design are the following:

- The steel frame with an overall assumed 87% recycled content
- The reinforcement bar with 98% recycled content
- Concrete mixes with 4% recycled content (assuming a nominal 25% GGBS cement replacement and currently 0% recycled aggregate).

Further opportunities will be sought as the design is progressed.

The proposed development is committed to a minimum of 25% of the building material elements comprising recycled or reused content (by value), exceeding the policy target of 20%, see Figure 3.16. The proposed development will endeavour to meet this target, wherever technically, practically, and feasibly possible.

The detailed Bill of Materials and calculations are included in the GLA Circular Economy Statement Template as part of this planning application. Refer to Appendix C.

Bill of Materials and Recycled Content by Building Element Categories

	Material quantity (tonnes)	Construction Waste (tonnes)	Recycled content (tonnes)	Recycled content by value (%)
Substructure	20,341t	819t	2,544t	65%
Superstructure	40,928t	425t	10,436t	70%
Facade	4,232t	323t	293t	8%
Internal Walls & Doors	3,650t	62t	213t	7%
Finishes and fittings	2,080t	111t	32t	TBC
Building Services	1,220t	11t	0t	0%
Total	**72,452t**	**1,752t**	**13,517t**	**26%**

Figure 3.14 Bill of Materials and recycled content summarised across building element categories

Bill of Materials Performance Indicator

	Material Intensity (Module A) (kg/m² GIA)	Performance Indicator
Substructure	262	2nd Quartile*
Frame	117	2nd Quartile*
Upper Floors	383	2nd Quartile*
Roof	23	2nd Quartile*
Fabric	55	2nd Quartile*
Internal Walls and Partitions	47	2nd Quartile*

** Evaluated based on GLA CE Statement Appendix 4. The values do not align with the CE Statement template which appears to be calculating incorrectly*

Figure 3.15 Material intensity results compared with GLA benchmark quartiles (Appendix 4 of the GLA CE Statement Guidance)

3.4 Recycling and Waste Reporting

The Recycling and Waste Reporting Table has been completed based on information provided by the design team. The quantities of construction and demolition waste, excavation waste, and municipal waste that arise throughout various life stages of the building have been estimated. A summary of the targets is shown in Figure 3.16. The proposed development will endeavour to meet these targets, wherever technically, practically, and feasibly possible.

3.4.1 Demolition waste

The demolition waste arising from the existing tower has been estimated in the Pre-demolition Audit to be 37,420 tonnes. A summary of the main materials can be found in Section 2.3.

Of the total waste, a minimum of 98% diversion from landfill for reuse, recycling or recovery is targeted.

For more details on the quantities of the demolition waste streams refer to the Pre-demolition Audit in Appendix A.

For details on the innovative approach to recovering the materials at higher value, refer to Strategy for Material Recovery in Appendix B.

3.4.2 Excavation waste

It is estimated that approximately 12,670 m^3 of excavated material will be produced. Applying an industry standard bulking factor of 1.2 to this volume equates to approximately 15,204 m^3 of excavated material, equivalent to 30,408 tonnes, assuming a conversion rate of 2 tonnes/m^3 material. The estimated material excavated from the foundations are anticipated to include the substructure concrete walls and slabs, piles arising, and pile caps.

Of this, a minimum of 95% will be diverted from landfill for beneficial use in line with policy requirements.

3.4.3 Construction waste

The proposed development is anticipated to generate approximately 5,185 tonnes of construction waste, assuming best practice performance is realised.

Construction waste will be separated into recyclable waste streams before removal from site for processing.

Of this, a minimum of 96% will be diverted from landfill for reuse, recycling and/or recovery, exceeding policy requirements.

3.4.4 Operational waste

The existing waste management operations are currently segregating material effectively, and the proposed waste strategy will therefore maintain the same principles of consolidation and collection for each waste stream.

The operational waste generation quantity has been estimated as 2,927 tonnes/annum. The proposed development is committed to targeting at least 65% recycling rate for municipal waste, contributing to achieving this 2030 target for Greater London.

More information on the excavation and construction waste is included the *Outline Site Waste Management Plan prepared by Velocity Transport Planning dated December 2023*, that forms part of this planning application. For more information on the operational waste refer to *Operational Waste Management Strategy prepared by Velocity Transport Planning dated December 2023*.

The detailed Recycling and Waste Reporting Table and calculations are included in the GLA Circular Economy Statement Template as part of this planning application. Refer to Appendix C.

Circular Economy Targets

	Policy Requirement	Target Aiming For (%)	Policy Met?
Demolition waste materials (non-hazardous)	Minimum of 95% diverted from landfill for reuse, recycling or recovery.	98%	Exceeds Policy
Excavation waste materials	Minimum of 95% diverted from landfill for beneficial reuse.	95%	Yes
Construction waste materials	Minimum of 95% diverted from landfill for reuse, recycling or recovery.	96%	Exceeds Policy
Municipal waste	Minimum 65% recycling rate by 2030.	65%	Yes
Recycled content	Minimum 20% of the building material elements to be comprised of recycled or reused content.	25%	Exceeds Policy

Figure 3.16 Circular economy targets for the proposed development

Waste Reporting and Performance Indicator

	Source of Information	Overall Waste (tonnes)	Overall Waste (kg/m² GIA)	Performance Indicator
Demolition Waste	Pre-demolition Audit	37,420	0.48	Median
Excavation Waste	Site Waste Management Plan	30,408	0.39	2nd Quartile
Construction Waste	Site Waste Management Plan	5,185	0.067	2nd Quartile
Municipal Waste	Operational Waste Management Strategy	2,927	0.038	3rd Quartile

Figure 3.17 Waste arisings in the proposed development compared with GLA benchmark quartiles (Appendix 4 of the GLA CE Statement Guidance)

3.5 End of Life Strategy

The end of life strategies included in the Bill of Materials are aligned with the Whole Life-cycle Carbon Assessment (WLCA) for the proposed development.

For the majority of the building components, the reuse and recycling targets are the default end of life scenarios, as per the RICS Professional Statement *Whole life carbon assessment for the built environment 2nd edition*.

3.5.1 Material passports

In line with British Land's ambitions, the proposed development is committed to preparing material passports for key reusable materials. The relevant key reusable materials will be identified as the design is developed.

Working with the Principal Contractor, material passports will be produced during construction and finalised at practical completion, to capture the materials used in the proposed development, and detailed data for the key reusable materials to better facilitate future reuse.

Figure 3.18 shows a sketch process to develop the material passports. The relevant key reusable products will be identified as the first step in this process. Some of the potential items have been identified in line with the circular economy design principles. There is a high potential for reusability and future impact in the steel elements for the proposed superstructure. Some of the facade elements, such as the glass and aluminium framing would be considered for key reusable products.

To secure implementation, data for the material passports will be gathered from the Principal Contractor through a material passport reporting template and specification clauses that will be included in the Contractor Preliminaries.

Indicative Process for the Application of Material Passports

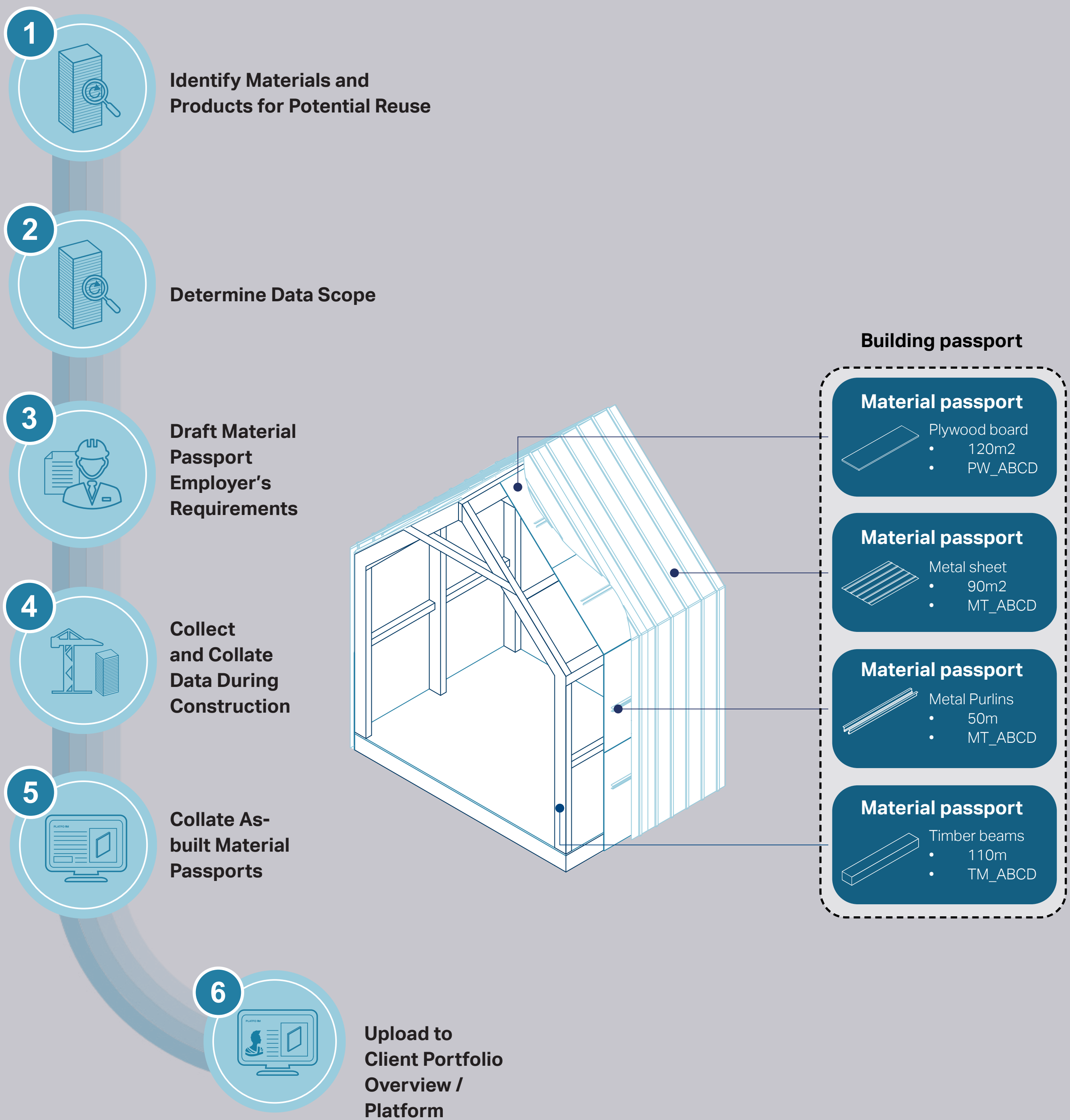


Figure 3.18 Waste arising in the proposed development compared with the GLA's benchmark figures

3.6 Implementation & Post-construction Reporting

The circular economy aspirations outlined in this statement will be managed by British Land and the project team throughout design development. The project team will assess the design based on the circular economy strategy, as well as the other sustainability criteria outlined in the *Sustainability Statement prepared by GXN dated December 2023*.

The design team is committed to ensuring ongoing monitoring of the stated circular economy strategies. Design commitments will be secured and advanced through materials and circular economy workshops to be held throughout the project stages. These workshops will be used to assess designs in line with the circular economy commitments and principles set out in this statement.

The following documents are actively being used to support the implementation of the aspirations outlined in this statement:

- Pre-demolition Audit (refer to Appendix A)
- Material Recovery Strategy (refer to Appendix B)
- Material efficiency report BREEAM Mat 06 - to be tracked and updated at each of the RIBA stages with implementation recorded from RIBA Stage 4
- Functional Adaptation study BREEAM Wst 06 - to be updated during RIBA Stage 4 (refer to Appendix D).

Where appropriate, targets and performance clauses will be included part of Contractor Preliminaries, to secure their implementation, with regular reporting required for tracking.

It is agreed that a Post-construction Report will be prepared on completion of the works, and submitted to the planning authority.

This report will be produced in line with the GLA Circular Economy Statement Guidance to include:

- Updated Bill of Materials based on actual materials used
- Updated Recycling and Waste reporting table based on actual materials handled, quantities, destinations, etc.
- As-built performance against all the key commitments and metrics that are included in this statement
- Lessons learned
- Supporting evidence as appendices.

Where significant change is noticed, between the as-built performance and the commitments in this statement, explanation will be provided to describe the reasons that have caused the difference.

Figure 3.19 Close up render of the proposed development

4

Euston Tower

Summary and Conclusions

4.1 Conclusion

This Circular Economy Statement demonstrates British Land's commitment to delivering a world leading science, technology and innovation building and public realm for Camden and the Knowledge Quarter that inspires, connects, and creates opportunities for local people and businesses.

As outlined in this statement, the proposed development adopts the principles of the circular economy across all areas of design, construction, and operation. This will ensure that it delivers world leading sustainably performance that is fit for now and the future.

Wherever technically, practically, and economically feasible, the proposed development meets and exceeds the sustainability requirements of planning policy.

The proposed development includes a range of circular economy strategies and approaches, as detailed in this statement and its supporting appendices, including:

- **Maximising utility of existing buildings**
  - Achieved by strategically retaining as much as possible of the existing building, reducing waste and the need for new materials
  - A thorough and transparent Feasibility Study studying the condition of the existing building, and assessing options for redevelopment has been undertaken and independently assessed
  - Retention of 31% of the existing structure, following a detailed feasibility study (satisfying the GLA requirements for a pre-redevelopment audit), which has been independently reviewed by a third-party assessor, and their report has been issued to Camden.
- **Minimising waste in deconstruction and construction**
  - A pre-demolition audit has been undertaken and is included in Appendix A
  - A transparent approach to handling deconstructed materials and identifying opportunities to put them to best use
  - A detailed assessment of opportunities for on site and off site deconstruction waste reuse/ upcycling/recycling are considered and captured in the material strategy as part of this statement
  - The proposed development is targeting 98% of the demolition waste to be diverted from landfill, 96% of the construction waste to be diverted from landfill and 95% of excavation waste to be put to beneficial use
  - Prototyping innovative approaches for structural reuse of concrete and recycling of building glass at scale, with ambition to publish the findings
  - Designing a modular facade utilising off-site manufacturing to reduce waste.
- **Minimising waste in operation and end of life**
  - The overall strategic design approach is to design a building for adaptability and longevity, reducing waste and preventing premature obsolescence
  - Particular focus is applied to the structure as it is the most carbon-intensive element, and is seen as foundational to meaningful long-term adaptability
  - Considering the different building elements in layers to enable maintenance and replacement that minimises destructive impacts on other building elements (especially structure)
  - Dedicated storage areas for waste recycling
  - The proposed development will contribute to achieving the GLA's municipal waste target of 65% recycling by 2030
  - Improving end of life reusability by committing to capture useful data for key building elements in material passports
  - Committing to submitting a post-construction report to report as-built circular economy performance.
- **Seeking to use reused/recycled materials**
  - Using reused and/or high recycled content materials where possible, targeting 25% recycled content by value
  - Driving innovation by upcycling/transforming materials from the deconstruction to reduce waste and the reliance on virgin materials, captured in the material strategy as part of this statement.

The Bill of Materials and Recycling and Waste Reporting Table has been summarised in this statement, with the full details and calculations included in the Circular Economy Statement Template which is located at Appendix C.

To ensure successful implementation, the key initiatives and commitments detailed in this statement, and its supporting documents, will be implemented, monitored, and/or reviewed as the design develops, and subsequently during the operational phase of the proposed development.

Figure 4.1 Render of the proposed development as seen from Tottenham Court Road

A

Euston Tower

Appendices

Appendices

List of Appendices

reusefully

Report From:

Katherine Adams and Gilli Hobbs
Circular Economy and Waste Specialists
Reusefully Ltd

Report Prepared For:

GXN

Pre-demolition audit of Euston Tower

24th August 2022

Executive Summary

The pre- demolition audit was undertaken on the 6th of January 2022 and 10th February 2022 by Katherine Adams and Gilli Hobbs of Reusefully Ltd. A visual survey of the building, combined with analysis of the plans provided, was used to calculate the Key Demolition Products (KDP). The audit has investigated the key materials which are likely to rise from the full demolition to aid with the decision making for the proposed development at RIBA Stage 1. The embodied carbon of these materials has also been estimated. The quantities are as follows:

Materials	**Tonnes**	**Volume (m^3)**
Concrete	36,981	15,548
Steel	1,942	250
Brick	389	229
Glass	378	151
Aluminium	305	140
PVC	120	48
Gypsum	105	137
Softwood	34	69
Ceramic	16	7
Chipboard	12	17
Fibreboard	7	10
Aggregate	6	4
Insulation	4	89
Vinyl	1	1
Grand total	**40,303**	**16,701**

Concrete is by far the most prominent material, estimated to be 36,981 tonnes from a full demolition (92% of all demolition arisings. This does not include waste that has already been generated as part of the strip out process, which is estimated to be 1,848 tonnes (as provided by the demolition contractor). The embodied carbon of the materials present within the building is estimated to be 10,937 tonnes of CO_2e.

Parameters and points of interest have been provided for key products to assist with reuse in this development and externally and to assist with BREEAM requirements. A presentation has also been issued which has the key parameters for products and images (titled *ET Pre-Dem Results 20.4.22*).

Contents

1. The Requirement

GXN have engaged Reusefully Ltd to carry out a pre-demolition audit of Euston Tower in London. The aim of the audit is:

- To provide an understanding of the types and amounts of products and materials arising during the demolition.
- Provide key parameters for products and elements to identify opportunities for reuse.
- 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 details of the embodied carbon of the materials resulting from demolition
- To provide technical advice on the reuse of products and recycling of material on site
- To provide data to help with populating the Resource Management Plan and in support of the BREEAM assessment and the Greater London Authority Circular Economy Statement
- To advise on targets for reuse and recycling for products and materials arising during the demolition

2. Site details

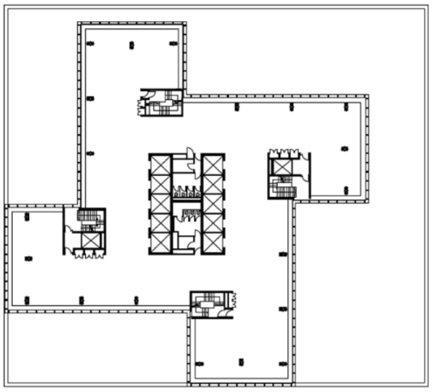
Euston Tower is located on Euston Road in the London Borough of Camden. It was built in 1970 and has been mainly used for offices. It has a storey height of 36 floors; the overall height of the building is 124 metres. There is a wraparound building on the ground and 1st floor which is used for retail/café space (on the ground floor) and offices (on the 1st floor). At the time of the visit, strip out works had occurred on most of the floors, with some plant equipment still being removed. The floor plate is the same for each floor of the tower with 4 core areas of stairs, a central core of bathrooms and lifts (one set to Floor 19 and the other set to Floor 35). There are a number of floors which have plant equipment (Floors 1, 12, 24, 34 and 25). The building comprises the following:

- Glass façade with aluminium mullions and aluminium sheet cladding on the tower
- Secondary glazing throughout the Tower (except Floor 36)
- Glass façade with louvres on the ground and first floor
- A double height glass atrium
- Reinforced concrete floors and columns – beam, ribbed and standard sections
- A mix of precast concrete, concrete block, brick and stud walling.
- A steel deck poured with concrete used for the lower floor building

The floor plate of the Tower is shown below(taken from Euston Tower Design Scheme Presentation 11.1.22).

Demolition

Existing



3. The Pre-Demolition Audit

The pre-demolition audit was undertaken on the 6th of January and the 10th of February 2022, consisting of a non-invasive visual survey of the buildings. Certain areas were inaccessible, such as the ground floor units and not all floors were visited. Hence, construction details and materials have been inferred based on typical practice. Survey notes and photographs were taken, and plans of the buildings were supplied (though not detailed floor layouts). Also provided was access to Matterport files, demolition and orginal architectural and engineers drawings. There is also a BIM model of the core areas and some floors.

On the basis of information gathered and provided, an analysis of materials arising from a full demolition has been undertaken, with results reported in both weight and volume. The weight has been calculated using standard density figures for the materials identified. Embodied carbon figures have also been used (See Appendix A for source and assumptions).

A presentation has also been issued which has the key parameters for products and images (titled '*ET Pre-Dem Results 20.4.22*).

The following assumptions have been applied:

Demolition

- Removal of the entire building down to floor slab

Please note, a number of areas have not been included in this audit, due to lack of access/information – however the amount of materials is thought to be relatively insignificant compared to the amount of materials already identified. This includes the internal areas of the commercial and retail units, the fixtures and fittings on the ground floor and first floor (which have not as yet been removed), any waste electronic and electrical equipment including lifts and plant equipment. As the basement is communal with other buildings, this has been excluded. Any equipment on the roof has not been included.

4. Demolition Results

Overall, there is an estimated 40,303 tonnes (16,701m^3) arising from the demolition. Concrete is the largest KDP (36,891 tonnes) followed by Steel (1942 tonnes), Brick (389 tonnes), Glass (378 tonnes), Aluminium (305 tonnes), PVC (120 tonnes), Gypsum (105 tonnes) and Softwood (34 tonnes) as shown in Figure 1 and 2 and Table 1. In volume, the largest KDP is Concrete (15,547m^3), followed by Steel (250m^3), Brick (229m^3), Glass (151m^3), Aluminium (150m^3), Gypsum (137m^3) and Insulation (89m^3). Each of these KDPs is described later in the report detailing their arising, likely management options and next steps (where applicable) to support reuse and/or higher value recycling.

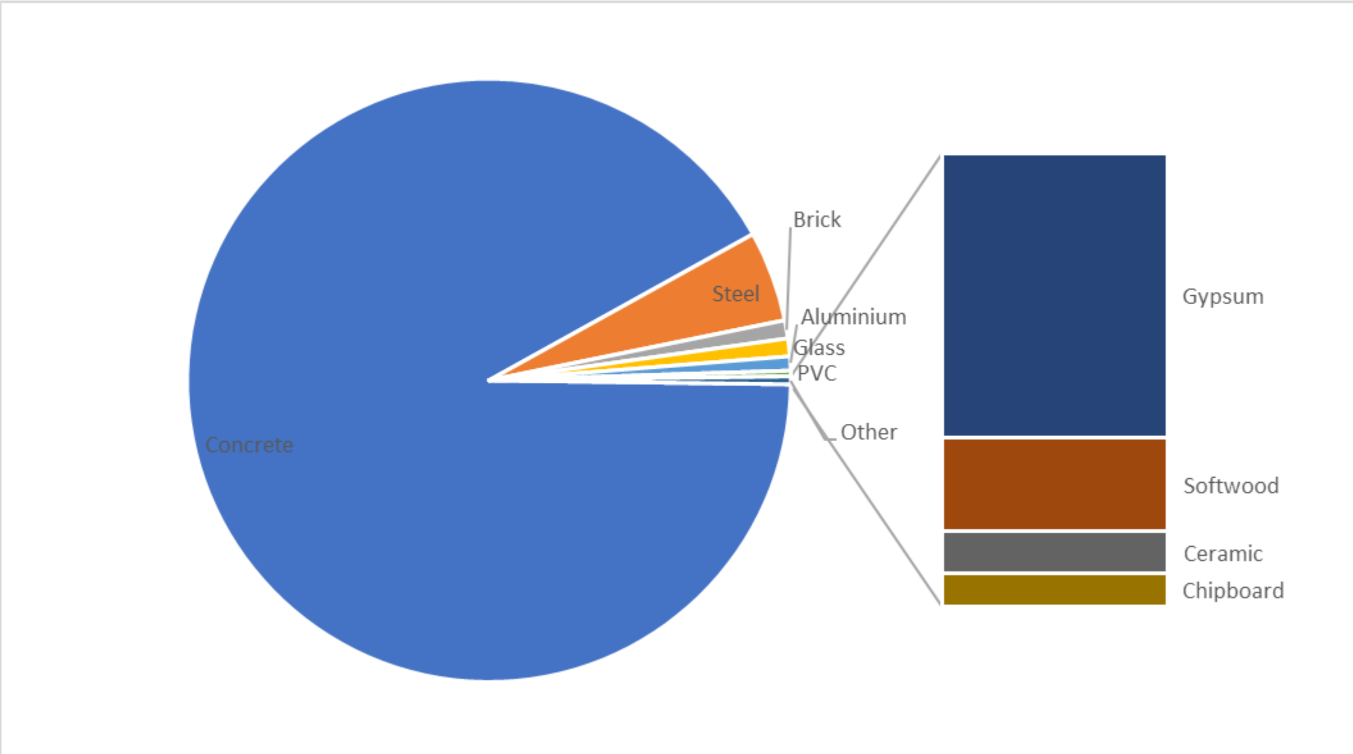


Figure 1: Demolition Results - KDPs by weight (tonnes)

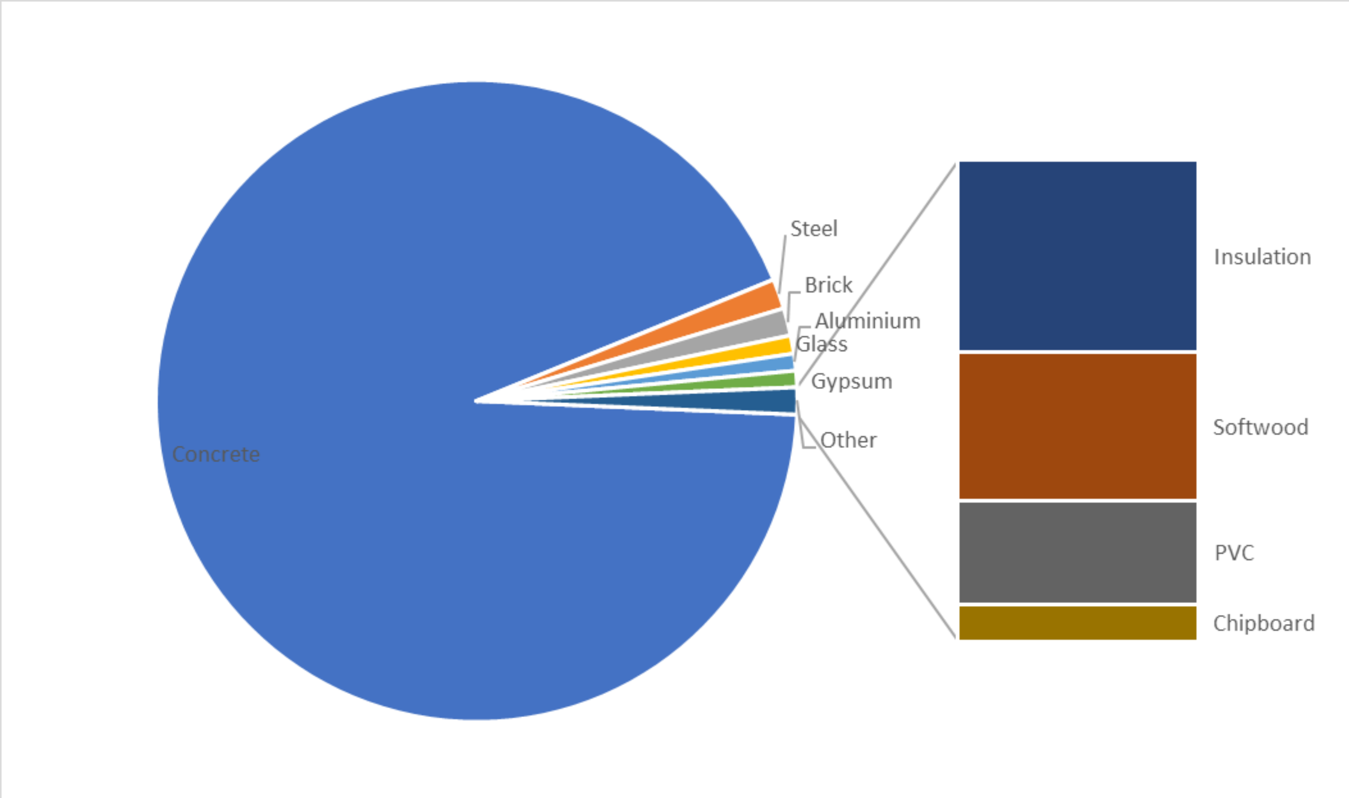


Figure 2: Demolition Results - KDPs by volume (m^3)

Table 1 provides the weight (tonnes), volume (m^3) and European Waste Codes for each KDP.

	Weight (tonnes)	Volume (m^3)	EWC
Concrete	36,981.12	15,547.81	17 01 01
Steel	1942.39	249.78	17 04 05
Brick	388.50	228.53	17 01 01
Glass	378.37	151.35	17 02 02
Aluminium	305.13	140.49	17 04 05
PVC	120.30	48.12	17 02 03
Gypsum	105.38	137.14	17 08 02
Softwood	34.31	68.63	17 02 01
Ceramic	15.84	6.60	17 01 03
Chipboard	12.22	17.46	17 02 01
Fibreboard	7.18	10.26	17 02 01
Aggregate	6.48	4.00	17 01 01
Insulation	4.47	89.36	17 06 04
Vinyl	1.34	0.99	17 02 03
Grand total	**40303.05**	**16700.52**	

Table 1: Demolition Results - KDPs by tonnage and volume (m^3)

Strip out results

Information has been provided by the contractor, JF Hunt, on the amount and type of waste that has been produced from the strip out process to December 2021. This has been logged on to BRE's SmartWaste system. As of the 21st of December 2021, 1,848 tonnes of waste had been produced and of that 100% diverted from landfill. Of this, metals were the greatest, at 740 tonnes (40%); followed by mixed waste at 527 tonnes (29%), plasterboard/gypsum at 222 tonnes (12%), timber at 193 tonnes (10%) and carpet at 70 tonnes (4%). There are smaller amounts (less than 30 tonnes each) of inert waste, floor coverings, tiles and ceramics and concrete. There was also 1.4 tonnes of hazardous materials (oils, refrigerants and asbestos). Due to way the data has been collected it is difficult to infer what materials are in the mixed waste category. The results can be seen in Table 2 and Figure 3. Note, these figures are likely to have increased as more plant has been taken out since these figures were provided.

	Weight (tonnes)	**EWC**
Metals	739.49	17 04 07
Mixed construction and/or demolition waste	526.52	17 09 04
Plasterboard / Gypsum	222.2	17 08 02
Timber	192.86	17 02 01
Carpets	69.5	20 01 11
Inert	30	17 01 07
Floor coverings (soft)	26.92	20 01 11
Tiles and Ceramics	23.82	17 01 03
Concrete	15	17 01 01
Oils	1	13 01 13*
Refrigerants	0.371	14 06 01*
Construction materials containing asbestos	0.03	167 06 05*
Grand Total	**1847.71**	

Table 2: Strip Out Results – Waste by tonnage

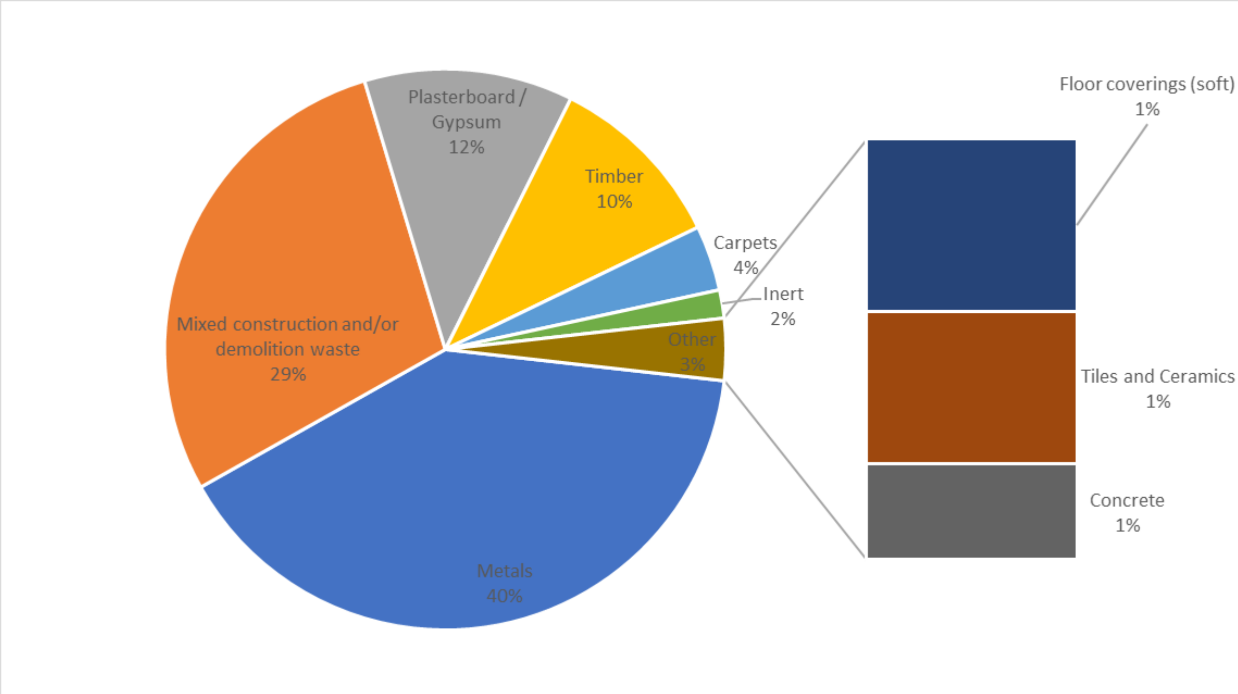


Figure 3: Strip Out Waste Results – waste by tonnage

The destination of the waste materials has also been recorded. This shows overall that 4% of materials was reused (all of the carpet at 60.5 tonnes); 41% of the materials were sent for direct recycling (largely the metals) and 37% for recovery (further reprocessing) which accounted for the plasterboard and gypsum. The majority of the timber was sent for energy recovery as well as the mixed construction and demolition waste at 39% (these figures seem high, so there could be some inaccuracy in their reporting). Table 3 and Figure 4 provide more information.

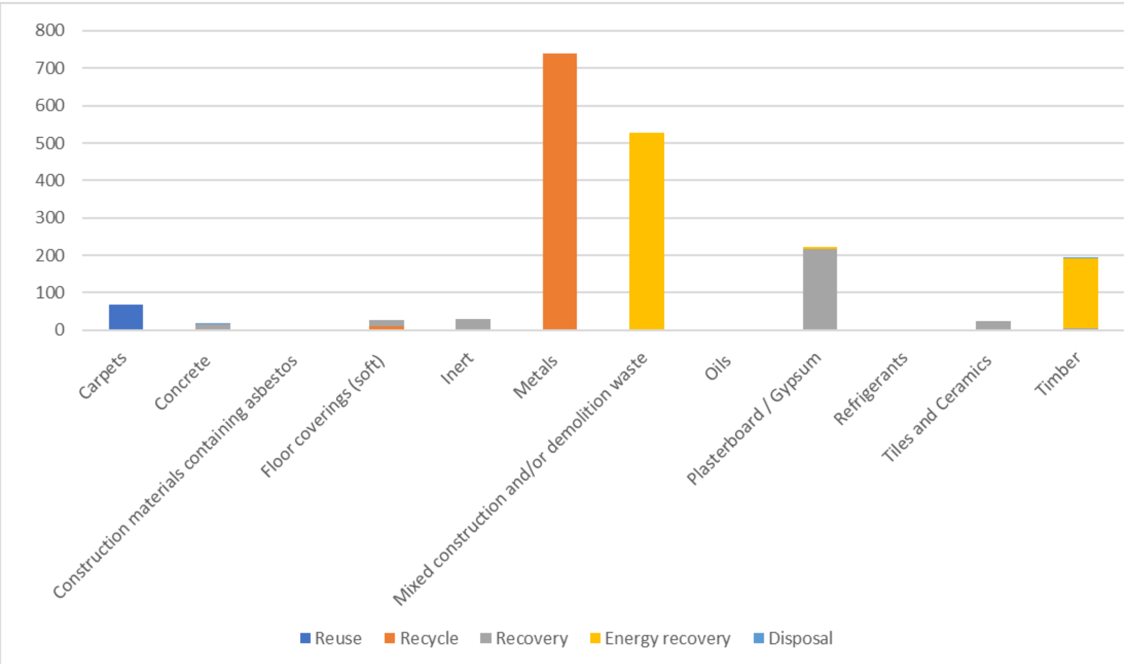


Figure 4: Strip Out Waste Results – waste management routes

	Reuse	Recycle	Recovery	Energy recovery	Disposal
Carpets	69.5				
Concrete			15		0.03
Construction materials containing asbestos					
Floor coverings (soft)		9.84	17.08		
Inert			30		
Metals		739.49			
Mixed construction and/or demolition waste				526.52	
Oils			1		
Plasterboard / Gypsum			216.64	5.56	
Refrigerants			0.371		
Tiles and Ceramics			23.82		
Timber			4.32	188.54	0.03
Grand Total	**69.5**	**749.33**	**308.23**	**720.62**	**0**

Table 3: Strip Out Results – Waste management routes (by tonnes)

Table 4 provides details of the waste destinations. Carpet was reused by community organisations (one abroad) via Globechain. Most of the waste was sent to waste transfer stations such as Westminster Waste, Suez and Powerday for either further sorting or recycling. Metals were sent directly to metal recycling sites. Concrete was also sent directly for recycling.

Waste type	Destinations
Carpets	CCORRN (Cambridgeshire Community Reuse and Recycling Network) via Globechain Hawa Trust via Globechain
Concrete	Recycled Material Supplies Ltd - Sunshine Wharf
Construction materials containing asbestos	Cohart Asbestos Disposal Ltd
Floor coverings (soft)	European Metal Recycling – Willesdon Worcester Recycling Croydon Ltd
Inert	Recycled Material Supplies Ltd - Sunshine Wharf
Metals	European Metal Recycling – Wandsworth European Metal Recycling – Willesdon Southwark Metals Ltd Suez Recycling & Recovery South East Ltd Westminster Waste
Mixed construction and/or demolition waste	Powerday Plc Suez Recycling & Recovery South East Ltd Westminster Waste
Oils	MAG Properties Services Ltd
Plasterboard / Gypsum	Powerday Plc Suez Recycling & Recovery South East Ltd

	Westminster Waste
Refrigerants	MAG Properties Services Ltd
Tiles and Ceramics	MSK Waste Management & Recycling Ltd
Timber	Powerday Plc Suez Recycling & Recovery South East Ltd Westminster Waste

Table 4: Strip Out Results – Waste management destinations

5. Concrete

Concrete is the largest KDP identified, estimated to be approximately 36,981 tonnes from the full demolition as shown by Table 5 (equivalent to 3,865 tonnes of CO_2e). This is from a number of sources, the most from the concrete floor slabs (17,613 tonnes), the columns (4,355 tonnes), precast walls (9,488 tonnes) and beams (4,043 tonnes). Most of the concrete is unsuitable for reuse, as it is not in precast sections, though some of the walls are precast. There is also fire retardant spray (similar to grout) on the underside of around half of the floor slabs; this maybe difficult to remove.

Concrete is in theory 100% recyclable. It can be segregated and crushed for reuse as hard core, fill or in landscaping or used as recycled aggregate in new concrete. Although recycled and secondary aggregates can be used in some concrete applications, other lower grade end uses (e.g. in unbound materials as fill and hardcore) may sometimes be more resource efficient due to reduced processing demands and transportation. Often such waste does not even leave the demolition site, being used for the site's redevelopment, as shown by the NFDC figures with nearly half of inert waste (over 9 million tonnes) treated this way. Otherwise, it is used on other sites as fill to offset the need for primary raw materials. Very little concrete waste therefore tends to go to landfill.

It is recommended that the concrete should be segregated either onsite (space is limited on site) or at a waste facility and crushed to produce recycled concrete aggregate (RCA)[1] in accordance with the WRAP Quality Protocol for aggregates[2] from inert waste. Ideally, this should be used back in concrete, possibly into precast elements to be used in the further development. It can also be used for lower value applications such as for piling mats and temporary/ permanent fill (infilling). If reprocessed, stored and/or used onsite then appropriate permits[3] or exemptions will be required for these operations. RCA is of a higher quality than recycled aggregate (RA) due to the limit of masonry in the aggregate (maximum of 5%). The performance characteristics of RCA are better than RA and therefore there are fewer restrictions on the use of RCA in concrete. The use of RCA in concrete is given in BS 8500-2[4].

Various options are available to utilise RCA as listed below.

Recycled concrete aggregates can be used in:

[1] Recycled concrete aggregate is aggregate resulting from the processing of inorganic material previously used in construction and principally comprising crushed concrete [BS 8500-1: 2002].

[2] https://www.gov.uk/government/publications/quality-protocol-production-of-aggregates-from-inert-waste

[3] https://www.gov.uk/guidance/waste-environmental-permits

[4] https://shop.bsigroup.com/products/concrete-complementary-british-standard-to-bs-en-206-specification-for-constituent-materials-and-concrete/standard

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 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.

Best practice

There is an opportunity to reuse the concrete paving stones used on the lower ground roof with the majority (at least 75%) which appear to be of good quality. There is an example of reuse of precast panels through a new EU Project: Recreate and the SuperLocal project Superlocal . There are also examples of higher value recycling technology where the constituents of concrete are separated, also producing a cementitious product that can reduce the need for new cement Smartcrusher (note not in the UK as yet).

Inert waste can also be used for making bricks e.g. the K-Briq (in Scotland) https://kenoteq.com/ and StoneCycle https://www.stonecycling.com/ .

Examples of structural concrete that have been used as RCA include the London Olympics 2012 London 2012 sustainable aggregates and Building B16 at BRE; BRE's Environmental Building

Otherwise, concrete waste can also be used for blocks and paving. For example, Blocks (Aircrete) can be up to 70%; other blocks average 24%; Aggregates in concrete blocks; but can vary considerably e.g. 74%; Sheehan Concrete blocks.

Further testing and investigation

It is recommended that further sampling and testing is carried out to enable high quality recycling of all the concrete removed. This includes:

- Testing of the 'groutlike' substance on the underside of numerous concrete floor slabs to determine the composition and likely impact as a contaminant in the recycling applications listed above.
- Testing of the concrete (removal of small samples) in each of the key areas – floor slab, columns and walls to determine composition of the concrete and possible contaminants, such as elevated levels of chlorides and sulphates.
- Further testing of the concrete, as required, to meet the specifications of potential high value end uses, such as precast concrete elements, concrete blocks etc
- Discussions with the providers of the SmartCrusher equipment on the viability of using this system in the UK.

Local waste management companies

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

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

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

Item	Area m^2	Volume (m^3)	Tonnes	Tonnes of CO_2e
Concrete floor slab	20,391.37	5,063.69	12,152.85	1,251.74
Columns	3,148.52	1,814.66	4,355.18	448.58
Concrete beams	5,691.15	1,680.88	4,034.12	415.51
Precast walls - 300mm	5,391.76	1,596.03	3,830.48	394.54
Ribbed slab - ribs	7,466.00	1,445.42	3,469.00	357.31
Precast walls - 200mm	7,110.34	1,407.89	3,378.94	348.03
Precast walls - 380mm	2,045.28	773.13	1,855.51	191.12
Ribbed slab - intermediate areas	11,172.17	541.85	1,300.44	133.95
Precast concrete staircase	34.80	477.46	1,145.89	118.03
Lower ground roof deck	2,304.00	345.60	691.20	71.19
Precast walls - 100mm	1,780.59	176.28	423.07	43.58
Block: Concrete: Lightweight	1,808.66	168.93	236.50	61.49
Mortar	4214.870843	52.90	100.51	20.10
Paving slabs lower roof	62.00	3.10	7.44	0.77
Total	**72,621.52**	**15,547.81**	**36,981.12**	**3,855.94**

Table 5: Estimated concrete arisings from demolition

6. Steel

Steel accounts for 1,942 tonnes (250m^3) of materials arising from the demolition as shown by Table 6 (equivalent to 3,938 tonnes of CO_2e). This comes from a variety of sources, but the majority is as reinforcement in the structure at 1,871 tonnes from the demolition. There is likely to be limited opportunity to reuse this steel as the majority is embedded within the structure. Smaller items such as the joists on the internal staircase, handrails and balustrades could potentially be reused, as could the steel supports on the secondary glazing structure.

Where structural steel is available and suitable for reuse, then the SCI has produced a protocol for its reuse[5] including how to test for recertification. This describes the following process:

- A building is offered for salvage of the steelwork for reuse. Considerations include the acceptability of the source material, the demountability of the structure, the increased cost of careful demolition, etc.

[5] https://steel-sci.com/assets/downloads/steel-reuse-protocol-v06.pdf

- A business case is established between the holder of stock and the company responsible for demolition.
- Important details of the anticipated salvaged steel are recorded as described in the document
- Salvaged steelwork is received by the stockholder, grouped and listed as described in the document. The necessary grouping has an important impact on the extent of testing required.
- Members are inspected and tested in accordance with the guidance with the information appended to the stock data. The testing regime involves a combination of non-destructive and optional destructive testing, with the opportunity to make conservative assumptions about certain material characteristics. Testing may be completed at any convenient time, but the seller of the stock is responsible for declaring the necessary characteristics as the material is sold.
- Material is sold, with an accompanying declaration of the material characteristics by the holder of salvaged stock.
- Structural design and member verification is completed with certain modifications, as described in the document.

For recycling, steel should be segregated on site. It is common practice for demolition contractors to reduce their contract value by allowing for the income from the recycling of metals during demolition. Standard skip hire companies are likely to charge for haulage costs only and may give back a small rebate on the metals. Once segregated, it is usually sent to a metal scrap merchants (recyclers). At these, the metals will be sorted, sheared (cutting large pieces), shredded, graded, and baled. The steel will be then sent to smelters to be re-melted as ingots (which are usually downcycles material), and then sent to steel furnaces. Much of this maybe abroad - depending on the price per tonnes the scrap merchant can obtain (currently it is around £350/tonne). The UK does not use all the scrap metal it produces with around 80% exported to countries such as China and Turkey.

Best practice

Best practice for steel is for it to be reused; recycling is the business as usual model. Cesla Steel (are introducing a scheme where steel can be bought by them and recycled in their furnace and a voucher provided for new high recycled content steel (around 98%) (mainly rebar). They are looking for companies to pilot this with.

Further testing and investigation

As indicated, there is limited reuse options for steel, with only a small quantity of structural steelwork available (as part of the internal staircase on level 34/35). Should this be suitable for reuse than further testing may be required to determine chemical composition, Charpy impact test (fracturing) and yield/tensile strength. This could also be useful if considering reuse opportunities for the secondary glazing support struts.

Local waste management companies

Local waste management contractors include:

- Capital Metal Recycling, http://capitalmetalrecycling.co.uk/ T: 0208 964 2120
- London Scrap Metal Recycling, http://www.londonscrapmetalrecycling.com T: 0208 809 1019
- EMR Group http://www.emrgroup.com/

Item	Area m^2	Volume (m^3)	Tonnes	Tonnes of CO_2e
Columns	3,148.52	80.62	624.74	1,270.75
Ribbed slab - steel rebar	17,875.48	55.24	429.45	854.61
Concrete floor slab - steel rebar	20,391.37	34.16	265.56	528.46
Concrete beams - steel rebar	5,691.15	26.46	205.76	409.46
Precast walls - 300mm - steel rebar	6,111.76	24.37	189.46	377.02
Precast walls - 200mm - steel rebar	7,110.34	14.18	110.23	219.37
Precast walls - 380mm - steel rebar	2,045.28	4.08	31.69	63.07
Steel deck	2,304.00	3.46	26.87	66.10
Secondary glazing support	146.00	2.13	16.55	45.69
Precast walls - 100mm - steel rebar	1,780.59	1.78	13.84	27.55
Metal ballustrade	1,319.50	1.32	10.26	28.01
Metal handrail	204.75	1.02	7.96	21.73
Metal studwork - joists	387.21	0.77	5.42	14.96
Metal studwork - top/base channels	69.52	0.28	1.95	5.37
Steel Staircase (internal)	6.32	1.14	1.17	3.23
Precast concrete staircase - steel rebar	34.80	0.14	1.08	2.15
Total	**68,626.58**	**251.14**	**1,942.00**	**3,937.53**

Table 6: Estimated steel arisings from demolition

7. Brick

Brick is estimated at 388 tonnes from the internal walls from the demolition, with an assumption of 4" thick. This is equivalent to 229m^3 and 138 tonnes of embodied carbon. They are thought to be a mix of brick types. However due to the age of the buildings it is likely that cement mortar has been used, making it much harder to reuse the bricks. Bricks can potentially be recovered and reused, but most often they are crushed and recycled into fill materials or recycled aggregate. Although there is a market for recovered clay bricks, it is not always done, commonly due to the inability to remove mortar from the bricks. Traditional lime-based mortars are generally weaker than cement-based mortars and hence easier to remove. The more recent use of strong mortars with a high cement content can increase the time and effort required to remove the mortar and/ or lead to subsequent damage to the bricks. These mortars may be chosen to improve longevity in use and reduce maintenance requirements from repointing for instance.

It is recommended that bricks that are unable to be reused are segregated either onsite or at a waste facility and crushed to produce recycled aggregate (RA). This RA can be used as fill materials or added (up to 20%) to a crush mix with concrete for end use applications such as Type 1 aggregates for road sub-base. Considering the size of the site, it is likely that this will be offsite. 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 aggregates standards. It is recommended that they are processed where possible into recycled aggregates (RA) following the Quality Protocol for inert materials (Quality Protocol for Aggregates from Inert Waste)

Best practice

There could be possibility of using the recycled aggregate to make new bricks and blocks, for example the K- Brick is a new product made from construction and demolition waste (https://kenoteq.com/).

In terms of reuse techniques not tried out in a commercial setting in the UK, there are a couple of areas to consider.

Firstly, is the brick panel cutting process, as deployed in the Resource Rows project in Copenhagen. Here, 1 metre square brick panels from a Carlsberg brewery demolition were incorporated vertically and horizontally in the façade of new housing (Resource Rows).

Secondly, recent R&D into the potential to laser cut brickwork adhered with cement mortar could be of interest for separating the bricks for further use. This was carried out as part of the REBUILD project (Rebuild).

Further testing and investigation

Sometimes, the cement mortar used in brickwork can be relatively weak and easy to separate. Therefore, it would be useful to test a sample of brickwork (taking down a section of wall) to determine the strength of the mortar bond to the brick. Should it be viable to clean the brick quickly and without damage then these bricks should be suitable for reuse. Typically, it is possible to gauge the condition of the bricks visually and use again in a brick as façade application. For use in further structural applications, it may be necessary to test for compressive strength and frost resistance.

If the mortar bond is very strong, the reuse options outlined above (create brick panels and/or laser cut walls to reclaim bricks) could be investigated in more depth for viability on this project.

Waste management companies

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

- Brewsters Waste, https://brewsterswaste.co.uk/, T: 020 7474 3535
- Ohara Bros, http://oharabros.co.uk/services/aggregates-recycling, 020 8424 2220
- RTS Waste, www.rtswaste.co.uk T: 020 7232 1711
- Days Group, http://www.daygroup.co.uk/. T: 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, T: 020 8452 1111
- Premier Reclaimed Bricks, http://www.premierreclaimedbricks.co.uk/, T: 020 8684 3537
- Contact Salvo, https://www.salvoweb.com/

8. Glass

Glass is estimated to be 378 tonnes (equivalent to 592 tonnes of CO_2e), the majority arising from the windows (façade) (169 tonnes) in the tower and the associated secondary glazing (161 tonnes) as shown by Table 7. For glass to be reused it needs to be collected on specialist steel A frame stillages, handled and stored carefully. There is potential for the newer facades on the lower floors to be reused and also some internal partitions, as these are relatively new and of good quality.

Glass can be collected in skips and containers for recycling. The quality of the glass in the skips will be dependent upon the awareness and training of those working on site and appropriate site management is required along with clear signage. They also need to be close to the workplace due health and safety risks from transporting glass.

A few glass manufacturers run their own cullet recycling scheme when they will collect cullet from processors or of older glass where they will be returned to the float line. The UK has three flat glass manufacturers, all operating float lines: Guardian Glass UK, Pilkington UK Ltd and Saint-Gobain Building Glass which are all based in the North of England. One of the limiting factors in the use of post-consumer flat glass as cullet back into the float glass manufacturing process is the availability of it in the right quality and chemical compatibility as the manufacturing process is sensitive to low levels of contamination. Most of post-consumer flat glass waste produced does not go back into glass and is will be used as aggregate or landfilled. For demolition, it is more likely to be crushed into aggregate with other inert waste.

There is a health and safety consideration for the workforce if it is to be segregated onsite. According to the NFDC, glass from facades may be available for recycling back into glass, as they are likely to be deconstructed and the glass less contaminated. As the cost of logistics is high, large volumes of waste are preferred when collecting. The quality of the glass waste is important with minimal contamination requiring the effective separation and segregation on site, which in turn requires education and training for those working on site. UKGBC have an example of glass being turned into new glass (UKGBC case study). Other markets include the use of glass in glass wool insulation, container glass and ballotini products (glass beads).

The glass recycling industry has developed grades of glass cullet:

- Class C – which is contaminated and not suitable for re-melting back into glass. Contamination can include ceramic frit, putty, lead beading and space bars. This will be used as aggregate and road paint.
- Class B – this is called 'mixed cullet' and may have some contamination such as laminated glass, which is suitable for glass wool insulation and container glass.
- Class A – clean clear glass cullet with no contamination which can be used back in the floating by re-melting. This is currently mostly from pre-consumer glass. Demand for this outstrips supply.

If glass waste is sent to landfill and not mixed with other types of non-inert waste, it will attract the lower rate of tax, currently at £3.10/tonne. There are economic opportunities with a market price of £50/tonne for recycled glass compared to €90/tonne for virgin material. For flat glass, one tonne of recycled material results in savings of 1200 kg of virgin material and 300kg of CO_2 emissions directly linked to the melting process[6].

[6] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52014DC0445&from=EN

Further testing and investigation

In the event that there's a possibility to reuse the glass panels on the ground - 2nd floor, further investigation into the ease of removal without causing damage should be undertaken by a competent contractor, such as JF Hunt who are currently on site. This limited panel removal could also provide an opportunity to develop prototype elements for the subsequent development, should this be considered as an end use option.

As described above, there are closed loop recycling opportunities with the façade/window glass. However, the level of contamination will need to be kept to a minimum and the method of extracting the glass will be critical to achieving this. The façade glass is referred to as 'Armour clad colour 3.039' in the original drawings so is likely to have coatings that could be detrimental to the new glassmaking process. Therefore, it would be useful to obtain clear specifications from the glass manufacturers in terms of glass composition and acceptable quality/ segregation to match against the glazing available and the likely demolition method. This could require laboratory testing for unacceptable coatings and chemicals. Alternatively, if it is too difficult to reach these specifications, for example it impacts negatively on safety, programme or cost, the next option should be to supply into the glass wool manufacturers. Again, this should be matched against their specifications for quality of feedstock.

Glass recyclers

- RTS Waste (www.rtswaste.co.u k T: 020 7232 1711). Note they may require the glass to be removed and stacked as panels.
- Berryman Glass Recycling (www.berrymanglassrecycling.com E: info@berryman-uk.co.uk
- May Glass Recycling (http://www.mayglassrecycling.co.uk/) ; may only take new glass
- Viridor https://www.viridor.co.uk/siteassets/document-repository/brochures/glass-recycling-ukviridor-low-res.pdf.

Item	Area m^2	Volume (m^3)	Tonnes	Tonnes of CO_2e
Façade (tower)	10,639.00	67.78	169.46	244.02
Secondary glazing	8,890.00	64.28	160.69	267.23
Glass façade (lower floor)	466.56	7.00	17.50	29.22
Windows (ground and first floor)	598.91	5.99	14.97	25.00
Windows (second floor)	286.05	2.86	7.15	11.94
Atrium	175.20	1.75	4.38	7.31
Doors (second floor)	84.60	0.85	2.12	3.53
Blue panels (int. ground floor)	42.12	0.42	1.05	1.76
Crazy glass feature (int.ground floor)	19.60	0.20	0.49	0.82
Staircase (internal)	13.30	0.13	0.33	0.56
Clear panel (int. ground floor)	6.71	0.07	0.17	0.28
Clear panel door (int. ground floor)	1.60	0.02	0.04	0.07

Total	**21,223.65**	**151.34**	**378.34**	**591.73**

Table 7: Estimated glass arisings from demolition

9. Aluminium

There is an estimated 305 tonnes of aluminium, equivalent to 2,035 tonnes of CO_2e from the demolition as shown by Table 8. Most of the items are panellised and as such may be suitable for reuse though may need to be cut and cleaned. This includes the cladding and the canopy.

Aluminium is usually treated in a similar manner to steel, in that it will be sent to a scrap merchant, where it will be sorted, sheared (cutting large pieces), shredded, graded, and baled. There are 14 aluminium recyclers in the UK and the total recycled is 800,000 tonnes per year. The UK exported nearly 437,500 tonnes of scrap aluminium in 2020[7]. As it is non-ferrous it needs to be separated from the ferrous (steel) material) either on or offsite. Aluminium will be sent for smelting (only one plant in the UK), the actual furnace type will depend on the level of contamination of the aluminium. Secondary aluminium refiners will either convert most of the materials into foundry ingot to produce aluminium castings. Some secondary refiners produce deoxidiser for the steel industry, this material being in a variety of forms such as notched bars and granules. Some secondary refiners also produce hardeners or master alloys such as aluminium-manganese alloys for use by other sectors of the aluminium industry. These hardeners are used to adjust the composition of molten aluminium so that specified alloy compositions can be produced. The wrought remelters take good quality old and new scrap and convert this into extrusion billet or rolling slab, usually of the same alloy. Secondary aluminium refiners may be integrated into major aluminium companies or they may be independent companies. The UK is unusual in that the arising of aluminium scrap more than meets the needs of the UK foundry industry, as such much gets exported, particularly to China. The remelters are usually within the control of the integrated, global aluminium companies and most of the production of rolling slab and extrusion billet is used within their own supply chain. The current scrap price is around £1000/tonne.

Aluminium has high recycling rates, which can be between 92% and 98% for architectural aluminium and there is a highly established aluminium recycling market. Around 75% of all aluminium ever produced is still in productive use. Recycling uses only 5% of the original energy used to produce primary Aluminium and water. Some aluminium can be up to 75% recycled content (postconsumer); about half of the aluminium produced in Europe originates from recycled materials.

Best practice

Reuse of panels is best practice. The original drawings indicate the aluminium cladding and mullions are a form of anodised aluminium sheeting. This material is highly durable whilst being lightweight and easy to handle.

The Council for Aluminium in Building has recently launched a closed loop recycling scheme for its members CAB recycling .

Further testing and investigation

There is a large surface area of anodised aluminium sheeting that could be used again in applications requiring, or benefitting from a form of lightweight cladding/covering. It is not clear, as yet, whether

[7] https://www.statista.com/statistics/518633/uk-volume-of-exports-of-aluminum-waste-and-scrap/

the new development designs will provide such as opportunity. If so, the performance requirements of the potential application should be matched against the ability of the sheeting, which could involve a range of tests and prototyping to be undertaken.
In the event of this not being possible and for residual scrap, there could be advantages of using the CAB closed loop recycling scheme as opposed to normal recycling routes. Alternatively, the aluminium will typically be recycled back into new aluminium even in the 'business as usual' management route.

Local waste management companies

Local waste management contractors include (same as steel):

- Capital Metal Recycling, http://capitalmetalrecycling.co.uk/ T: 0208 964 2120
- London Scrap Metal Recycling, http://www.londonscrapmetalrecycling.com T: 0208 809 1019
- EMR Group http://www.emrgroup.com/

Item	Area m^2	Volume (m^3)	Tonnes	Tonnes of CO_2e
Anodised aluminium curtain walling	784.78	36.13	90.33	602.51
Aluminium panels (Ground and first floor)	219.53	32.93	86.94	579.90
Aluminium/ secondary glazing window frame		51.93	77.90	519.58
Mullions (Aluminium)	196.80	9.19	22.99	153.32
Canopy	585.60	5.86	15.81	105.46
Frames	372.15	4.45	11.17	74.47
Total	**2158.86**	**140.49**	**305.13**	**2035.23**

Table 8: Estimated aluminium arisings

10. PVC

There is an estimated 120 tonnes (16m^3) of plastic arising, from the uPVC windows used for secondary glazing on the tower floors, with an estimated 372 tonnes of CO_2e. The uPVC may be collected through the Recovinyl scheme for recycling: Axion recycling . It should be noted that there is likely to be more plastic arising than estimated from hidden components such as cabling. The management of the PVC should be done in conjunction with the glass recycling to maximise the amount and quality of recycled feedstock of both materials.

11. Gypsum

There is an estimated 105 tonnes (137m^3) of plaster and plasterboard arising from full demolition. See Table 9. Plaster skim is assumed to be used on the internal brick walls.

Plasterboard should be possible be segregated on site, or if room does not permit then well sorted and segregated at a waste transfer station. The plaster maybe difficult to remove from the brickwork/blockwork, and as such it can be treated with the bricks as Recycled Aggregates, if it is in low quantities. There are a number of companies within the London area that offer recycling services, as long as the plasterboard is relatively free from contamination. Some of the recycling routes can include being used in the plasterboard manufacturing process (although this tends to be mainly for new plasterboard offcuts rather than older plasterboard from demolition). The legal minimum, if sent to disposal, is to landfill in a monocell (landfilled separately from any degradable waste) to avoid the production of hydrogen sulphide gas.

A recovery use previously existed in animal bedding but the risk to animals, humans or the environment from hydrogen sulphide generation through the mixing with biodegradable waste means that this is not an acceptable route currently. Paper from the plasterboard can also be recycled, for example, for wallpaper manufacture.

<u>Further testing and investigation</u>

For demolition plasterboard, the options for closed loop recycling back into new plasterboard are very limited, if at all. Therefore, recovery is principally as a soil conditioner as land treatment.

It is technically possible to recycle back into gypsum for plasterboard manufacture through demonstrating compliance with BSI PAS 109 Specification for the production of recycled gypsum from waste plasterboard (2008). This standard includes meeting certain threshold levels for particle size distribution, residual paper, purity levels and presence of soluble chloride, magnesium oxide and sodium oxide. However, the current position is that demolition waste is not accepted. It may be worthwhile making further enquiries to each of the three UK manufacturers to see if they can make exceptions where the composition has been tested and meets the quality criteria.

<u>Local waste management companies</u>

Local waste management options include:

- Powerday, https://www.powerday.co.uk/ T: 020 3858 0504
- Plasterboard Recycling Solutions http://www.plasterboardrecyclingsolutions.co.uk/ T: 0780 118 6380
- Hintons Waste, https://www.hintonswaste.co.uk/recycling-facilities/plasterboard-recycling/ T:020 3322 3476
- Hippo Waste (collect in bags), https://www.hippowaste.co.uk/blog/plasterboard-recycling-removal/ T: 0333 9990 999
- RTS Waste Management, https://www.rtswaste.co.uk/plasterboard-mobile-compaction-service/ T: 020 7232 1711

Item	Area m^2	Volume (m^3)	Tonnes	Tonnes of CO_2e
Plasterboard - walls	1,844.76	27.67	20.75	8.09
Plaster skim (modern) walls	1,363.52	4.09	3.48	0.45
Plasterboard (secondary glazing)	6,137.00	58.30	43.73	17.05
Plaster skim (modern) walls	7,044.67	21.13	17.96	2.34
Plasterboard - walls	1,729.46	25.94	19.46	7.59
Total	**18,119.40**	**137.14**	**105.38**	**35.52**

Table 9: Estimated plaster and plasterboard arisings

12. Softwood

As shown by Table 10, there is an estimated 34 tonnes (68m^3) of timber arising from the demolition, equivalent to the storage of 44 tonnes of CO_2e. The largest source is from the framing system used in the secondary glazing system – as these are largely uniform they could be suitable for reuse/remanufacture. Other sources include the doors and riser cupboards.

It is recommended that a local wood recycling organization is contacted (Community Wood Recycling, www.communitywoodrecycling.org.uk) to see what timber items are suitable for reclamation and reuse. The nearest enterprise is Shaw Trust Wood Recycling (Croydon); T: 020 8300 9744, and Solo Wood Recycling; www.solowoodrecycling.co.uk There are also examples of the reuse of doors (FCRBE door reuse). If reuse is not viable, most of the solid timber can be recycled, usually into chipboard. Due to the age of the building, some of the timber maybe hazardous due to the coatings and preservatives used. Guidance has been issued for this[8]. Timber should be segregated on site if space permits, to improve level of reuse or recycling. If sent offsite to a licensed waste management contractor, this will typically result in recycling for chipboard (if well segregated) or as an energy feedstock (especially where mixed with other materials).

Further testing and investigation

For any significant amounts of timber that seem to be coated or treated prior to 2007 it is recommended to test for preservatives containing hazardous substances. In the event these occur over certain threshold limits the waste wood is classed as a hazardous waste.

Most of the visible timber (supporting the secondary glazing) seems to be of the type of timber used to construct stud walls and hence less likely to have been treated. This timber also seem to be highly reusable in any similar applications, such as partitioning, other internal joinery etc.. Depending on the application, further testing linked to performance requirements may be required.

Item	Area m^2	Volume (m^3)	Tonnes	Tonnes of CO_2e

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

Timber struts (secondary glazing)	480.88	52.18	26.09	-33.65
Fire Doors and Frames	211.20	8.45	4.22	-5.45
Riser Cupboards (full)	451.44	5.42	2.71	-3.49
Riser Cupboards (half)	158.40	1.90	0.95	-1.23
Riser Cupboards (frame)	68.64	0.69	0.34	-0.44
Total	**1370.56**	**68.68**	**34.34**	**-44.27**

Table 10: Estimated softwood arisings

13. Other materials

Ceramics

There is an estimated 16 tonnes (6.6m^3) of ceramic materials arisings covering 1320m^2; with an embodied energy of 12 tonnes CO_2e. This is estimated to be from the WCs on Floor 2 to 35, on the walls and the floor. It will be difficult to remove these tiles intact for reuse without damage and their monetary value is relatively low. There is a factsheet produced by the FCRBE project which discusses the requirements for reuse; see FCRBE ceramic reuse. However, for this project, it is recommended that these are either crushed with the inert waste on site or sent off site to produce recycled aggregate.

Chipboard

There is an estimated 12 tonnes of chipboard (17.5m^3) arising from the demolition; with 11 tonnes from the toilet cubicles and 1.6 tonnes from the sink carcasses. This equates to -14 tonnes of CO_2e if carbon sequestration is factored in. It is unlikely that this will be suitable for reuse as it is of low monetary value and of average quality. However, the panel sizes are consistent and could potentially be repurposed. It is also difficult to recycle due to the length of the fibres and the glues, so the most appropriate route is likely to be energy from waste.

Further testing and investigation

In the event that recycling is considered to be an important option to pursue, there has been R&D in the past to separate MDF back to particle form (and then used to make more timber based board products). This is now a commercial process, run by MDF Recovery. Other R&D revolved around composting with high organic matter substances for soil replacement. Either of these options could be investigated in more detail if of interest.

Fibreboard

Fibreboard in the form of a wool wood board (assumed) is apparent on Floor 34, above the internal windows, covering an area of 95m^2, estimated to be 7 tonnes (10m^3) and 7 tonnes of CO_2e. The board is of low quality and low monetary value, making reuse difficult. It is unlikely to be recycled due to its composite nature. The most likely recovery route is energy from waste.

Aggregate

There is loose aggregate on the lower floor roof, covering around 800m^{2,} with a volume of 4m^3 and a tonnage of 6.5. The embodied carbon of this material is estimated to be 0.05 tonnes. The aggregate is loose and not fixed to the substrate and of reasonable condition. As such it should be suitable for reuse on another similar project, donated or used for landscaping elements.

Insulation

There is an estimated 4.5 tonnes (89m^3) of insulation arisings from the demolition, covering an area of 1789 m^2; this equates to 5.7 tonnes CO_2e. This insulation is assumed to be mineral wool and present in the internal stud walls that are to be removed. From a visual inspection it is difficult to ascertain the type of insulation used and the extent of it. There may be more present within the external walls. No insulation has been included which has been used for pipes. Recovery of insulation material is unlikely to be possible if it is bonded to the substrate. Insulation is usually disposed of to landfill via a licensed waste management contractor or could be sent for energy recovery if foam-based insulants can be successfully segregated. There is a pilot project looking at the recycling of insulation including from Knauf: (Knauf recycling) and Rockwool offer a recycling scheme: Rockwool recycling. Care should be taken to ensure that insulation that may contain ozone-depleting substances are removed and handled carefully.

Further testing and investigation

It could be useful to test samples of the insulation to determine the composition and check for problematic substances or fibres.

Vinyl

There is an estimated 1.3 tonnes (0.99m^3) of vinyl covering approximately 495m^2 of the toilet areas from Floors 2 to 35. This is equivalent to 9 tonnes of CO_2e. The condition is thought to be average (note, not all floors were observed). The best route for this vinyl is either recycling or energy recovery. Schemes exist to recycle old vinyl flooring, depending on the quality and amount of screed attached. This can either be dropped off at specific locations or collected. See Recofloor and Recofloor specifications for more details. Tarkett also has a program, called ReStart program, where old vinyl flooring can be reused in new flooring: Tarkett flooring. If the product does not meet the specification for recycling, then it is likely to be sent for energy recovery.

Further testing and investigation

As described above, there are recycling schemes that could be relevant to this waste stream. However, conditions in terms of quantities and flooring type are attached so it would be necessary to investigate further with each option, and carry out any tests (if needed) to determine polymer type, presence of unwanted substances etc..

14. Maximising Reuse and Best Practice

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

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

Table 11 shows the items that maybe suitable for reuse. The following recommendations may assist in maximising the reclamation potential of the items identified:

- Consult the client on the findings of this report and consider any options for closed-loop re-use in a similar project (or within the further development)
- Consider setting aside storage on site for segregation of salvaged items.

There are a few organisations that may be able to assist with the reuse of items, which are listed below in London:

- Reyooz: http://www.reyooz.com/about/clients. Offer a service to collect surplus and distribute to charities, schools and small businesses.
- Globechain: https://globechain.com/; a reuse marketplace that donates to charities, schools and small businesses
- Reuse Network: https://reuse-network.org.uk/donate-items/#/
- Collecteco: https://www.collecteco.co.uk/; donation of furniture and equipment to charities, schools and small businesses.
- London Reuse Network - http://lcrn.org.uk/projects-services/london-re-use-network/
- Scrapstores: https://www.workandplayscrapstore.org.uk/ and Reuseful UK https://www.reusefuluk.org/

There is also an interactive map available from the Supply Chain Sustainability School, which shows geographically the different platforms available for material exchange.
https://www.supplychainschool.co.uk/school-launches-new-mep-mapping-tool/

For items that may have some architectural salvage value, specific salvage items can be advertised for free on www.salvo.co.uk or low value materials on www.salvomie.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. Local architectural salvage merchants about specific items can also be contacted. Salvo publishes a directory on their website. Ensure that salvaged items are removed and stored in such a way that all components remain together, e.g. doors in their frames.

Table 11 summarises the products that are likely to be more suitable for reuse. This amounts to 3176 tonnes (174m^3) and 1,516 tonnes of CO_2e.

Item	Area m^2	Volume (m^3)	Tonnes	Tonnes of CO_2e
Anodised aluminium curtain walling	784.78	36.13	90.33	602.51
Aluminium panels (Ground and first floor)	219.53	32.93	86.94	579.90
Timber struts (secondary glazing)	480.88	52.18	26.09	-33.65
Mullions (Aluminium)	196.80	9.19	22.99	153.32
Glass façade (lower floor)	466.56	7.00	17.50	29.22
Secondary glazing support (Steel)	146.00	2.13	16.55	45.69
Canopy	585.60	5.86	15.81	105.46
Paving slabs (lower roof)	62.00	3.10	7.44	0.77
Loose aggregate	800.00	4.00	6.48	0.05
Metal ballustrade	819.00	0.82	6.37	17.38
Metal handrail	120.75	0.60	4.69	12.82
Glass atrium panels	175.20	1.75	4.38	7.31
Fire Doors and Frames	211.20	8.45	4.22	-5.45
Riser Cupboards (full)	451.44	5.42	2.71	-3.49
Steel Staircase (joists)	6.32	1.14	1.17	3.23
Blue panels (int. ground floor)	42.12	0.42	1.05	1.76

Riser Cupboards (half)	158.40	1.90	0.95	-1.23
Crazy glass feature (int.ground floor)	19.60	0.20	0.49	0.82
Riser Cupboards (frame)	68.64	0.69	0.34	-0.44
Clear glass panels (int. ground floor)	6.71	0.07	0.17	0.28
Total	**5821.53**	**173.98**	**316.67**	**1516.25**

Table 11: Products that are potentially suitable for reuse/repurposing/remanufacture

Table 12 summarises the standard and best practice opportunities for each of the KPDs identified on this project.

	Opportunities	
	Standard practice	**Best practice**
Concrete	Crushed as RA for fill on/offsite	Crushed for RCA back into concrete
Steel	Recycled as scrap on the global market	Reuse (structural); closed loop recycling as scrap
Brick	Recycled as RA for fill on/offsite	Reuse; recycle into higher value products
Glass	Crushed and used for RA for fill on/offsite	Reuse; closed loop recycling
Aluminium	Recycled as scrap on the global market	Reuse; closed loop recycling as scrap
PVC	Sent for energy recovery/landfill	Closed loop recycling as scrap
Gypsum	Sent to cement kilns; or spread on land	Closed loop recycling
Softwood	Sent for energy recovery	Reuse; recycled into panelboard and animal bedding
Ceramic	Recycled as RA for fill on/offsite	Higher value recycling e.g into tiles
Chipboard	Sent for energy recovery	Sent for energy recovery (opportunities limited)
Fibreboard	Sent for energy recovery	Sent for energy recovery/landfill (opportunities limited)
Aggregate (loose)	Reuse as RA as fill etc	Reuse as aggregate
Insulation	Sent for energy recovery/ landfill	Closed loop recycling
Vinyl	Sent for energy recovery/ landfill	Closed loop recycling

Table 12: Standard and best practice opportunities for the KPDs

15. Targets

It is highly recommended that to maximise the reuse and recycling of the KDPs that the following materials are segregated on site:

- concrete
- glass
- brick
- steel
- aluminium
- timber (softwood)
- plasterboard
- any hazardous waste

Potential targets for materials are shown in Table 13. Overall, an estimated 98% could be diverted from landfill.

	Reuse	**Recycling**	**Diversion from landfill**
Concrete	0%	98%	98%
Steel	1%	99%	100%
Brick	0%	98%	2%
Glass	6%	90%	96%
Aluminium	30%	70%	100%
PVC	0%	50%	75%
Gypsum	0%	50%	75%
Softwood	50%	20%	100%
Ceramic	0%	98%	98%
Chipboard	0%	0%	90%
Fibreboard	0%	0%	90%
Aggregate (loose)	95%	5%	100%
Insulation	0%	25%	50%
Vinyl	0%	50%	75%

Table 13: Recommended targets per material

During the demolition, details of the actual materials arisings and the waste management methods used should be recorded to compare actual with forecast and to assess performance against the targets set. Following completion of the project, any barriers to achieving the targets should be reviewed to ensure that in future projects these barriers can be overcome.

Appendix A

Sources of embodied carbon figures

The embodied carbon figures have been taken from the freely available ICE Inventory of Carbon and Energy V3 -10th November 2019. This can be downloaded at: https://circularecology.com/embodied-carbon-footprint-database.html. It should be noted that as the original material is not known in detail (in terms of its composition, source etc), then the figures used for CO_2e must be treated with some caution).

Material	**Kg/CO2e**	**Assumption**
Aggregate	0.007	Aggregates and sand, general UK, mixture of land won, marine, secondary and recycled, bulk, loose
Aluminium	6.670	Aluminium General, European Mix, Inc Imports
Block: Concrete: Lightweight	0.093	Concrete block, medium density solid, average strength, per kg
Bricks	0.354	Clay: all data collected
Ceramic	0.780	General
Chipboard	-1.120	Chipboard - including carbon storage
Concrete	0.103	General
Glass	1.663	Glass glazing (double)
Mineral wool insulation	1.280	Mineral wool
Mortar	0.200	Mortar (1:3 cement:sand mix)
Plaster	0.130	General, gypsum
Plasterboard	0.390	Plasterboard
PVC	3.100	PVC General
Softwood	-1.290	Softwood - including carbon storage
Steel (rebar)	1.990	Steel Rebar
Steel (plate)	2.460	Steel Plate
Steel (hot galavanised)	2.760	Steel hot galvanised)
Steel, finished cold-rolled coil	2.730	Steel, finished cold-rolled coil
Woodwool board	0.980	CO2 Only
Vinyl	3.190	Vinyl

Appendix B

Report Authors

Gilli Hobbs is working with Reusefully Ltd and is based in France & UK and has provided technical & expert input to sustainability related projects in the built environment for over 25 years. Until 2021, this was at BRE, where she was Director in the Strategic Advisory team, working across low carbon buildings and building products, circular & lean construction, renewable energy technologies and sustainable communities, in the UK and overseas. During the last year, Gilli has focussed on working with the World Green Building Council, an expert technical assistance to FCO project in India, and a Rapid Evidence Assessment for Defra. She is also an advisor to London Borough of Enfield on the Meridian Water regeneration project and member of various standards committees including CEN TC 350 SC1 Circular Economy (Chair of UK mirror committee), BS 8895 Material efficiency, B/558 Sustainability of Construction Works and CB/101 Service Life Planning.

Dr Katherine Adams has worked in the area of construction resource efficiency for nearly 20 years, mostly at BRE, where she has been instrumental in shaping the construction industry to achieve high levels of diversion of waste from landfill and reducing waste. She has much experience of Pre-refurbishment and demolition audits, having undertaken and reviewed many for various clients, which has involved the development of a robust methodology. She has been responsible for developing waste reporting, including the online system Smartwaste. She enjoys working closely with many elements of the industry, at both a sector and project level. She has recently finished a PhD at Loughborough University looking how circular economy can be embedded in the building sector. She has recently set up a consultancy, Reusefully Ltd, providing advice on circular economy and waste, to the building sectors. She continues to assist BRE and other organisations such as the Alliance of Sustainable Building Products (ASBP).

EUSTON TOWER

Strategy for Material Recovery

December 2023

British Land

The Euston Tower Material Recovery Strategy
Made for British Land by GXN

December 2023

Issue: 05 December 2023
Rev: A

Contents

1

Euston Tower

Introduction

1.1 Background and Purpose

1.1.1 General

The construction sector is known as the one third industry. Responsible for 37% of global energy-related carbon emissions and 33% of global waste, there are few industries more injurious to the planet than the construction industry.

In London it's even more influential. The construction industry consumes 400mt of material every year and generates 10mt of construction and demolition waste, comprising 54% of all London's waste.

It is clear that buildings and cities have a large role to play in addressing this damage. Extending the life of buildings and recovering and reusing materials at the end of their life can help reduce the demand for virgin materials and waste arising in the built environment.

This document is the Material Recovery Strategy, and forms part of the holistic circular economy strategy for the redevelopment of Euston Tower. It is an appendix to the Circular Economy Statement that forms part of the full planning application.

1.1.2 Purpose of this document

The purpose of this strategy document is to:

- Identify the materials in the existing building quantitatively and qualitatively
- Develop solutions that minimise waste, avoid carbon emissions, and generally maintain or increase the value/ utility of materials
- Tell a circular economy story through the reuse and upcycling of materials from the existing tower
- Establish best in class routes for handling the deconstruction materials.

Figure 1.1 (Opposite) Statistics for construction materials and waste in London. Data from GLA's Design for a Circular Economy v

400mt

materials consumed annually by built environment sector in London

54%

of total London waste

10mt

construction and demolition waste generated annually in London

1.2 Aspirations and Targets

1.2.1 A holistic approach

The vision for Euston Tower is to create a world leading science, technology and innovation building and public realm for Camden and the Knowledge Quarter that inspires, connects and creates opportunities for local people and businesses.

The disused tower represents an ideal opportunity to achieve this vision, by transforming the tower and its surrounds to be highly sustainable and fit for the future, while offering a number of benefits to its direct users and to the community.

A tiered approach to developing a holistic sustainability framework is proposed for the proposed development. Planning Policy and British Land's ambitious sustainability brief are used to establish a high quality baseline, including many aspirations that relate directly to the Circular Economy. This is underpinned and verified by targeting leading certification schemes, with the proposed development aspiring for BREEAM "Outstanding" certification, seeking credits across the materials and waste categories.

Best in class sustainable solutions are proposed throughout the scheme, cutting across all aspects of the Sustainability Brief, with a strong focus on solutions that avoid carbon emissions, reduce waste, and promote the circular economy. These concepts are held up as inspirations that guide decision making on the project.

Together the proposed development aims to be an exemplar of circular economy thinking and design for office buildings, both considering working with existing buildings and materials, and avoiding premature obsolescence and waste in the future.

1.2.2 Targets and KPIs

The key targets and KPIs relating to material recovery are outlined in Figure 1.3. As a response to planning policy, the proposed development is committed to the following targets to minimise waste in deconstruction and construction:

- Targeting 98% of demolition waste to be upcycled, recycled, or downcycled, exceeding policy target
- Targeting 96% of construction waste to be upcycled, recycled, or downcycled, exceeding policy target
- Targeting 95% of excavation waste to beneficial use, meeting policy target.

The project brief targets are highly ambitious, generally exceeding the planning policy targets with regard to circular economy. It is recognised that some of the targets will prove challenging to achieve, however, it is the intention of the proposed development to strive towards the project brief targets as far as technically, practically and economically possible.

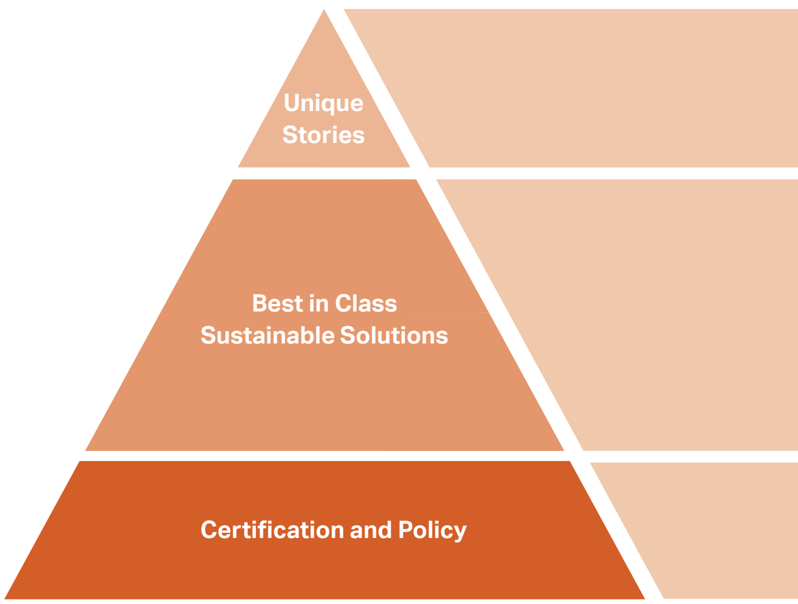
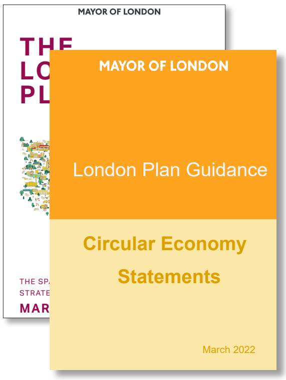
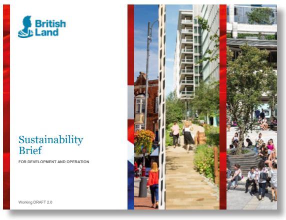


Figure 1.2 The proposed development's approach to delivering a sustainable building for now and the future

Circular Economy Targets for Material Recovery





Policy SI 7 (and SI 8)
Reducing waste and supporting the circular economy
- Design for deconstruction and reuse of materials
- Divert waste from landfill (via reuse, recycling or recovery)
- Demolition and construction waste - 95% to reuse, recycling, recovery
- Excavation 95% 'beneficial use'
- Use efficient demolition equipment.

Policy SI 7
LPG Circular Economy Statement
- Circular Economy Statement (incl. pre-demolition audit, pre-redevelopment audit, and GLA Template)
- Follow GLA design approaches for existing and new buildings.

Project Brief
The British Land Sustainability Brief 2030
- Waste diverted from landfill and incineration to be minimum 100% (by mass)
- Waste recycled via upcycling to be minimum 90% (by mass)
- Waste recycled via downcycling to be maximum 10% (by mass)
- Report quantity of waste reused, composted or recycled.

Figure 1.3 Circular economy targets relating to material recovery for the proposed development

Inspirational

Unique Stories: Net Zero Carbon Frontrunner; Circular Economy Pioneer; Eudaimonia and Delight

Operational

Best in Class Sustainable Solutions: Energy & Carbon; Circular Economy & Materials; Water; Biodiversity; Wellbeing; Community; Climate Resilience; Employment; Education; Local Business

Foundational

Certification and Policy: BREEAM; WELL; NABERS UK; Project Brief; Policy

1.3 Approach

1.3.1 Integrated approach to carbon and materials

The overarching principles that have been developed for the material strategy are shown in Figure 1.4.

Carbon emissions and waste reduction
The first principle is an integrated approach to carbon and resources. A focus is put on the larger material fractions that can be reused or recycled, especially the materials that are still heavily reliant on raw material extraction and/or the material fractions with carbon-intensive production, such as concrete, glass, and aluminium. Decisions are made based on how best to minimise carbon emissions and avoid waste.

Material transparency and provenance
The second principle is to provide transparency around the process by being able to demonstrate where waste materials have gone, and how they've been reused/recycled. This entails mapping out and keeping close engagement with all links in the waste chain to capture the steps along the way. It enables the design team to make informed decisions to best support material reuse and recycling at the highest value.

Innovation for Greater London
The third principle is to drive innovation for Camden, Greater London, and beyond. This is achieved by exploring alternative routes for recovering materials, compared to what is currently established as standard practice. By innovating and prototyping approaches on some of difficult-to-handle materials, the proposed development seeks to help the industry accelerate its transition towards a circular economy. Key to the project team is sharing any learnings, and the findings from these prototype processes will be shared for others to build on.

Overarching Approaches for the Material Recovery Strategy

Material Transparency and Provenance

Being able to demonstrate where waste materials have gone, and how they've been reused / recycled

Carbon Emissions and Waste Reduction

Reducing carbon emissions and waste through strategic reuse / recycling of waste

Innovation for Greater London

Innovation and trialling to help the industry accelerate its transition towards a circular economy

Figure 1.4 Overarching approaches for material recovery strategy

1.3.2 A material reuse and recycling hierarchy

The material strategy hierarchy adopted for the proposed development can be seen in Figure 1.5. Here the "Reuse Some Stuff" layer is added to guide how to best take advantage of the existing resources on site.

The materials removed in the deconstruction have been thoroughly analysed and the guiding hierarchy has been used to establish the best end of life route for each material. The hierarchy preferences reuse, upcycling, and recycling, with downcycling as a last resort (save for landfill). Given the quality of the existing materials, the proposed development has focussed on establishing routes for the key deconstruction materials.

A definition of these pathways can be found in Figure 1.6.

1.3.3 Process for assessing end of life strategy

To evaluate strategies for the material end of life routes, a Pre-demolition Audit has been prepared, supported by the building surveys carried out for the Feasibility Study, and complemented by a Matterport scan of the existing building.

From the Pre-demolition Audit, the material quantities and conditions have been assessed, and from a map of local waste chains, standard and best practice material end of life routes are evaluated. The key recoverable products are identified through the these steps.

This process is detailed in Section 2 of this document.

Material Reuse and Recycling Hierarchy

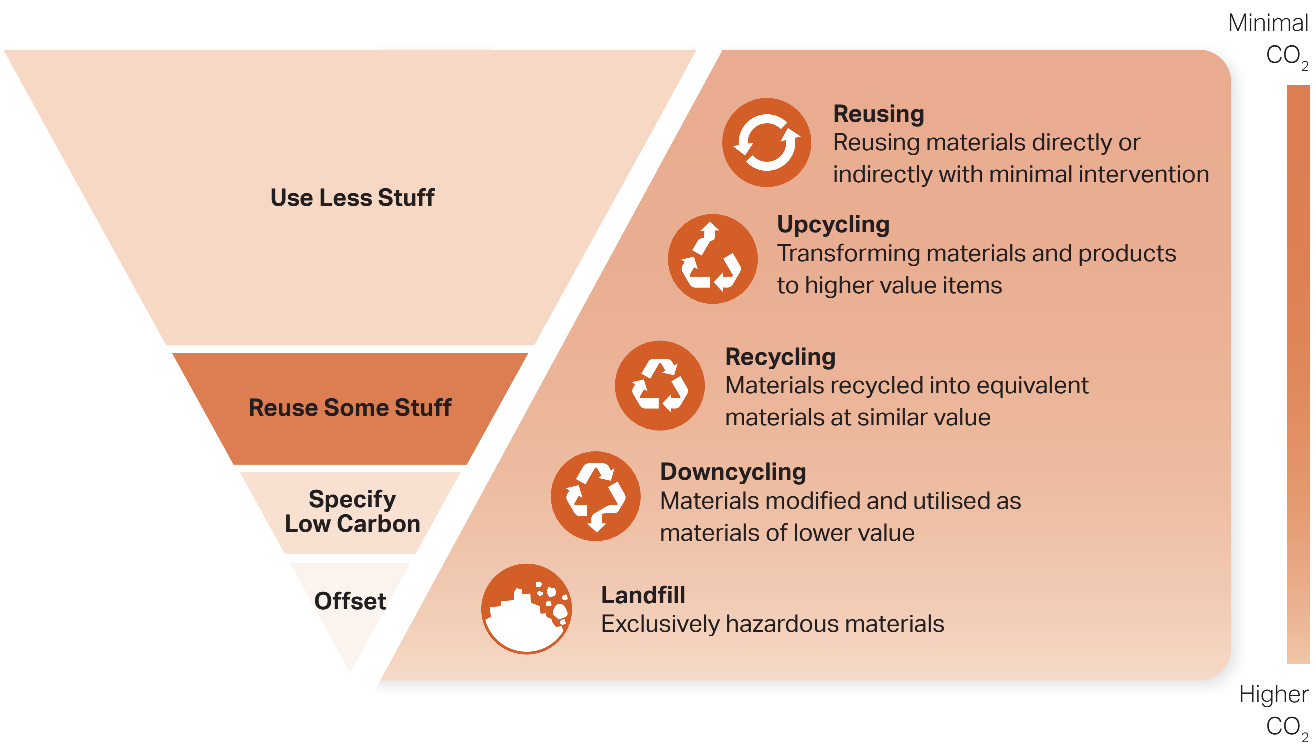


Figure 1.5 Material reuse and recycling hierarchy

End of Life Route Definitions

Reuse

Reusing maintains value and functionality.
Direct or indirect reuse of products, components, or materials with little or no loss of value and minor interventions to the material. This entails checking, cleaning, repairing, and refurbishing whole items or parts.

Upcycling

Upcycling increases value.
Upcycling is transforming products, components, or materials into higher quality and/or higher value items. This entails transforming and re-manufacturing in ways that reduces demand for extracting raw materials from the environment.

Recycling

Recycling maintains value and quality.
Recycling is the process of recovering materials for the original or alternative purposes. The materials recovered feed back into the manufacturing process as crude feedstock.

Downcycling

Downcycling diminishes value and quality.
If a process results in an output of lower value and/or quality, this is referred to as downcycling. It is the least preferable (save for landfill) route, but can still be better than standard practice for certain products and materials.

Figure 1.6 End of life route definitions

Identifying End of Life Routes for Deconstruction Materials

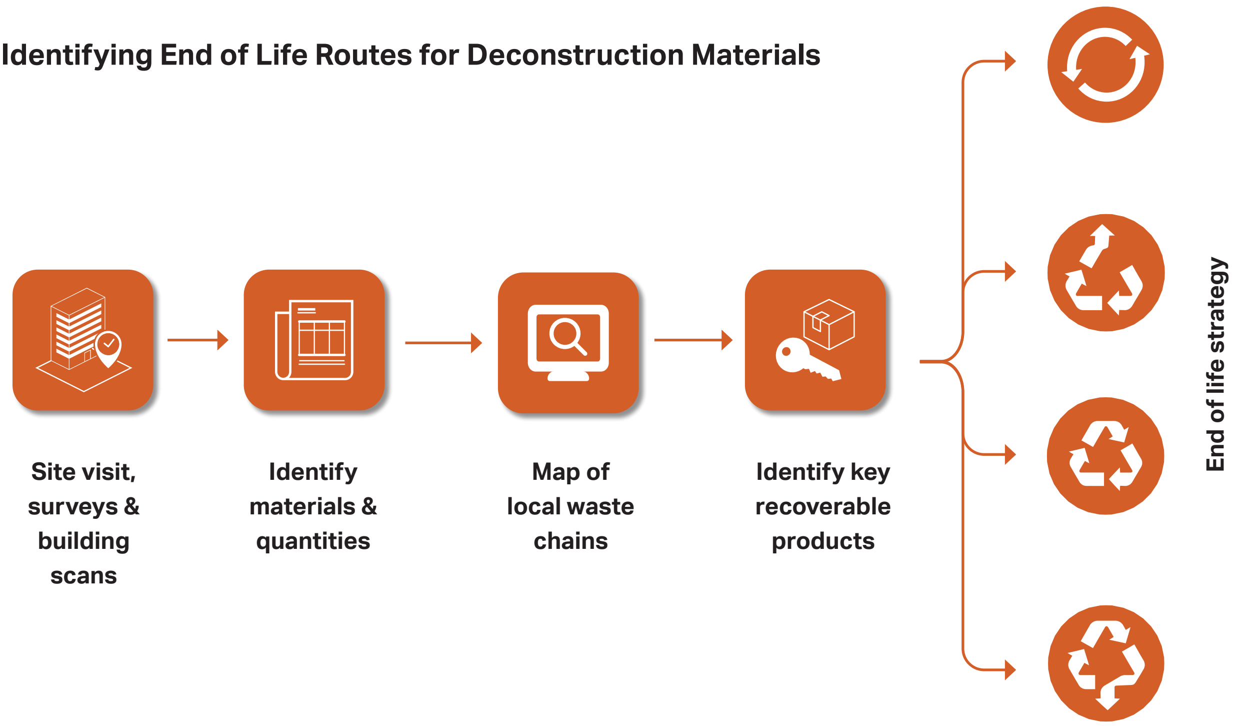


Figure 1.7 Process for identifying end of life routes for deconstruction materials

2

Euston Tower

Holistic Approach

2.1 Surveys and Scans

2.3.1 General

Many of the original drawings and documentation for the existing building have been lost. Several intrusive and non-intrusive surveys have been conducted, along with several site visit surveys to provide information of the existing building.

These surveys, along with dedicated site visits, have been used as the basis for assessing material quantities and conditions for the Pre-demolition Audit, and act as a basis for this strategy.

2.3.2 Facade

A condition survey of the existing facade was conducted in 2018, compromising five abseil drops at select locations on the tower. Due to insufficiencies in the existing documentation, later site visit surveys were conducted to visually assess condition and better understand the existing systems build ups.

2.3.3 Structure

An extensive structural investigation was commissioned to Sandberg at the end of 2019 to test the reinforced concrete elements for concrete strength and condition, and to confirm the location of reinforcement and existing concrete cover. Testing covered 13 storeys including the ground floor and basement. In 2021, targeted excavation work was conducted under the existing tower's foundation to reveal the distribution, quality, and composition of the existing piles.

2.3.4 Others

A full asbestos survey was carried out in 2020 ahead of the strip out works, which identified some asbestos that needed to be removed, some of which was completed during the strip out works. The remaining asbestos located within risers and basement plant rooms will be removed upon full strip out works under any main works development.

A Matterport survey was commissioned in 2021 to capture a 3D photo-realistic scan of all levels of the existing tower. The scan was carried out by Plowman Craven. A survey model of the full tower was prepared along with the Matterport scans.

3D Scan of a Typical Floorplan using Matterport

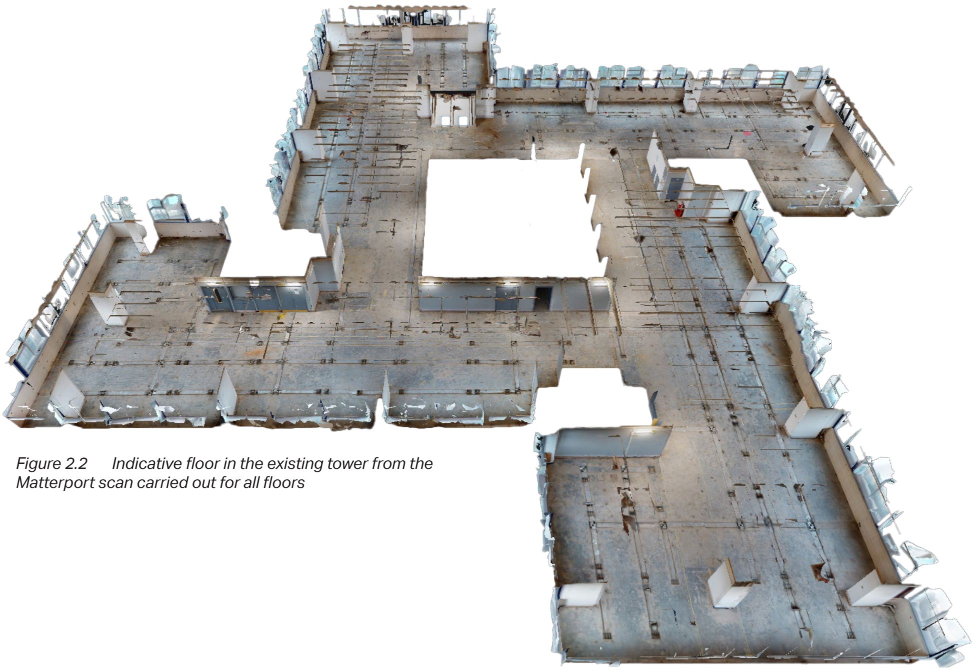


Figure 2.2 Indicative floor in the existing tower from the Matterport scan carried out for all floors

Structural Survey of Euston Tower

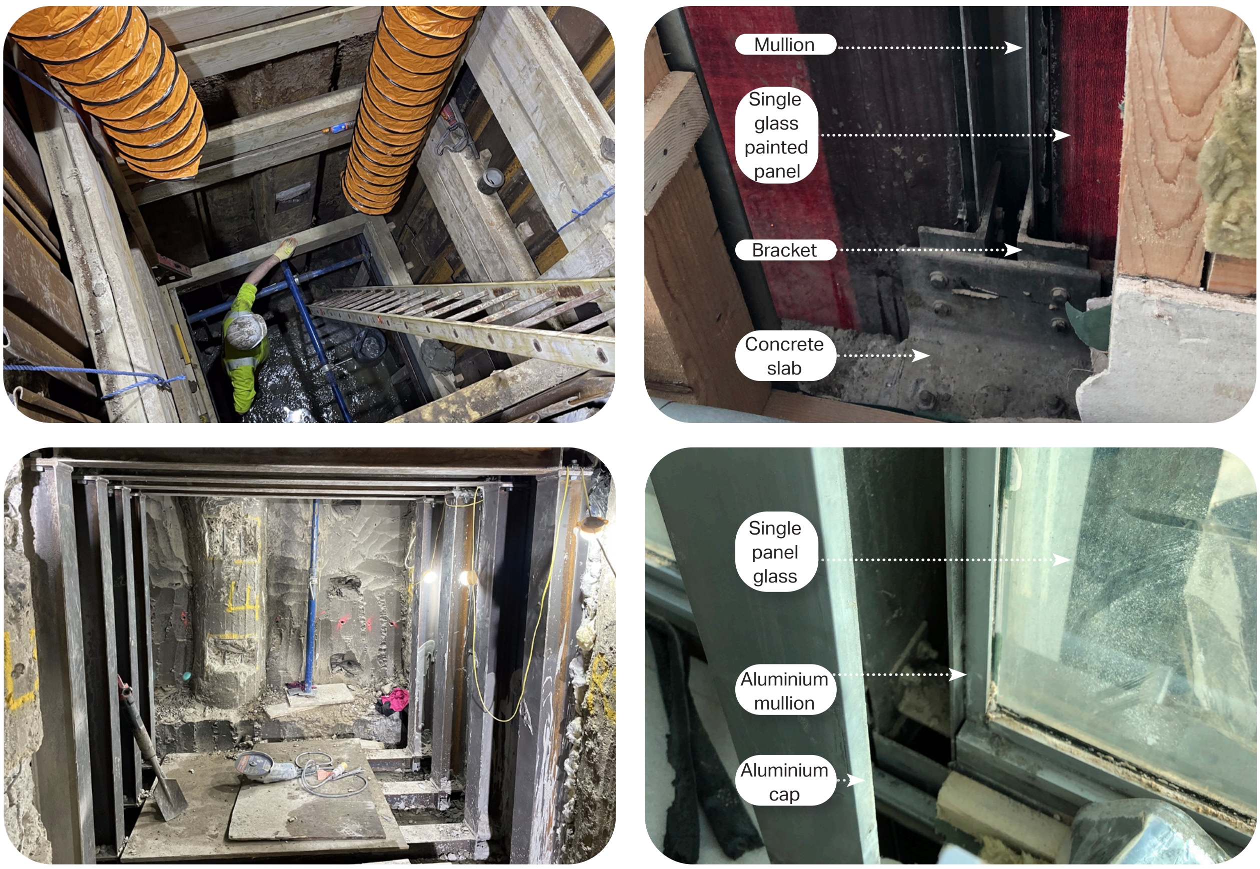


Figure 2.1 Images from structural survey of pile foundation (left) and facade survey (right)

2.2 Pre-demolition Audit

2.2.1 General

A Pre-demolition Audit (PDA) was conducted in accordance with GLA Circular Economy Statement Guidance. The audit was undertaken on the 6th of January 2022 and 10th February 2022 by Katherine Adams and Gilli Hobbs of Reusefully Ltd.

The PDA was carried out at a point in time when the degree of deconstruction of the existing tower was uncertain (prior to the Feasibility Study) and therefore initially accounted for all existing materials above ground. The quantities reflected in this report consider the extent of retention commensurate with the design proposal. Specifically retention of the existing substructure (14,369 tonnes of concrete and steel equivalent to 1,683 tCO_2e) as well as the central core (2,898 tonnes of concrete and steel equivalent to 552 tCO_2e).

2.2.2 Source data and assumptions

The PDA consisted of a non-invasive visual survey of the building along with the Matterport files, and facade and structural surveys. Certain areas were inaccessible, such as the ground floor units, and not all floors were visited. Hence, construction details and materials have been inferred based on typical practice. Survey notes and photographs were taken, and plans of the buildings were supplied (though not detailed floor layouts). In addition, demolition and original architectural and engineering drawings were used.

On the basis of information gathered and provided, an analysis of materials arising from a full demolition has been undertaken (noting that this is *not* the preferred option for the proposed development), with results reported in both weight and volume. The weight has been calculated using standard density figures for the materials identified. The Inventory of Carbon and Energy (ICE) database has been used for calculating the embodied carbon emissions related to the materials. The embodied carbon assumptions are listed in the PDA in Appendix A to the Circular Economy Statement.

2.2.3 Outputs from the PDA

The outputs of the PDA provided the team with the following:

- An understanding of the types and amounts of products and materials arising during the demolition
- Key parameters for products and elements to identify opportunities for reuse
- Advise on optimising the management of products and materials from the demolition, and 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
- Details of the embodied carbon of the materials resulting from possible demolition
- Technical advice on the reuse of products and recycling of material on site
- Data to help with populating the Resource Management Plan and in support of the BREEAM assessment and the Greater London Authority Circular Economy Statement
- Advise on targets for reuse and recycling for products and materials arising during the demolition.

Capturing and Documenting Existing Materials

PRE-DEMOLITION AUDIT REPORT

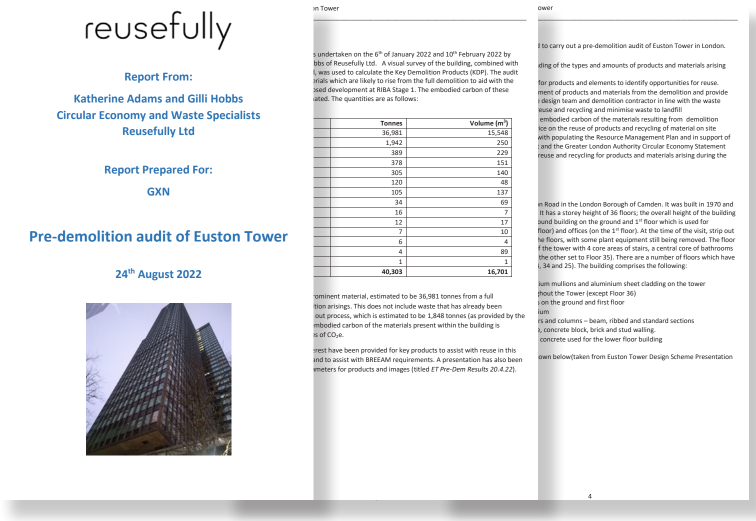


Figure 2.3 Pre-demolition Audit report. Refer to Appendix A of the Circular Economy Statement

REMOVED MATERIALS

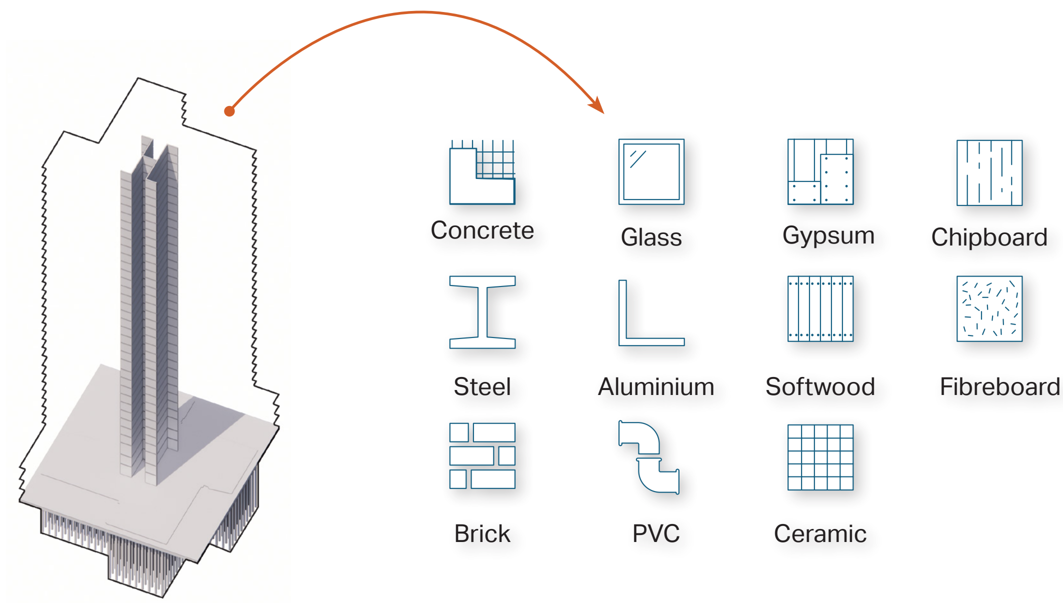


Figure 2.4 The central core and substructure are retained as part of the proposed development

2.2.4 Stripped out materials

The majority of the interior finishes, fit-out and services have already been stripped out of the existing building.

Information has been provided by the contractor, on the amount and type of waste that has been produced from the strip out process to December 2021. This has been logged on to BRE's SmartWaste system and this is captured in the Pre-demolition Audit.

As of the 21st of December 2021, 1,848 tonnes of waste had been produced and besides the 0.06 tonnes sent to disposal, the remainder (100%) has been diverted from landfill. The quantities of the materials along with the route of treatment have been captured. Figure 2.6 shows the destinations of the stripped out materials.

Out of the stripped materials, 4% were reused. This accounts for the existing carpets that were reused by community organisations via Globechain.

Most of the materials were sent to waste transfer stations such as Westminster Waste, Suez, and Powerday for further sorting or recycling.

Other routes included the following:

- Metals (41%) were sent directly to metal recycling sites
- Concrete was also sent directly for recycling
- Plasterboard/gypsum and tiles/ceramics (17%) were sent to recovery
- Mixed construction waste and timber (39%) was sent to energy recovery.

Figure 2.5 Stripped out materials end of life route (totals in tonnes)

Stripped out Material Quantities and Waste Destinations

Material	Quantity (tonnes)	Company
Oils	1	MAG Properties Services Ltd
Mixed Construction & Demolition waste	526.5	Powerday Plc, Suez Recycling & Recovery South East Ltd, Westminster Waste
Plasterboard/Gypsum	222.2	Powerday Plc, Suez Recycling & Recovery South East Ltd, Westminster Waste
Timber	192.9	Powerday Plc, Suez Recycling & Recovery South East Ltd, Westminster Waste
Carpets	69.5	CCORRN (Cambridgeshire Community Reuse and Recycling Network) via Globechain, Hawa Trust via Globechain
Inert	30.0	Recycled Material Supplies Ltd - Sunshine Wharf
Floor Coverings (soft)	26.9	European Metal Recycling – Willesden, Worcester Recycling Croydon Ltd
Tiles & Ceramics	23.8	MSK Waste Management & Recycling Ltd
Concrete	15.0	Recycled Material Supplies Ltd - Sunshine Wharf
Metals	739.5	European Metal Recycling,Southwark Metals Ltd, Suez Recycling & Recovery South East, Westminster Waste
Refrigerants	0.37	MAG Properties Services Ltd

Figure 2.6 *Summary of stripped out materials quantities and waste destinations*

2.2.5 Key demolition products (KDPs)

Overall, there is an estimated 37,420 tonnes (15,540 m³) of material arising from the deconstruction[1].

The following are the largest key demolition products (KDPs) by mass, as shown in Figure 2.7 and Figure 2.8:

- Concrete 34,237 tonnes
- Steel 1,806 tonnes
- Brick 389 tonnes
- Glass 378 tonnes
- Aluminium 305 tonnes
- PVC 120 tonnes
- Gypsum 105 tonnes
- Softwood 34 tonnes.

When considered by volume, the following are the largest KDPs:

- Concrete 14,405 m³
- Steel 233 m³
- Brick 229 m³
- Glass 151 m³
- Aluminium 140 m³
- Gypsum 137 m³
- Insulation 89 m³.

The top five materials in the existing building make up 98% of all existing materials (by mass).

The materials are quantified in historical embodied carbon. This approach has been taken to provide a focus on not just the largest material fractions by mass, but also the material streams with largest carbon emissions impact, and therefore the important new material production streams to address.

Each of these KDPs are described in Section 3 detailing their arisings, likely management options, and next steps (where applicable) to support reuse and/or higher value recycling.

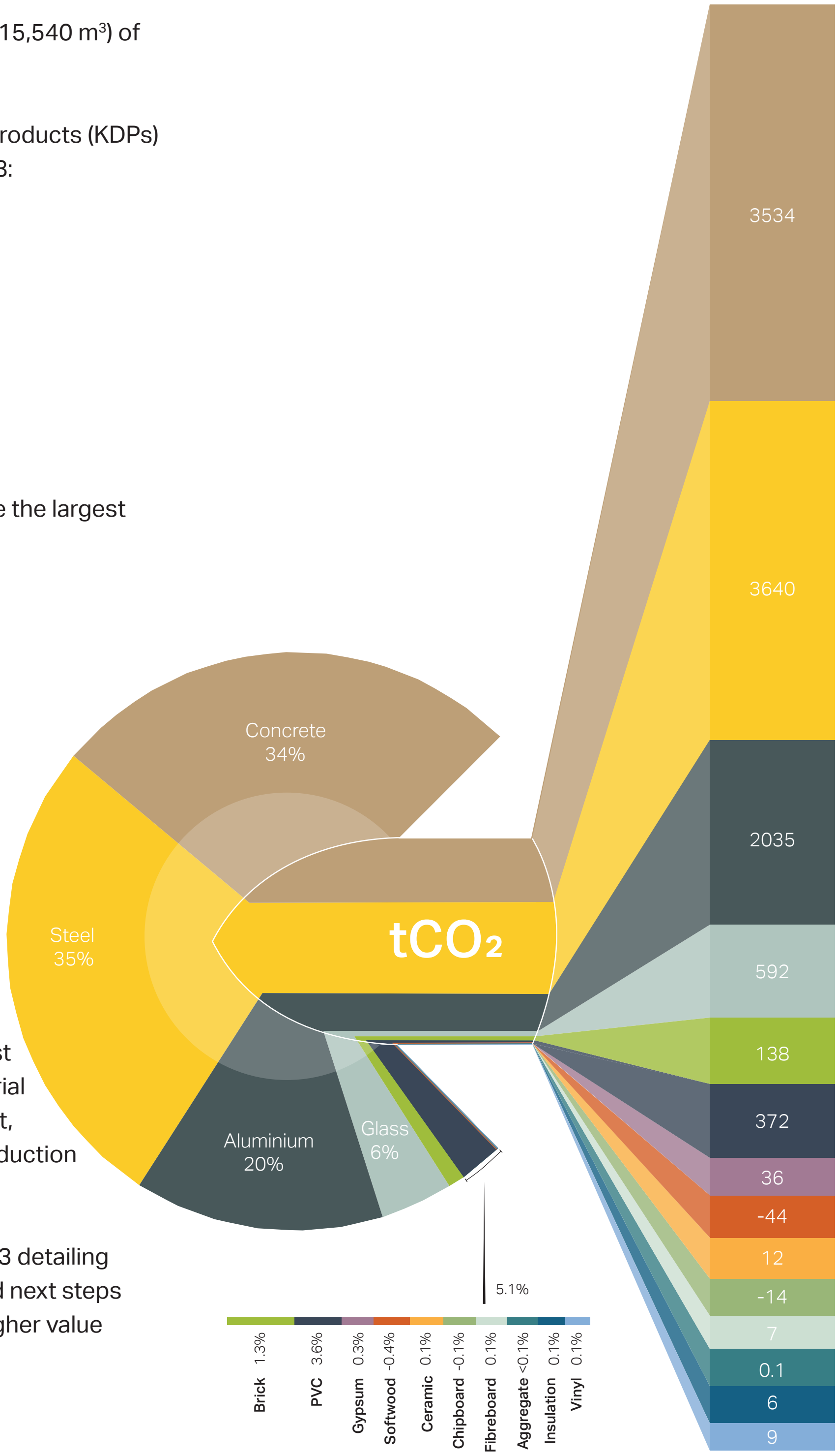


Figure 2.7 Key demolition products (tonnes CO_2e)

[1] *Figures considering retention of the existing central core in the proposed development.*

Overview of Materials, Products, and Quantities

Concrete

Volume: 14,405 m³
Weight: 34,237 t
Embodied carbon: 3,534 tCO₂e

	Volume	Weight	Impact		Volume	Weight	Impact
Floors slab	5,064 m³	12,153 t	1,252 tCO_2	Staircase	477 m³	1,146 t	118 tCO_2
Columns	1,815 m³	4,355 t	449 tCO_2	Roof deck	345 m³	691 t	71 tCO_2
Beams	1,681 m³	4,034 t	416 tCO_2	Blockwork	169 m³	237 t	22 tCO_2
Walls*	2,810 m³	6,744 t	695 tCO_2	Mortar	53 m³	101 t	20 tCO_2
Ribbed slab	1,987 m³	4,769 t	491 tCO_2	Paving slabs	3 m³	7 t	1 tCO_2

Steel

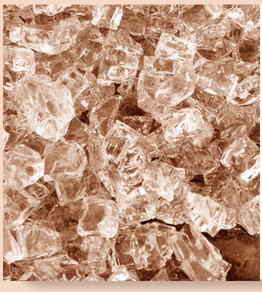
Volume: 233 m³
Weight: 1806 t
Embodied carbon: 3,640 tCO₂e

	Volume	Weight	Impact		Volume	Weight	Impact
Columns rebar	81 m³	625 t	1243 tCO_2	Glazing Support	2 m³	17 t	46 tCO_2
Floorslab rebar	34 m³	266 t	528 tCO_2	Balustrade	1 m³	10 t	28 tCO_2
Beams rebar	26 m³	206 t	409 tCO_2	Handrail	1 m³	8 t	22 tCO_2
Ribbed slab rebar	55 m³	409 t	855 tCO_2	Studwork Joists	1 m³	5 t	15 tCO_2
Walls rebar*	27 m³	210 t	417 tCO_2	Studwork Channel	0 m³	2 t	5 tCO_2
Steel Deck	3 m³	27 t	66 tCO_2	Staircase rebar	0 m³	1 t	2 tCO_2

Aluminium

Volume: 140 m³
Weight: 305 t
Embodied carbon: 2,035 tCO₂e

	Volume	Weight	Impact		Volume	Weight	Impact
Curtain Walling	36 m³	90 t	603 tCO_2	Frames	4 m³	11 t	75 tCO_2
Panels	33 m³	87 t	580 tCO_2				
Second. Frame	52m³	78 t	520 tCO_2				
Mullions	9 m³	23 t	153 tCO_2				
Canopy	6 m³	16 t	105 tCO_2				



Glass

Volume: 151 m³
Weight: 378 t
Embodied carbon: 592 tCO₂e

	Volume	Weight	Impact		Volume	Weight	Impact
Facade (Tower)	68 m³	169 t	244 tCO_2	Doors (2nd)	0.9 m³	2 t	4 tCO_2
Secondary Glazing	64 m³	161 t	267 tCO_2	Blue Panels	0.4 m³	1 t	2 tCO_2
Glass (Lower)	7 m³	18 t	29 tCO_2	Glass Feature	0.2 m³	0.5 t	0.8 tCO_2
Windows (lower)	9 m³	22 t	37 tCO_2	Staircase	0.1 m³	0.3 t	0.6 tCO_2
Atrium	2 m³	4 t	7 tCO_2	Clear Panel	0.1 m³	0.2 t	0.3 tCO_2

Others

Volume: 611 m³
Quality: 694 t
Embodied carbon: 517 tCO₂e

	Volume	Weight	Impact		Volume	Weight	Impact
Brick	229 m³	389 t	138 tCO_2	Fireboard	10 m³	7 t	7 tCO_2
Softwood	69 m³	34 t	-44 tCO_2	Aggregate	4 m³	6 t	0 tCO_2
PVC	48 m³	120 t	373 tCO_2	Insulation	89 m³	4 t	6 tCO_2
Gypsum	137 m³	105 t	36 tCO_2	Vinyl	1 m³	1 t	4 tCO_2
Chipboard	17 m³	12 t	-14 tCO_2	Ceramic	7 m³	16 t	12 tCO_2

**Quantity differs from what is recorded in the Pre-demolition Audit as this document accounts for retention of the existing central core in the proposed development.*

Figure 2.8 Overview of volume and tonnes CO_2e of key demolition products by material types and products

2.3 Material Flows

The material flow diagram is used as a structured/methodical framework for decision making. The materials are split up and evaluated at component/product level where the quantities or historical embodied carbon emissions are visualised in the size of the flow. The materials are evaluated at component level rather than total mass in order to provide a better basis for reuse and a more granular evaluation of the end of life routes.

2.3.1 Standard material flow

A business as usual (standard practice) route is specified for each of the materials in the Pre-demolition Audit.

The flow chart in Figure 2.9 illustrates the likely distribution of the material products/components in the six defined end of life routes, with the size of the flow representing the estimated historical embodied carbon emissions.

The standard practice flow is defined to evaluate the impact of using the established waste chains, and also to identify potential areas of improvement.

Concrete
Concrete makes up the majority of the material by embodied carbon (6,029 tCO_2e). The standard practice for treating concrete waste is to downcycle it, by crushing it down for use as recycled aggregate in lower value products such as hard core, fill or in landscaping.

Similarly, brick and ceramics would also be crushed as recycled aggregate for fill.

Steel
Steel makes up the second largest material group arising from the deconstruction, and is a material with high embodied carbon emissions (4,113 tCO_2e). The current standard practice for treating steel is to recycle it as scrap on the global market.

Glass
Though glass is recyclable, the current standard practice for building glass is to downcycle it. Because of the difficulty of providing uncontaminated cullet (crushed glass used as feedstock in flat glass production), most post-consumer building glass waste does not go back into flat glass production, but is instead used in road paint or insulation production.

This process is strictly downcycling.

Aluminium
Aluminium is usually treated in a similar manner to steel, in that it will be sent to a scrap merchant, where it will be sorted, sheared (cutting large pieces), shredded, graded, and baled. Secondary aluminium refiners will typically convert most of the materials into foundry ingot to produce aluminium castings.

If the aluminium alloy is degraded in this process, this would strictly be considered downcycling.

Other
The majority of the smaller material fractions arising from the deconstruction would usually be sent for energy recovery (PVC, softwood, chipboard, fibreboard, insulation and vinyl).

Standard Practice End of Life Routes for Existing Materials

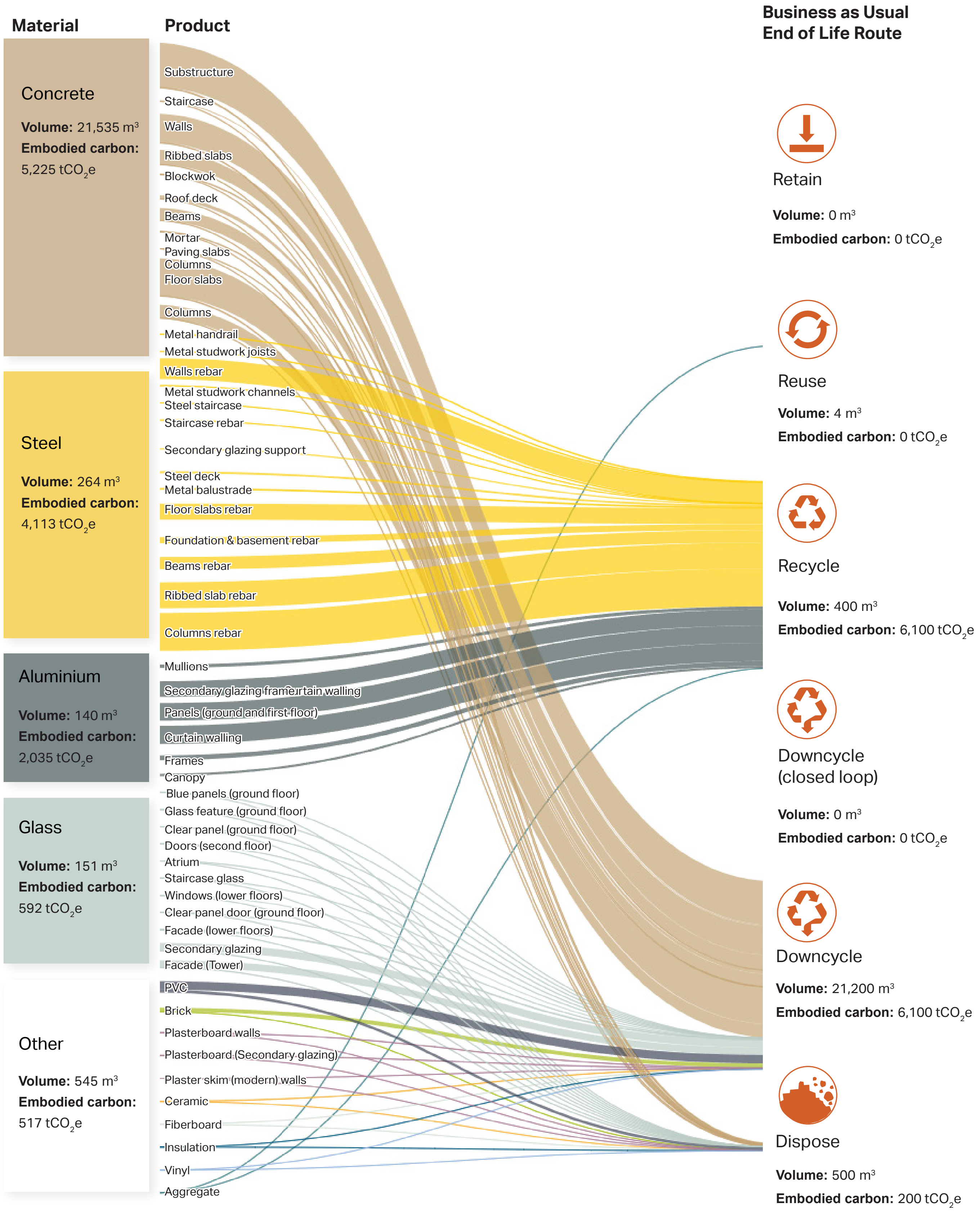


Figure 2.9 Business as usual end of life routes for existing materials (including existing foundation and central core)

2.3.2 Local waste management

To help identify the best end of life routes for the deconstruction products, the local waste chains have been mapped out.

The ambition is to use the local waste map as a means of informing the best routes for treatment, and assist with the ambition of proving transparency around the material strategy. In order to understand the standard practice routes of waste treatment, a focus has been put on mapping as many of the relevant links in the waste chain as possible.

The local waste map seen in Figure 2.10 shows the potential waste streams for the main material groups, glass, steel, concrete and other mixed construction waste. This mapping exercise is a starting point at understanding the waste streams, and will be expanded once a demolition contractor is appointed.

The decision tree in Figure 2.11 is applied across the various material streams to ensure the waste is treated at the highest value and as locally as possible. In collaboration with partners from the waste chain, the existing materials and components have been evaluated using the decision tree to move them as far up the value chain as possible.

Sketch Local Waste Management Map

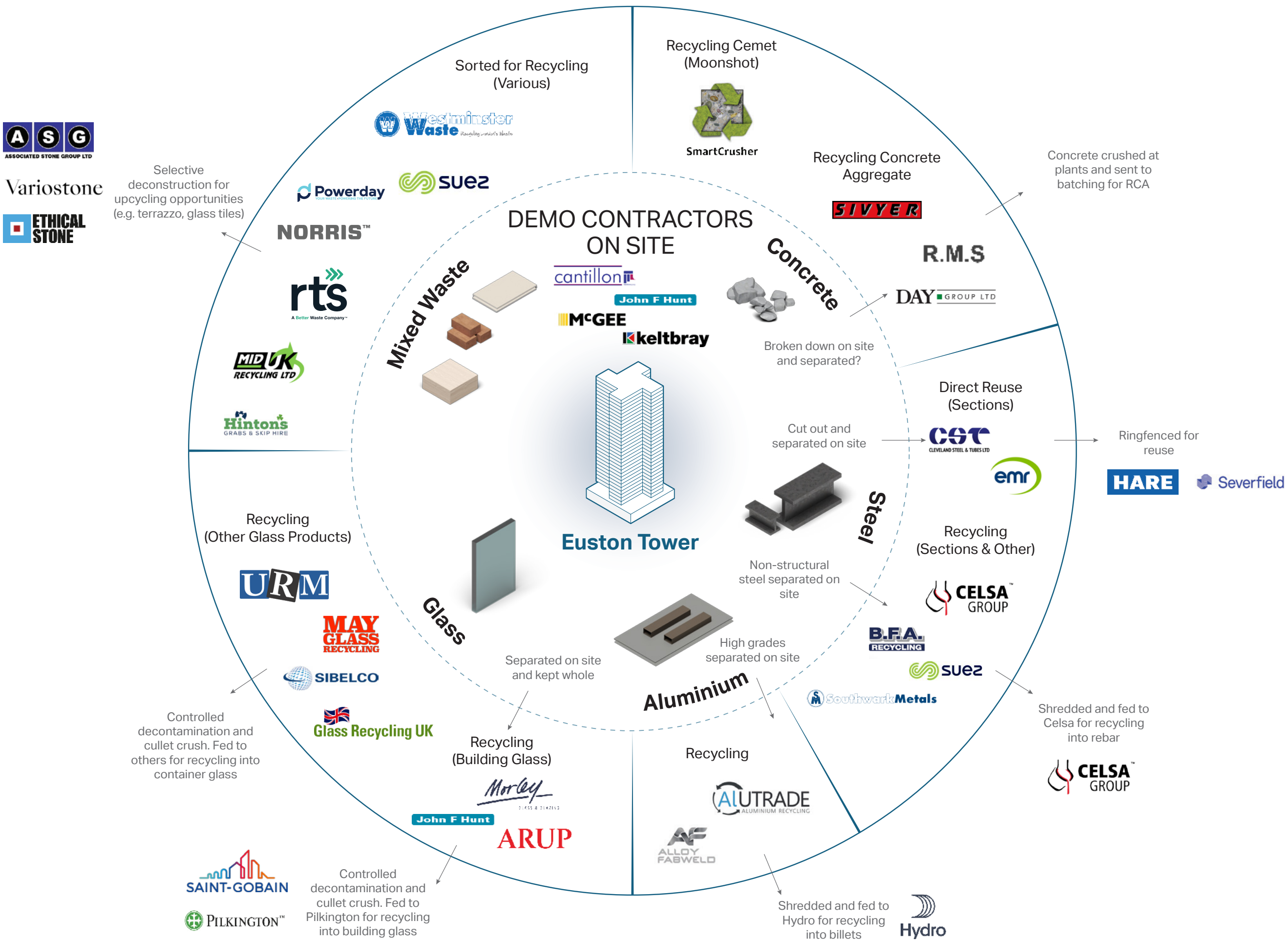


Figure 2.10 Early sketch of a local waste map used to understand waste stream destinations

Decision Tree for Determining Material End of Life Routes

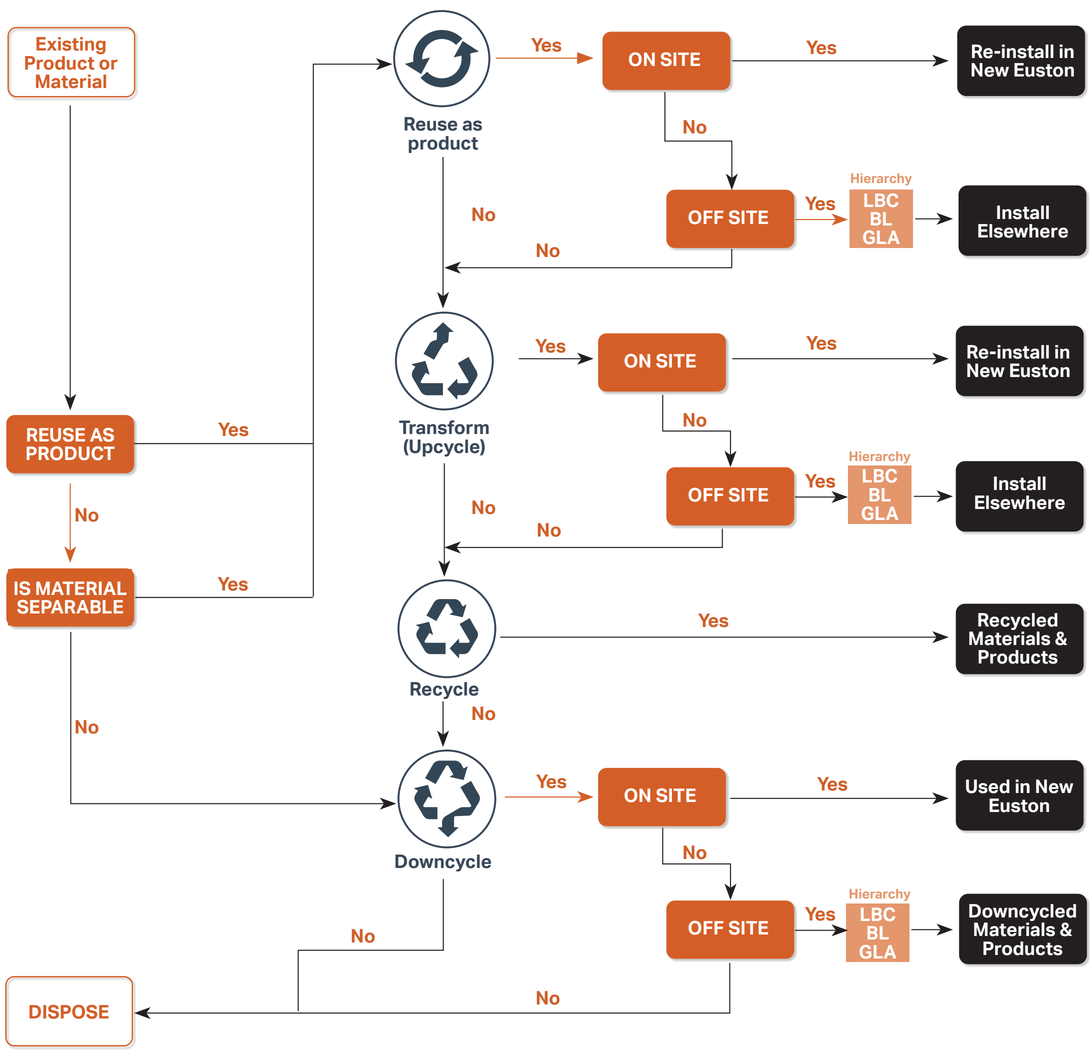


Figure 2.11 Decision tree to evaluate material end of life routes

2.3.3 Proposed material flow

A proposed material flow can be seen in Figure 2.12. The proposed flow brings ca. 14,300 m^3 of material out of downcycling and into higher value end of life routes.

This is one of many possible proposed flows, and can be considered a "best case" scenario if the prototyping trials prove successful.

Concrete and steel
The retention of the foundation, basement and central core brings all of the ca. 6,000 m^3 of the concrete from being downcycled, and 13 m^3 rebar from recycling, to direct reuse in the proposed development.

It is an ambition to test the feasibility of cutting out and reusing some of the existing concrete slabs. If successful, this could *potentially* move a large part of the concrete and rebar from downcycling and recycling into reuse. This is further detailed in Section 3.

Out of the 1,806 tonnes of steel, 96% is found in the rebar. Because of this, there is a limited opportunity to directly reuse the steel from the building, unless it is part of the reused concrete elements. Beyond this, the best use of the existing rebar is to feed it back for recycling in steel production.

The remaining concrete is likely to be crushed down. To use the concrete at highest value, it is suggested that some of this will be used as recycled concrete aggregate (RCA) in new concrete.

It is not currently possible in the UK market[1], to separate out the cement from concrete. Accordingly concrete waste cannot be recycled back into a concrete product. It can only be added as RCA (or similar), and this does not avoid the need for virgin cement which is the carbon-intensive element of concrete making. Therefore, this is indicated as closed loop downcycling in the flow diagram, where RCA could theoretically be continuously "closed loop downcycled" from concrete products.

[1] Engagement has been made with SmartCrusher to understand the potential of their technology becoming available outside of the Dutch market.

Glass
The existing facade glass is not in a condition to be directly reused. The best use is to recycle it back into flat glass production. This would bring the majority of the glass fraction from downcycling up to recycling.

As noted in Section 2.3.1, this is not standard practice. The feasibility of doing so currently being tested. This process is further detailed in Section 3.

Aluminium
The aluminium is mainly found in the existing facade frames. Since it is not possible to reuse the facade directly, in whole or in part, the best route is to feed it back into the aluminium production for new extrusions. Key in this process is ensuring adequate segregation of the aluminium alloys, so that high quality alloys are not contaminated. This process is further detailed in Section 3.

Others
Some of the remaining products, and the smaller items within the glass and concrete fractions, are addressed in Section 4 for reuse and upcycling as products. These are not currently captured in the flow diagram.

Proposed Routes for Existing Materials

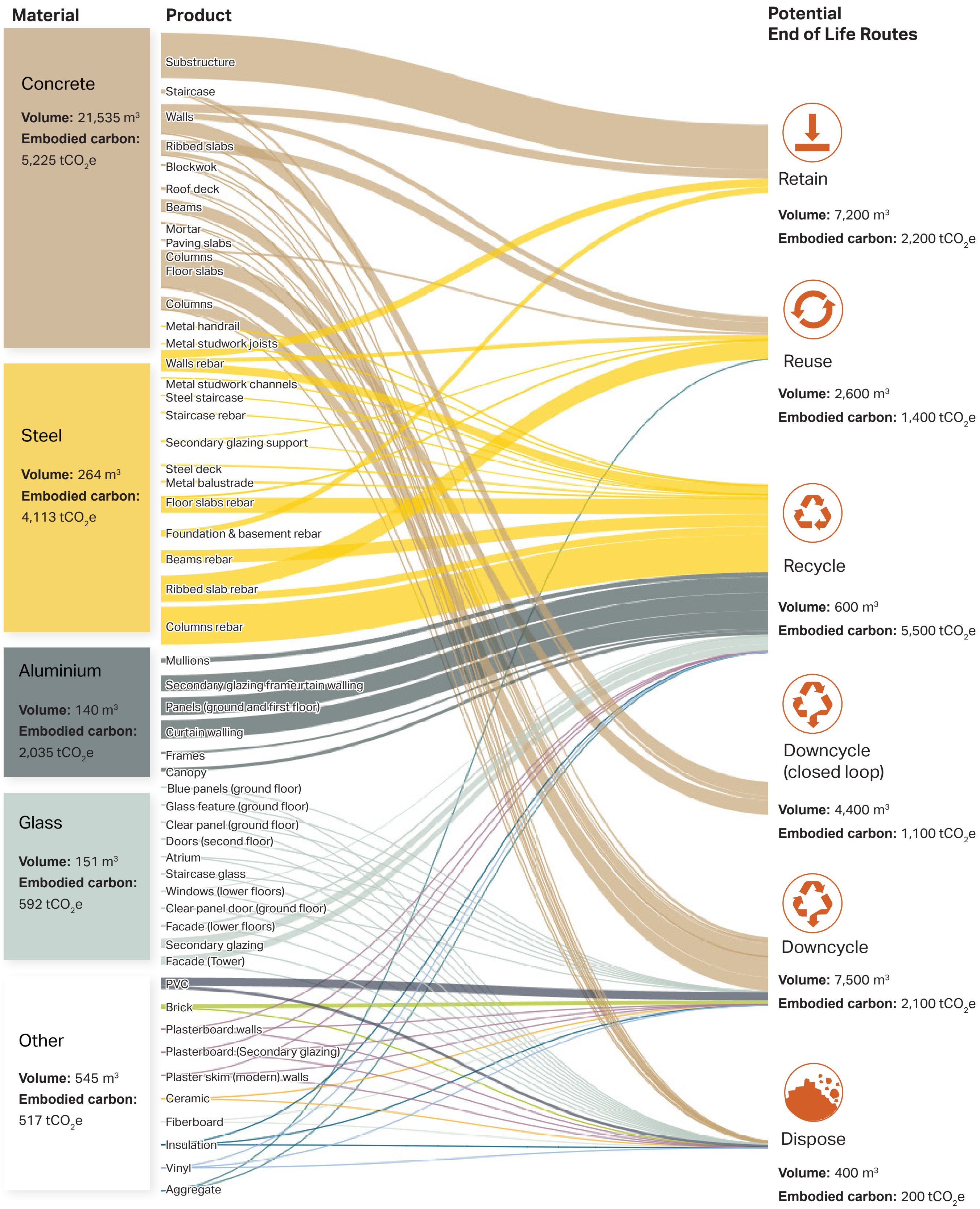


Figure 2.12 Proposed routes for existing materials (including existing foundation and central core)

3

Euston Tower

Hard-to-Handle Materials

3.1 Focus Areas

As shown in 2.2.5, the existing tower comprises primarily concrete, steel (rebar), brick, glass, and aluminium from the original 1960s construction. With the exception of aluminium and steel to the extent that it is well recycled, these are typically hard-to-handle material fractions in a way that promotes reuse/recycling and avoids downcycling.

It is acknowledged that solving the end of life routes for all materials simultaneously is a challenge beyond the influence of the proposed development. Accordingly, the focus areas are on those material fractions that are largest in quantity or have the highest embodied carbon.

These are referred to as the material hotspots.

Figure 3.2 maps the material fractions on a grid evaluating quantity along with embodied carbon. It is clear that most of the impact is due to concrete, aluminium, glass and steel. Progressing the reuse/recycling of these fractions, and avoiding downcycling, has been adopted as a focus area for the proposed development as it strives to be a circular economy pioneer.

While steel is the second most impactful material, it is mainly present in the building as reinforcement bar. Because of this, there is a limited opportunity to directly reuse the steel from the building, unless it is part of the reused concrete elements. The potential of reusing the rebar as part of the concrete floor slabs will be described in Section 3.2. Otherwise the best use of the existing rebar is to feed it back for recycling in steel production.

This Section goes into detail on how reuse/recycling of these material fractions is addressed, and describes the approaches taken to push current industry standard practice within these areas.

Figure 3.1 Images from existing building showing its current condition

Key Material Hotspots

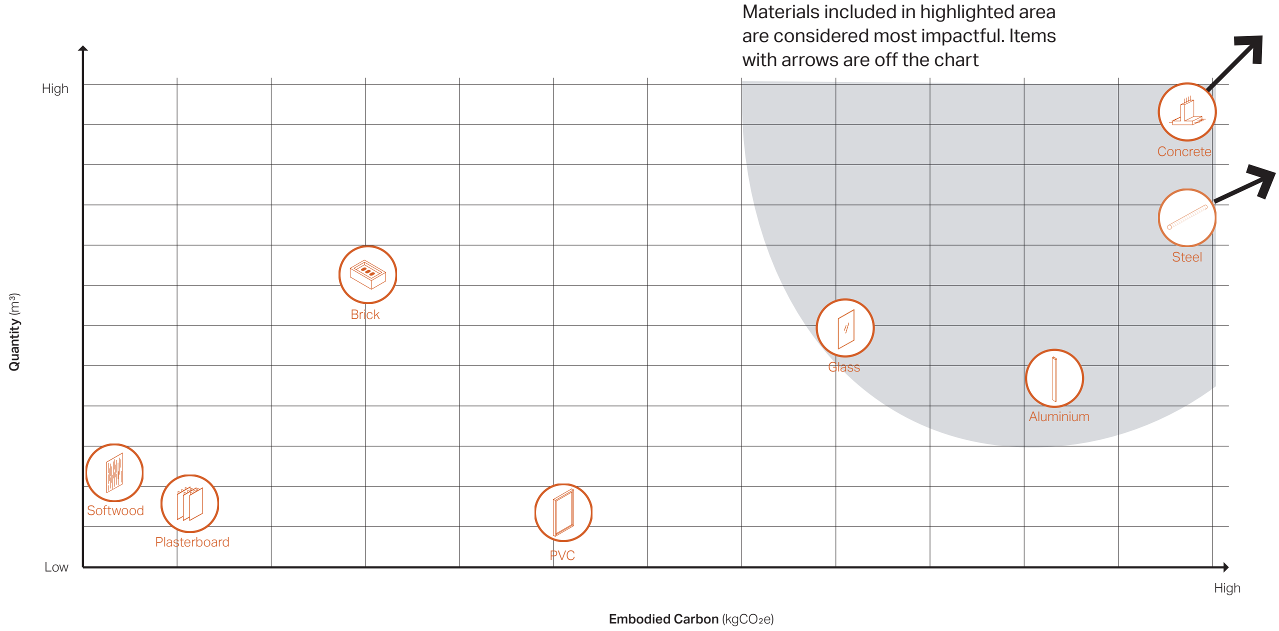


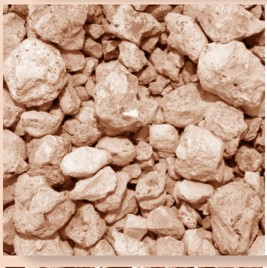
Figure 3.2 Diagram for identifying key material hotspots

Steel

Volume: 233 m^3
Weight: 1806 t
Embodied carbon: 3,640 tCO_2e

	Volume	Weight	Impact
Columns rebar	81 m^3	625 t	1243 tCO_2
Floorslab rebar	34 m^3	266 t	528 tCO_2
Beams rebar	26 m^3	206 t	409 tCO_2
Ribbed slab rebar	55 m^3	409 t	855 tCO_2
Walls rebar*	27 m^3	210 t	417 tCO_2
Steel Deck	3 m^3	27 t	66 tCO_2

	Volume	Weight	Impact
Glazing Support	2 m^3	17 t	46 tCO_2
Balustrade	1 m^3	10 t	28 tCO_2
Handrail	1 m^3	8 t	22 tCO_2
Studwork Joists	1 m^3	5 t	15 tCO_2
Studwork Channel	0 m^3	2 t	5 tCO_2
Staircase rebar	0 m^3	1 t	2 tCO_2



Concrete

Volume: 14,405 m^3
Weight: 34,237 t
Embodied carbon: 3,534 tCO_2e

	Volume	Weight	Impact
Floors slab	5,064 m^3	12,153 t	1,252 tCO_2
Columns	1,815 m^3	4,355 t	449 tCO_2
Beams	1,681 m^3	4,034 t	416 tCO_2
Walls*	2,810 m^3	6,744 t	695 tCO_2
Ribbed slab	1,987 m^3	4,769 t	491 tCO_2

	Volume	Weight	Impact
Staircase	477 m^3	1,146 t	118 tCO_2
Roof deck	345 m^3	691 t	71 tCO_2
Blockwork	169 m^3	237 t	22 tCO_2
Mortar	53 m^3	101 t	20 tCO_2
Paving slabs	3 m^3	7 t	1 tCO_2

Aluminium

Volume: 140 m^3
Weight: 305 t
Embodied carbon: 2,035 tCO_2e

	Volume	Weight	Impact
Curtain Walling	36 m^3	90 t	603 tCO_2
Panels	33 m^3	87 t	580 tCO_2
Second. Frame	52m^3	78 t	520 tCO_2
Mullions	9 m^3	23 t	153 tCO_2
Canopy	6 m^3	16 t	105 tCO_2

	Volume	Weight	Impact
Frames	4 m^3	11 t	75 tCO_2

Glass

Volume: 151 m^3
Weight: 378 t
Embodied carbon: 592 tCO_2e

	Volume	Weight	Impact
Facade (Tower)	68 m^3	169 t	244 tCO_2
Secondary Glazing	64 m^3	161 t	267 tCO_2
Glass (Lower)	7 m^3	18 t	29 tCO_2
Windows (lower)	9 m^3	22 t	37 tCO_2
Atrium	2 m^3	4 t	7 tCO_2

	Volume	Weight	Impact
Doors (2nd)	0.9 m^3	2 t	4 tCO_2
Blue Panels	0.4 m^3	1 t	2 tCO_2
Glass Feature	0.2 m^3	0.5 t	0.8 tCO_2
Staircase	0.1 m^3	0.3 t	0.6 tCO_2
Clear Panel	0.1 m^3	0.2 t	0.3 tCO_2

**Quantity differs from what is recorded in the Pre-demolition Audit as this document accounts for retention of the existing central core in the proposed development.*

Figure 3.3 Component quantities for the four main material fractions

3.2 Concrete

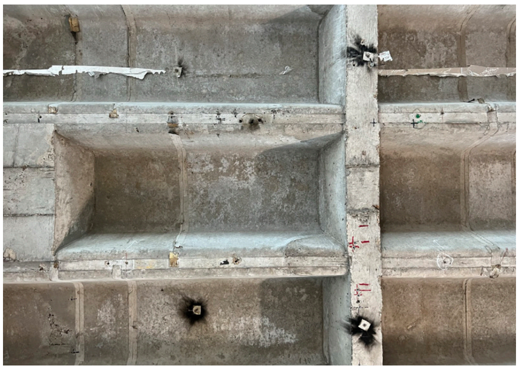
3.2.1 Elements and components

The existing Euston Tower is an in-situ concrete framed building. Generally the existing structural system is a reinforced concrete frame with a combination of ribbed and flat slabs for the decks. A ring beam runs around most of the perimeter. Lateral stability is provided by a central reinforced core, in combination with four satellite cores at the extremities of the floorplate.

Concrete the largest Key Demolition Product (KDP) identified, estimated to be approximately 34,237 tonnes equivalent to 3,534 tonnes of CO_2e. This is from a number of sources:

- Concrete floor slabs (16,922 tonnes)
- Walls (6,744 tonnes)
- Columns (4,355 tonnes)
- Beams (4,043 tonnes).

The structural concrete is generally in a good condition, however, since all the elements are in-situ, it makes it difficult to recover and reuse, and would typically be downcycled.



Concrete

Volume: 14,405 m^3
Weight: 34,237 t
Embodied carbon: 3,534 tCO_2e

	Volume	Weight	Impact		Volume	Weight	Impact
Floorslabs	5,064 m^3	12,153 t	1,252 tCO_2	Staircase	477 m^3	1,146 t	118 tCO_2
Columns	1,815 m^3	4,355 t	449 tCO_2	Roof deck	345 m^3	691 t	71 tCO_2
Beams	1,681 m^3	4,034 t	416 tCO_2	Blockwork	169 m^3	237 t	22 tCO_2
Walls*	2,810 m^3	6,744 t	695 tCO_2	Mortar	53 m^3	101 t	20 tCO_2
Ribbed slab	1,987 m^3	4,769 t	491 tCO_2	Paving slabs	3 m^3	7 t	1 tCO_2

Quantity differs from what is recorded in the Pre-demolition Audit as this document accounts for retention of the existing central core in the proposed development.

Figure 3.4 Component quantities for concrete

Key Concrete Component Hotspots

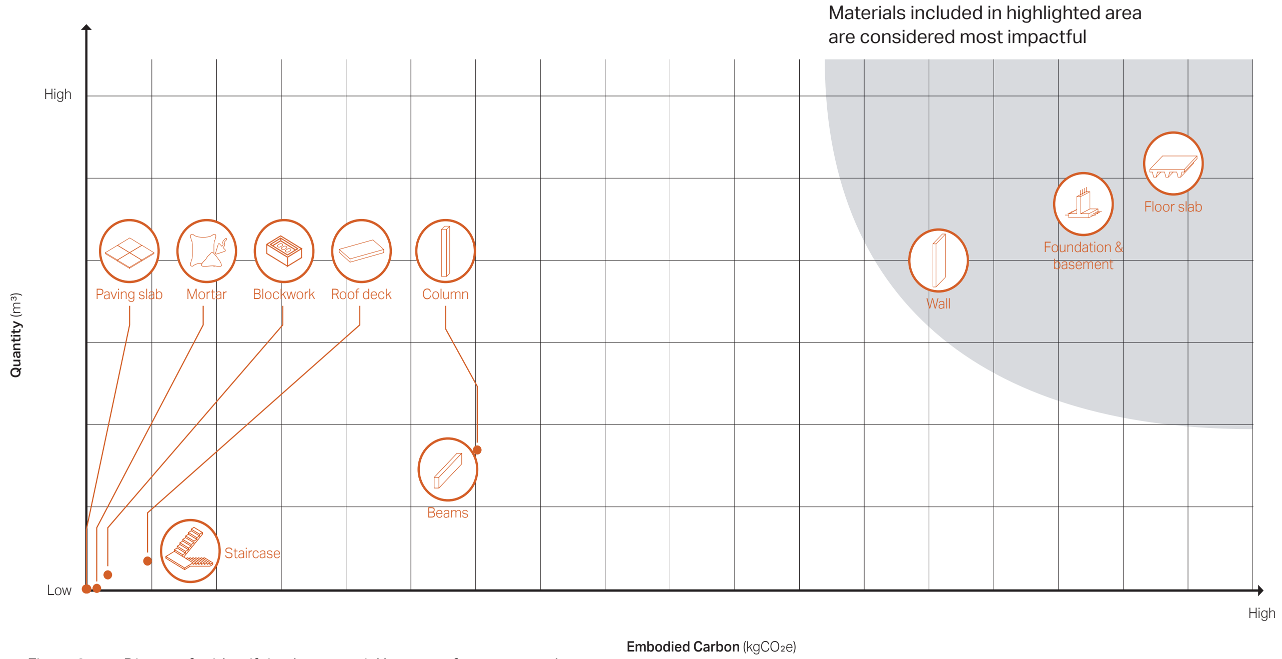


Figure 3.5 Diagram for identifying key material hotspots for concrete elements

Concrete Components on Site

Figure 3.6 Images of main concrete components in the tower (slabs, columns, cores)

3.2.2 Concrete processing

Figure 3.7 illustrates the potential end of life routes evaluated for the deconstructed concrete, each of which are elaborated upon below.

Standard practice
The standard practice for treating concrete waste is to downcycle it. This would entail crushing it for use as lower value product such as roadfill.

Best practice
An alternative is to use the rubble as a Recycled Concrete Aggregate (RCA) in new concrete. Recycled concrete aggregates can be used in:

- Bitumen bound materials
  RCA may be used in a variety of base course and binder course mixtures.
- Concrete
  RCA can be used to replace 20% of the coarse aggregate in concrete (up to grade 50 concrete)
- Pipe bedding
  Suitably graded recycled concrete aggregate is used in pipe bedding
- Hydraulically bound mixtures (HBM) for sub-base and base
  Used in construction of car parks, minor roads
- Unbound mixtures for sub-base
  Suitably graded recycled concrete aggregate is used as sub-base
- Capping
  Recycled concrete aggregate is suitable for capping applications.

Where it cannot be reused, it is the ambition in the proposed development to treat the existing concrete as RCA, as opposed to lower level products.

SmartCrusher
Considerations have been made as to possibilities of recycling the concrete instead of downcycling it. The SmartCrusher technologies have been considered.

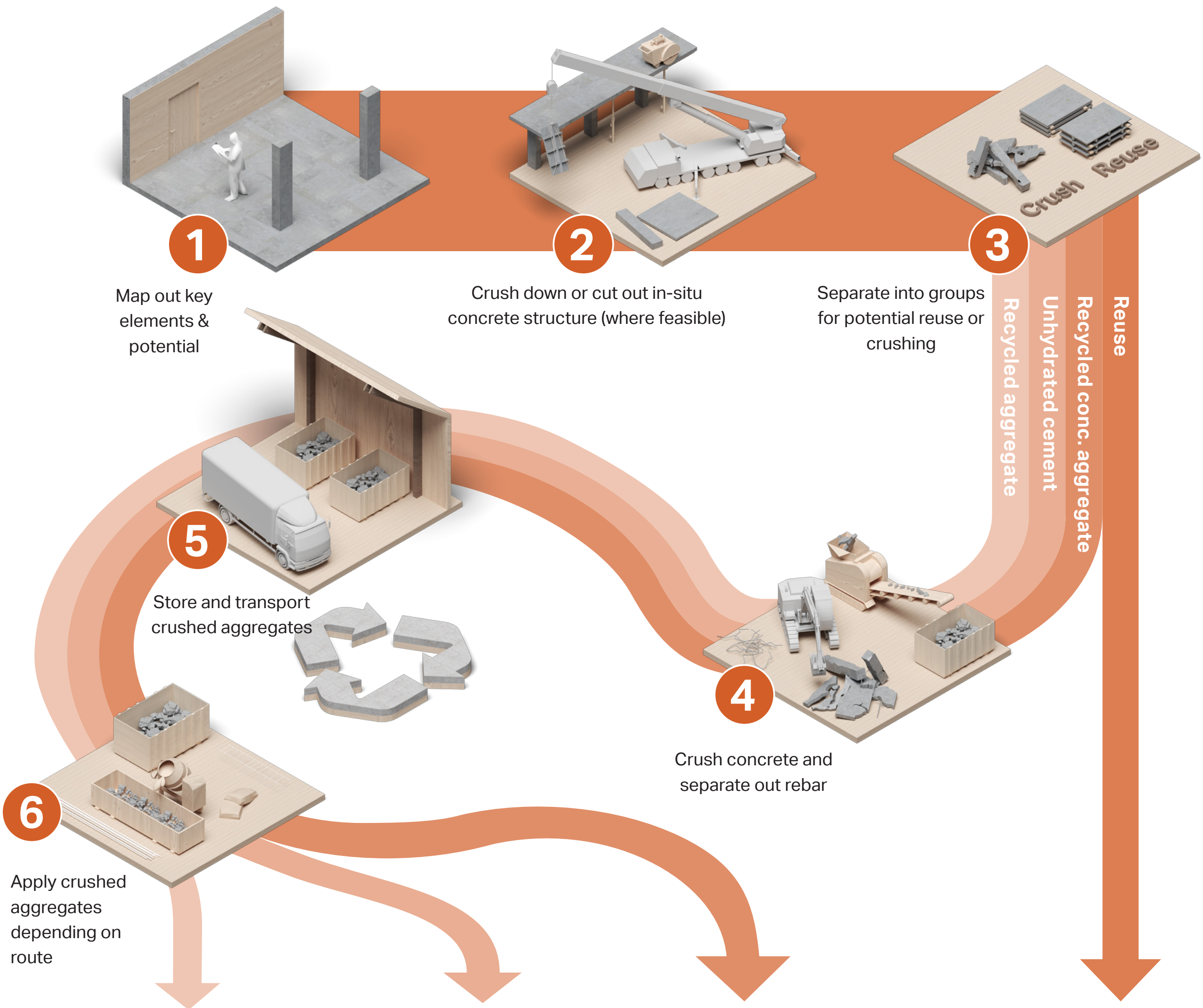
Unlike traditional methods, the SmartCrusher process allows for a more granular separation of the constituent parts of the concrete which enables reuse of the cement (the carbon-intensive portion of concrete making).

The team behind SmartCrusher have been engaged about potential for testing/applying their technology on the proposed development, however currently their efforts are focused in the Netherlands, before initiating future plans for licensing technologies internationally.

Structural reuse
Structural reuse of in-situ concrete elements is not typically conducted, and certainly not at the scale of Euston Tower.

It is the ambition for the proposed development to test the potential of cutting out the existing in-situ slabs for reuse elsewhere in a structural application. Refer to 3.2.3.

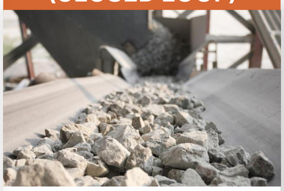
Potential End of Life Routes for Concrete



DOWNCYCLING

Roadfill

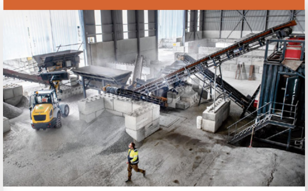
DOWNCYCLE (CLOSED LOOP)



Recycled concrete aggregate

Considered

RECYCLE



SmartCrusher process allows for a more granular separation of the constituent parts of the concrete which enables reuse of the cement.

Not mature on UK market

UNIQUE REUSE

Cutting out and reusing in-situ concrete ribbed slabs

Current test and trials

Figure 3.7 Potential recovery routes for concrete

3.2.3 Roadmap to reuse

The existing floor plates comprise 10" (254mm) deep concrete ribs spanning onto beams or directly onto walls. The potential for cutting out, testing, and reusing the existing ribbed slabs in structural application is currently being evaluated.

Key to innovation at this scale is being able to break down the problem. A roadmap has been prepared of the initial steps required to test the feasibility of reuse back into the new structure. This is shown in Figure 3.10.

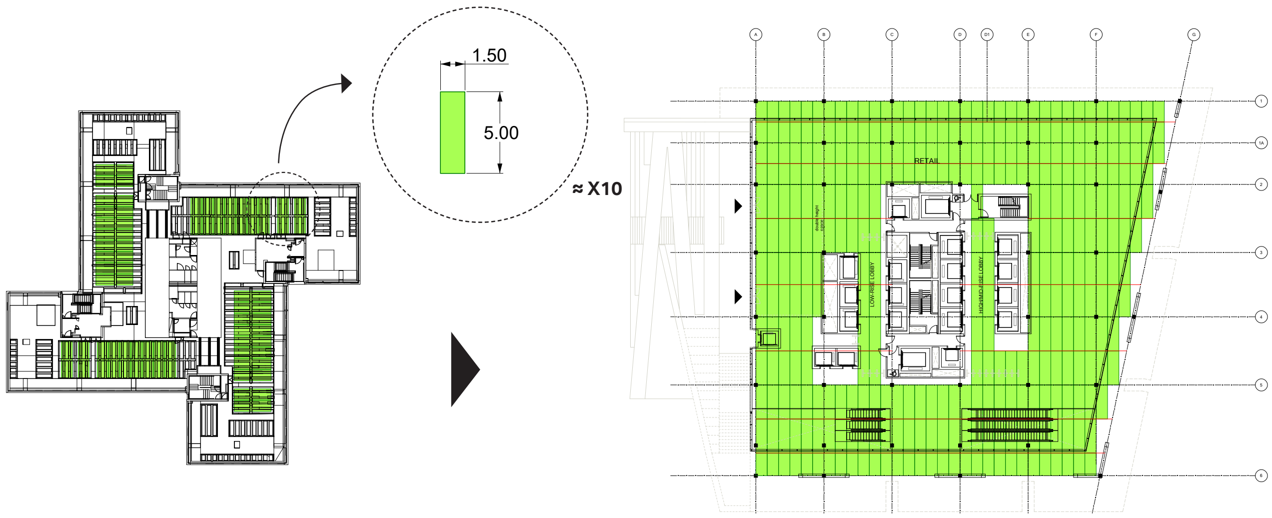
From the non-intrusive and intrusive studies of the existing structure, information is available on the conditions of the ribbed slabs. A desktop study has been carried out to identify the overall quantities and qualities. The sketch in Figure 3.9 illustrates that for each floor of the existing tower there are approximately 38 panels with dimensions of 5m x 1.5m. Approximately 355 of these panels would be required per floor, for the lower floors in the proposed development.

Additional in-situ testing on carbonation and rusting have been carried out to prepare the way for more detailed simulation and testing of the structural capability of the panels.

The methodology and logistics for cutting out a sample panel for testing with the University of Surrey has been developed. Cutting out of the test panel is about to be conducted at the time of writing.

Figure 3.8 Images of existing ribbed slabs

Potential Reuse of Concrete Slabs



Existing Plan

Ribbed Slab Panels (Available per floor)

Quantity: 38 panels
Area: 285 m^2

Proposed plan

Ribbed Slab Panels (Required for one floor)

Quantity: 355 panels*
Area: 1,940 m^2

*Note maximum span of 4.5m. Due to current grid, full length of each panel may not be fully utilised, waste to be considered.

Figure 3.9 Sketches quantifying potential structural reuse of concrete slab elements (sketch by Arup)

Roadmap for Reuse of Concrete Slabs

1 Prepare the Way

- On site audit and feasibility assessment
- Identify overall quantities and qualities
- In-situ testing (carbonation, rusting, etc.)
- Concept design and application areas

Gateway
Technical feasibility assessment

2 Simulation and Testing

- Develop testing methodology and drawings
- Brief key sign-offs (insurance, building control, leasing, etc.)
- Cut out test panels
  In progress (November 2023)
- Transport
- Clean and prepare panels for testing
- Test panels are per testing regime

Gateway
Testing report and sign off

Future

3 Technical and Sign-offs

- Review overall quantities
- Technical design of panels (structure and fire)
- Finalise application areas (on site, LBC, BL, etc.)
- Cost and programme review

Gateway
BL review and engagement with key sign-offs (insurance, building control, leasing)

Figure 3.10 Roadmap for structural reuse of concrete slab elements

3.2.4 Testing and trials

The design team is intending to extract a test specimen of the existing structural ribbed slab for investigation and load testing.

A technical note was prepared by Arup to provide a location and considerations for the slab extraction, and a specification of the testing requirements. The following are included as expected outcomes of the trials.

- Dimensional survey of specimen to be extracted, including any deviations or modifications from as-built condition (i.e. damage, inclusion of embed channels etc.)
- Full cover meter survey of both top and bottom surfaces to assess reinforcement within slab and ribs, including longitudinal, transverse and shear reinforcement.
- Sawcut specimen of slab to provide 4.5 x 1.5m panel upon extraction (this may require larger section to be removed and trimmed to size)
- Extracted section to include min. 2 no. ribs
- Removal of section from building and delivered to testing site at University of Surrey.

The testing results will provide an indication of the technical feasibility of reusing the cut out panels in the new structure, or elsewhere in a structural application.

Once the initial technical studies are assessed, further studies will be carried out to assess the suitability with regards to fire requirements and compatibility with current structural design, as well as economic and programmatic implications of reusing the panels in the proposed development.

The testing and reuse of in-situ concrete is an innovation for Greater London, and has not been conducted previously at scale.

Diagram for Potential Reuse of Concrete Slabs

Sample Slab
Indicative location for panel removal
Panel Dimensions: 1.5m wide x 4.5m long
Approx weight = 2.5-3t

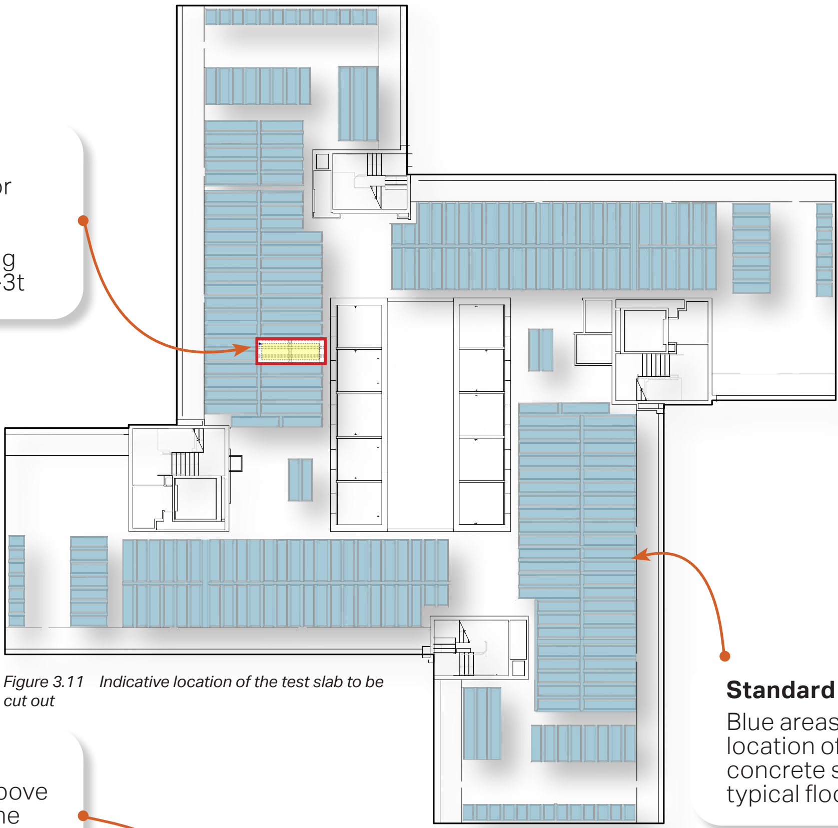


Figure 3.11 Indicative location of the test slab to be cut out

Standard Floorplate
Blue areas show the location of the ribbed concrete slabs on a typical floorplate

Removal
Slabs are cut from above and removed by crane to be transported for testing and future reuse

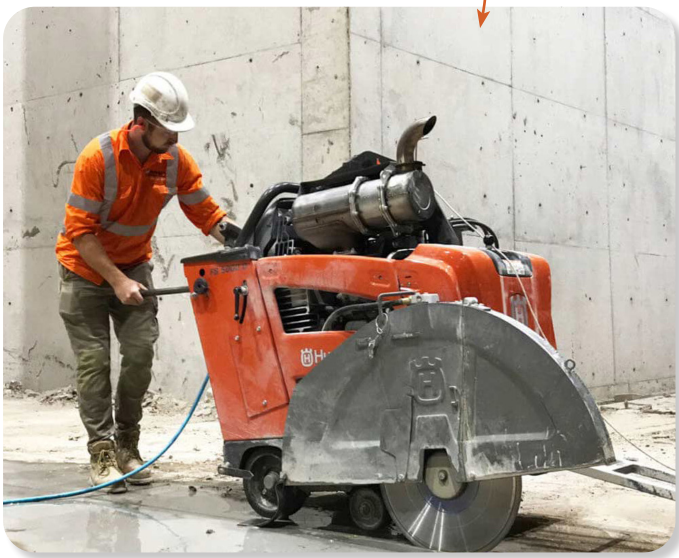


Figure 3.12 Reference photo for cutting of in-situ concrete elements

Figure 3.13 Reference photo for example slab location

3.3 Glass

3.3.1 Elements and components

The facade is the original 1970s construction, and relatively recently, has been upgraded with the addition of reflective solar film for internal glare control and secondary glazing for acoustic and thermal comfort.

The main system comprises single glazed vision glazing and a red back-painted (though recently it is suspected that this is ceramic frit) and toughened glass spandrel panel. The transparent panel has a solar coating film post-applied on the inner side. The spandrel panel has had a security film applied to it approximately ten years ago following spontaneous breakages from NiS inclusions. None of the glass is laminated. There is an additional secondary glazing system which consists of aluminium framing with horizontal sliding vents on standalone steel framed support system.

Notwithstanding their age and condition, the glass panels in the facade system and secondary glazing are difficult to reuse, repair or refurbish due to their specific coatings, applied films and treatments. Nonetheless, remanufacture of glass products utilising reclaimed glass materials have a significant benefit to future glass manufacture, in the form of avoided carbon emissions and virgin material use.

A detailed survey was carried out by Arup to provide more details on these glass types and quantities, as shown in Figure 3.16. It is clear that the majority of the glass is:

- External vision glazing (310 tonnes)
- Secondary glazing (108 tonnes)
- Spandrel glazing (99 tonnes).

These elements were identified as being the best candidates for glass recycling trials. Refer to 3.3.3.

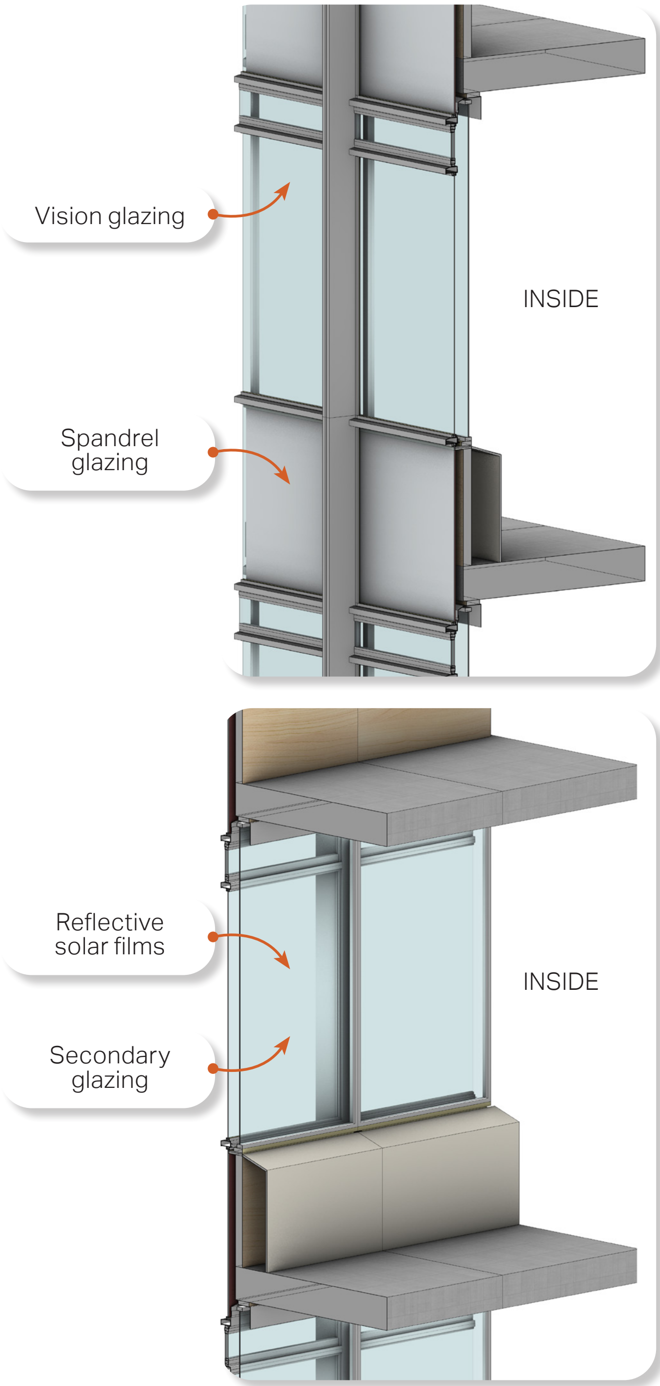


Figure 3.14 Facade build up with different glazing types indicated

Key Glass Component Hotspots

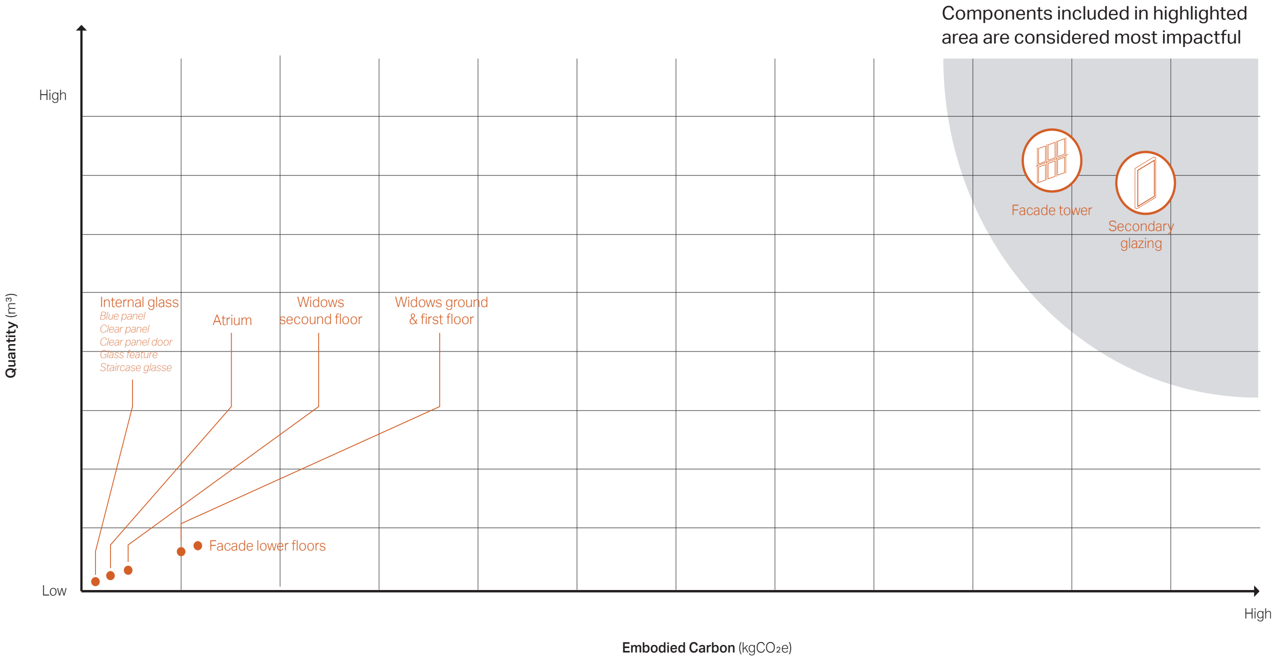


Figure 3.15 Diagram for identifying key material hotspots for glass

Detailed Glass Library

	Glazing type and description	Number of Floors	Area per Floor (m²) [1]	Total area (m²)	Total Mass (tonnes)
GL-01	External vision glazing (full height) Monolithic, 12 mm thickness (assumed toughened with solar film)	31*	220	6,915	207
GL-01A	External vision glazing (ventilation sections tall) Monolithic, 12 mm thickness (assumed toughened with solar film)	31	80	2,482	74
GL-01B	External vision glazing (ventilation section short) Monolithic, 12 mm thickness (assumed toughened with solar film)	31	30	920	28
GL-02	Secondary Glazing Monolithic, 6 mm thickness (assumed toughened with solar film)	31	232	7,184	108
GL-03	Spandrel Glazing Monolithic, 6mm thickness (assumed ceramic frit)	31**	207	6,612	99
GL-04	Rolled patterned glass (plant room) Monolithic, 6mm thickness (assumed Stippolyte)	0.5	116	58	0.87

[1] Dimension averaged from internal façade dimensions
** Additional half height storey for plant room*
*** Additional double height storey for plant room*

Figure 3.16 Detailed survey providing information on glass types and quantities

3.3.2 Glass processing

Figure 3.17 illustrates the potential end of life routes evaluated for the deconstructed glass, each of which are elaborated upon below.

Reuse
For glass to be reused it needs to be collected on specialist steel A-frame stillages, handled and stored carefully. The majority of the facade glass is unfit for reuse. There are some internal glass partition walls that could have potential for reuse, this is addressed in Section 4.4.

Upcycled products
It is intended to use some of the glass cullet for upcycled products. For more information see Section 4.3 of this document.

Downcycling
Since the facade glass is unfit for direct reuse, the standard practice would be to downcycle the glass. The glass recycling industry has developed grades of glass cullet:

- Class C
  Which is contaminated and not suitable for re-melting back into glass. Contamination can include ceramic frit, putty, lead beading, and space bars. This will be used as aggregate or road paint.
- Class B
  This is called "mixed cullet" and may have some contamination such as laminated glass, which is suitable for glass wool insulation or container glass.

Recycle
It is the ambition to get higher value out of the facade glass than what is standard practice. There is an industry demand for high quality cullet, but almost no post-consumer recovery is undertaken. Class A cullet is required to facilitate this:

- Class A
  Clean clear glass cullet with no contamination which can be used back in the floating by re-melting. This is currently mostly from pre-consumer glass. Demand for this outstrips supply.

[1] *This excludes the 86 tonnes of ceramic fritted glass, which would be recycled for other applications. For this study, we have approximated a carbon saving of 1/3 of the closed loop recycling process which equates to an estimated saving of a further 17 tCO_2e*

Based on the material quantity estimations of the glass materials at the existing Euston Tower, there is a potential to remanufacture up to 376 tonnes of glass back into the glass float line for use within new flat glass products, avoiding more than 218 tCO_2e, and avoiding 452 tonnes of virgin material. The additional carbon implication associated with transport from a regional material dismantler is approximately 13 tCO_2e resulting in a net avoidance of 205[1] tCO_2e.

Every tonne of cullet saves up to 310kWh of energy at the glass furnace

116,666 kWh

of energy at the glass furnace

Every tonne of cullet saves 1.2 tonnes of virgin raw materials

452 tonnes

of virgin material saved

Every tonne of cullet saves up to 580 $kgCO_2e$ in future glass manufacture

205 tCO_2e

avoided in manufacture

Potential End of Life Routes for Glass

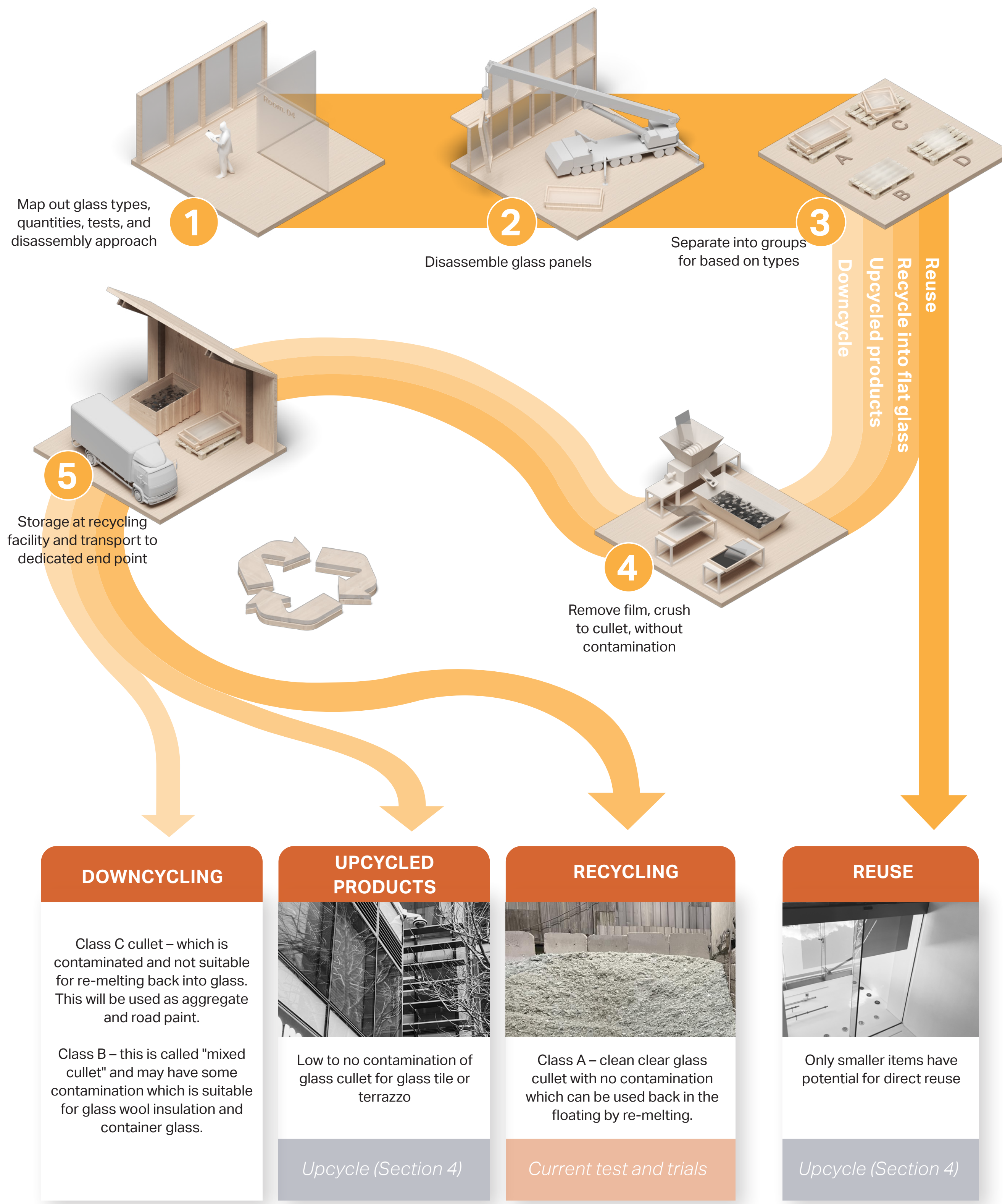


Figure 3.17 Potential end of life routes for glass

3.3.3 Roadmap to recycling

The most suitable reclamation process of glass is dependent on the quality and quantity of the materials, site trials, market demand, and reuse marketplaces in addition to any added time and cost associated with reuse, re-manufacturing or recycling. A lot of these procedures currently rely heavily on manual labour, and it is therefore imperative that this is discussed early with contractors to understand the most efficient way of handling these materials.

Arup has been involved in the project to identify, quantify, and test the potential for enabling and certifying the recovery process of the flat glass materials from the existing tower.

Figure 3.18 presents a roadmap for recovering the existing facade glass and unfolds the first steps that have been completed. A detailed survey was carried out by Arup to provide more detailed audit of the glass types and quantities. A glass disassembly and recycling feasibility report was prepared with the detailed overview of the existing glass types, and estimated the reclamation potential thereof.

Figure 3.19 shows the quantities of the constituent glass types along with the opportunities for recovery evaluated feasible for the specific type.

This report furthermore includes a methodology and description of logistics for dismantling the glass panels for testing and trials.

Roadmap to Glass Recycling

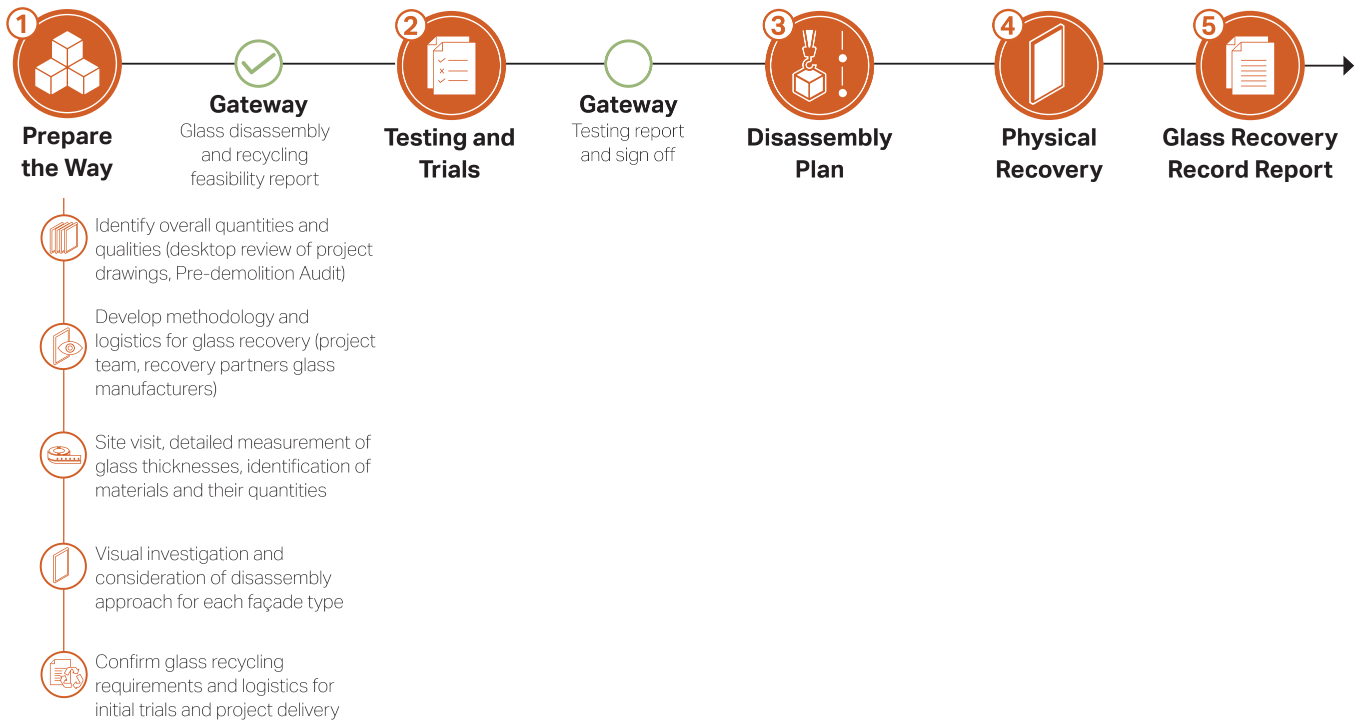


Figure 3.18 Initial steps unfolded in roadmap to glass recycling which have already been completed

Quantities and Opportunities for Specific Glass Types

	Glazing Type and Description	No. Glass Panes per Floor	90% Total Area (m^2) [1]	Total Glass Mass (tonnes)	Opportunity
GL-01	External vision glazing (full height) Monolithic, 12 mm thickness (assumed toughened with solar film)	100	6,223	187	Trials for film removal required. Glass prepared for closed loop remanufacturing
GL-01A	External vision glazing (ventilation sections tall) Monolithic, 12 mm thickness (assumed toughened with solar film)	50	2,234	67	Trials for film removal required. Glass prepared for closed loop remanufacturing
GL-01B	External vision glazing (ventilation section short) Monolithic, 12 mm thickness (assumed toughened with solar film)	50	828	25	Trials for film removal required. Glass prepared for closed loop remanufacturing
GL-02	Secondary Glazing Monolithic, 6 mm thickness (assumed toughened with solar film)	150	6,466	97	Trials for film removal required. Glass prepared for closed loop remanufacturing
GL-03	Spandrel Glazing Monolithic, 6mm thickness (assumed ceramic frit)	150	5,951	89	Recycling only [2]
GL-04	Rolled glass (plant room floors only) Monolithic, 6mm thickness (assumed Stippolyte)	75	52	1	Suitable for closed loop remanufacture likely to rolled glass
	Closed loop recycling opportunity Subtotal		15,804	376	
	Total		21,755	466	

[1] Total area reduced by 10% to account for framing and yield and rounded to the next whole number
[2] Ceramic frit prevents closed loop remanufacturing routes, the material can be recycled for other lower grade glass products

Figure 3.19 Material quantities and opportunities for the various glass types

3.3.4 Testing and trials

From the candidates for the glass recycling trials, three panels each have been carefully extracted and dismantled for testing. Figure 3.21 illustrates the disassembly process of the three glass panel types: vision glazing, secondary glazing, and spandrel glass.

At the time of this document, the panels for trial have been removed and transported to the recovery partner, separated, and crushed to cullet.

The cullet is to be sent to a glass manufacturer for laboratory testing to identify the make up of the cullet and its suitability for re-manufacture. Throughout the process, the material will be kept separate for analysis of each glass type and for the avoidance of contamination. The results of this testing will identify the suitability of the different glass type as for use in new flat glass manufacturing.

The results of the testing and recycling trials will be published to share learnings with the wider industry.

Roadmap to Glass Recycling

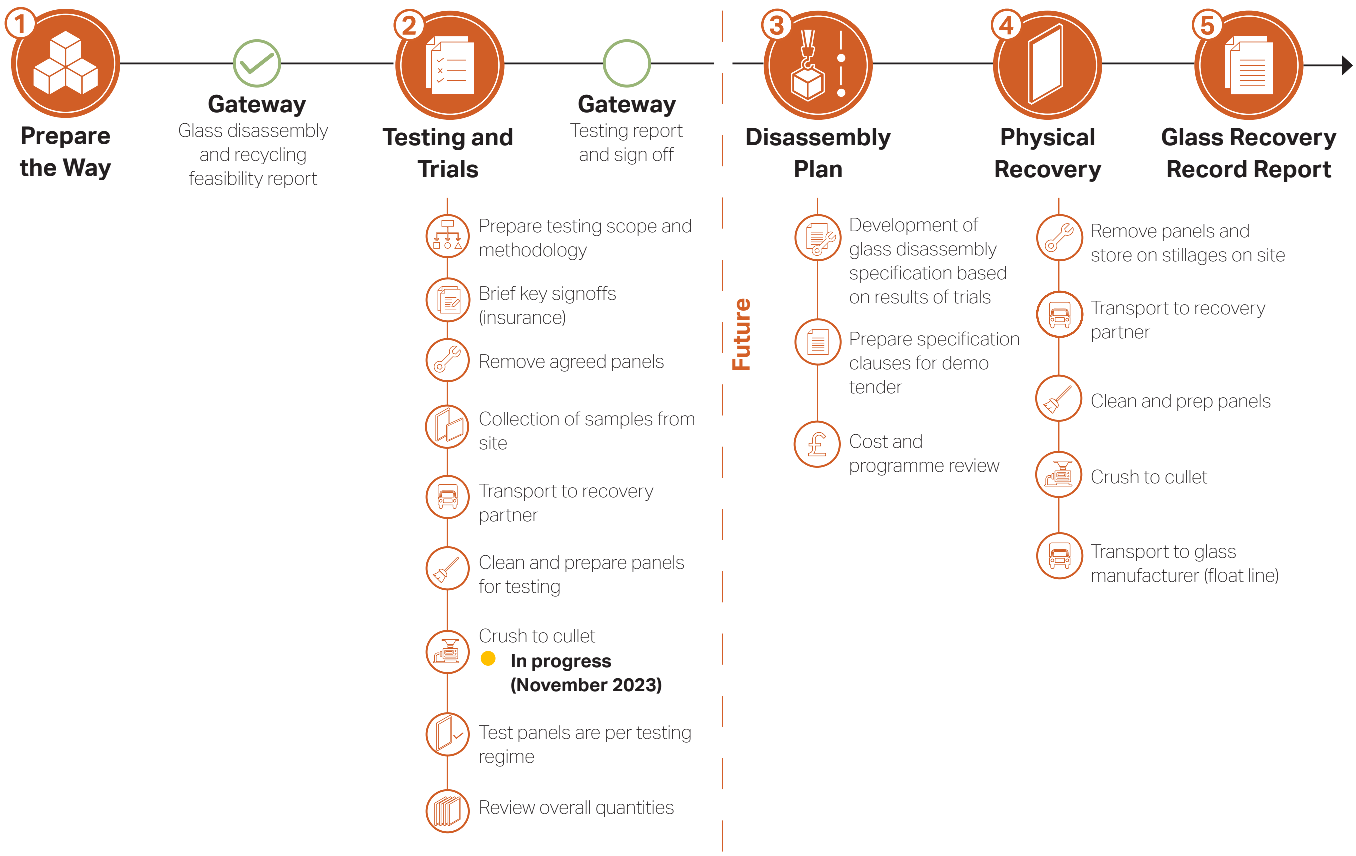


Figure 3.20 Current and remaining steps unfolded in roadmap for glass recycling

Secondary Glazing

Removal of secondary glazing
Remove glass with its aluminium frame out of sliding tracks to inside of building, remove aluminium frame, store glass on stillages, and transport for crushing

Crush to cullet
Culletised separately, to be sent to glass manufacturer

Vision Glazing

Removal of vision glazing
Hold glass with sucker unit and remove glass to inside of building, store glass on stillages, and transport for crushing

Crush to cullet
Culletised separately, to be sent to glass manufacturer

Spandrel Glazing

Removal of spandrel glazing
Hold glass with sucker unit and remove glass to outside of building, store glass on stillages, and transport for crushing

Crush to cullet
Culletised separately, to be sent to glass manufacturer

Figure 3.21 Photos of the three types of glass panels being extracted, dismantled and crushed for testing and trials

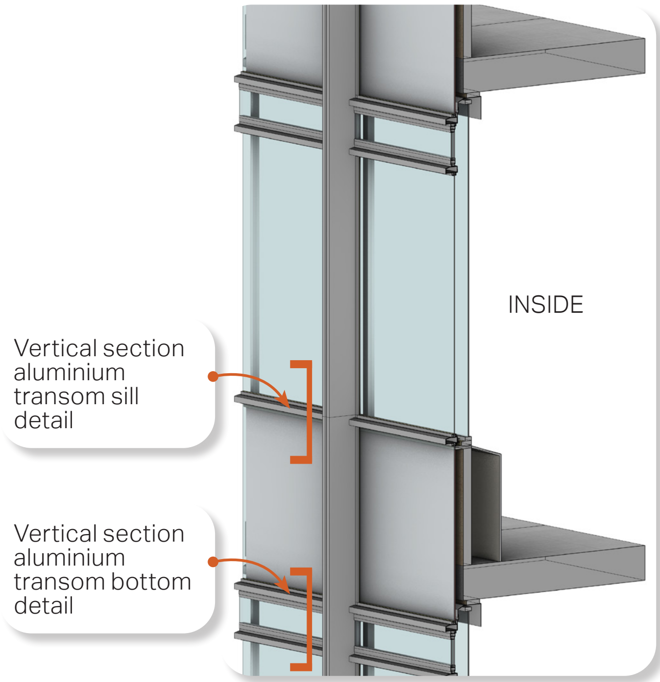
3.4 Aluminium

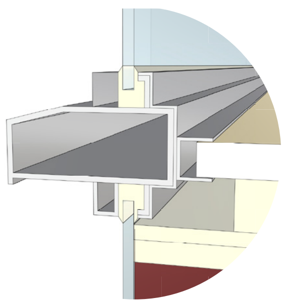
The main facade system is an anodised aluminium stick system with the structural mullions on the outside of the building emphasising the verticality.

The mullions and transoms in the facade system make up the largest quantity of aluminium in the existing building. A vertical section of the aluminium transoms can be seen in Figure 3.22.

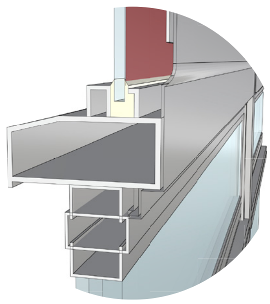
Additional aluminium is located in the podium wind canopy. This may be the most suitable aluminium for reuse/ upcycling.

There is an estimated total of 305 tonnes of aluminium, equivalent to 2,035 tCO_2e from the deconstruction, as shown in Figure 3.23.





Vertical section aluminium transom sill detail



Vertical section aluminium transom bottom detail

Figure 3.22 Details of aluminium components in the facade

Aluminium Components Quantities

Aluminium

Volume: 140 m³
Weight: 305 t
Embodied carbon: 2,035 tCO₂e

	Volume	Weight	Impact
Curtain Walling	36 m³	90 t	603 tCO_2
Second. Frame	52m³	78 t	520 tCO_2
Mullions	9 m³	23 t	153 tCO_2
Canopy	6 m³	16 t	105 tCO_2
Frames	4 m³	11 t	75 tCO_2

Figure 3.23 Aluminium component quantities

Key Aluminium Component Hotspots

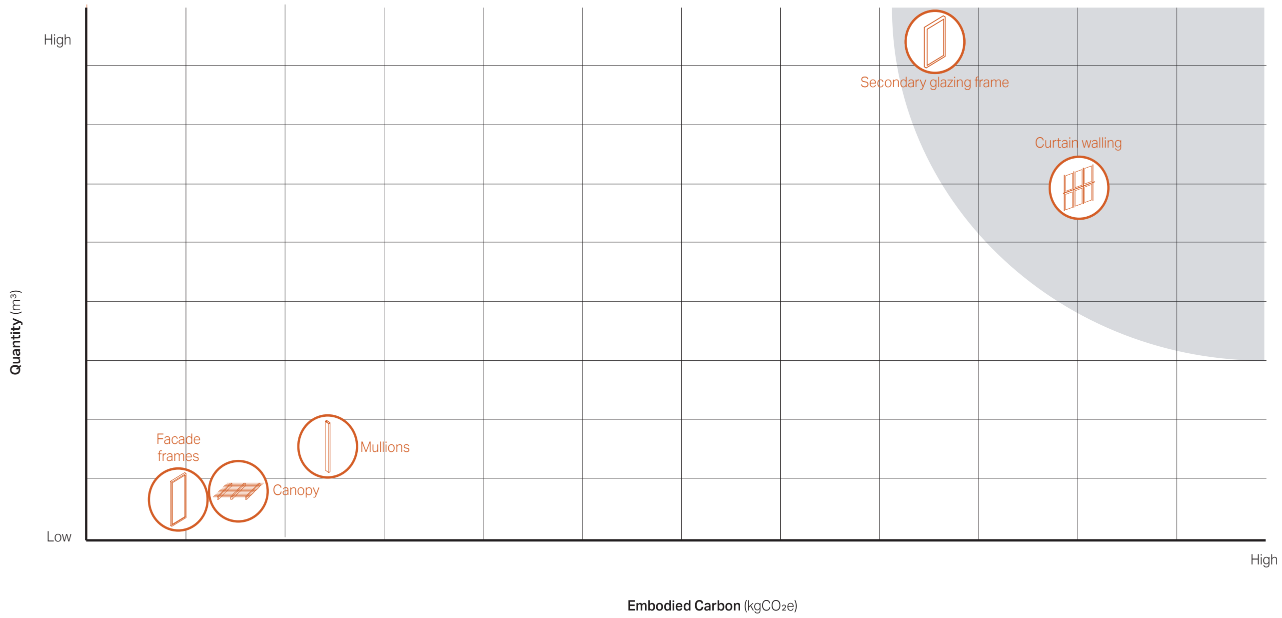


Figure 3.24 Diagram for identifying key material hotspots for aluminium

Figure 3.25 Images of aluminium components in the building. Wind canopy (left), facade mullion (middle) secondary frame (right)

3.4.1 Aluminium processing

Figure 3.26 illustrates the potential end of life routes evaluated for the deconstructed aluminium, each of which are elaborated upon below.

Standard practice
Aluminium is usually treated in a similar manner to steel, in that it will be sent to a scrap merchant, where it will be sorted, sheared (cutting large pieces), shredded, graded, and baled.

Aluminium has high recycling rates, which can be between 92% and 98% for architectural aluminium, and there is a highly established aluminium recycling market.

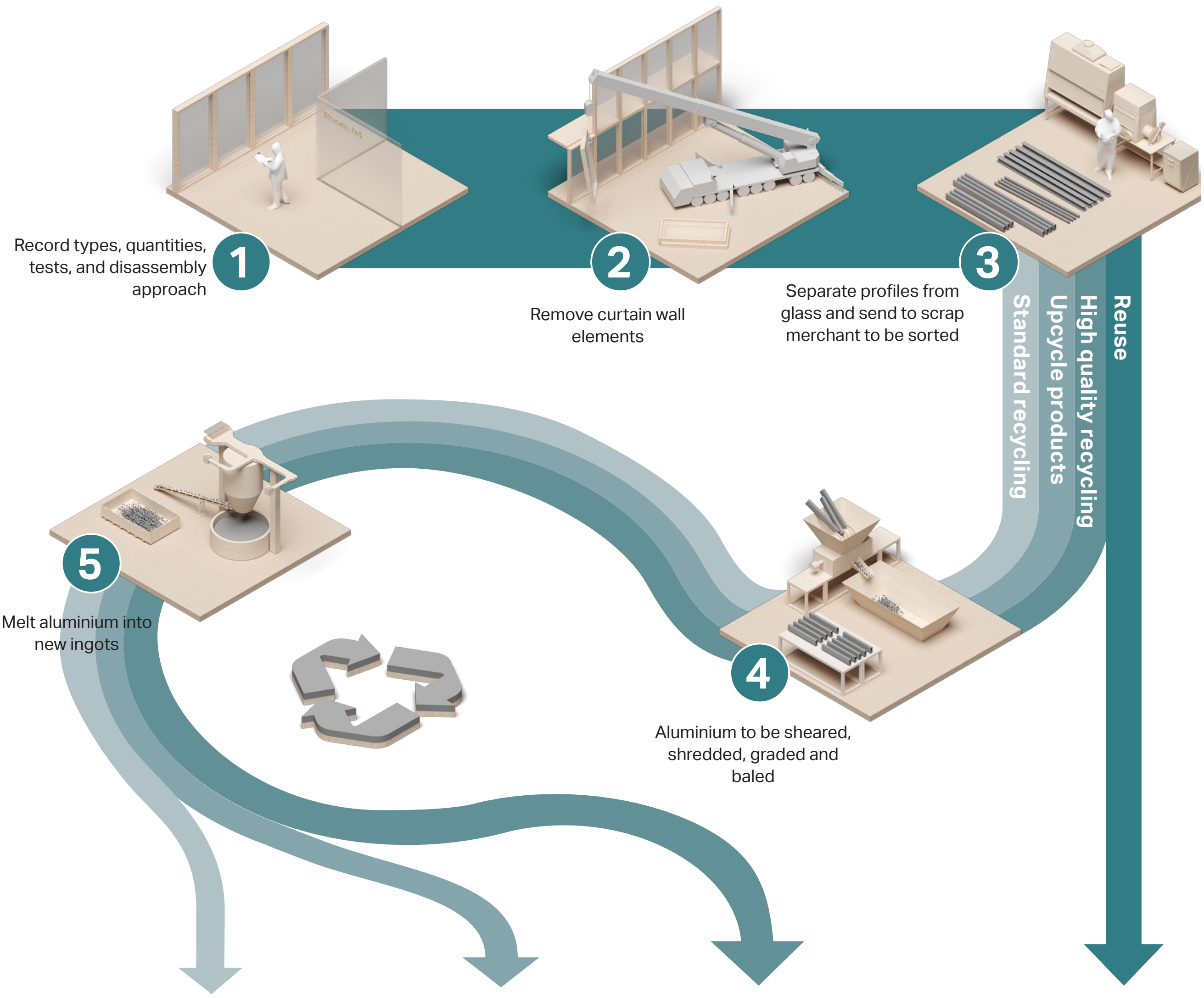
The aluminium will typically be recycled back into new aluminium. However, there is no guarantee what type or grade of aluminium that will be produced from the scrap.

Best practice
It is an ambition to ensure that the aluminium scrap from the existing building is being fed back into the production of extrusions for building use (or similar high quality aluminium alloys that avoid degradation of the product).

The project team has engaged in dialogue with Alutrade to discuss potential route for the aluminium scrap. Alutrade is an aluminium recycler in the UK that ensures post-consumer scrap is sorted to separate out contamination that allows for the high-quality alloys needed for facade extrusions. Alutrade works as part of Hydro's supply chain, to deliver scrap that is used for the production of Hydro CIRCAL recycled aluminium billets.

Reuse/upcycling
The wind canopy at podium level is the aluminium component in the best condition and with potential for reuse/upcycling. Potential for doing so is explored in Section 4.6.

Potential End of Life Routes for Aluminium



STANDARD PRACTICE RECYCLING

Aluminium will typically be recycled back into new aluminium, but with no guarantee of the alloy quality

UPCYCLING

Upcycling ideas for recovering and transforming canopy

Upcycle (Section 4)

BEST PRACTICE RECYCLING

Aluminium recycling back into extrusions for architectural use

Engaging in dialogue

REUSE

No items identified as suited for direct reuse

Figure 3.26 Potential end of life routes for aluminium

3.5 Sharing Our Learnings

The focused efforts described in this Section will be proceeded as far as technically, practically, and economically possible. Subject to considerations on project risks, cost, and programme.

It is acknowledged that the aims in this Section are ambitious. But it is indeed this level of ambition that is needed for the construction industry to accelerate its transition to a circular economy.

One of the barriers to this transition is siloed knowledge.

Accordingly, throughout the process, the learnings regarding technical feasibility, logistics and, challenges met will be documented and shared. The aim is to push industry standard practice for how these large, high-impact, material fractions are treated, and provide transparency around the process.

If the full recovery is not successful on the proposed development, at the very least it should be a step towards making it easier to achieve and implement on the next.

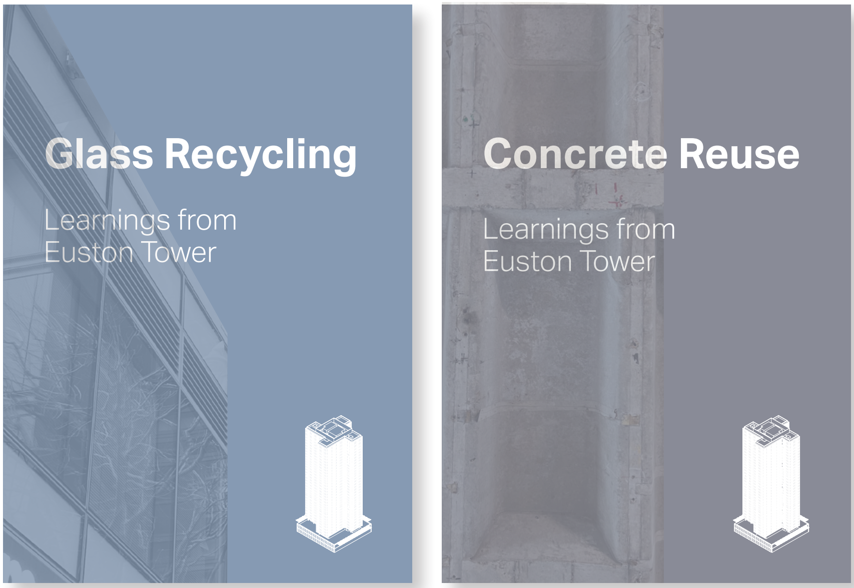


Figure 3.27 The learnings regarding technical feasibility, logistics, and challenges met will be documented and shared

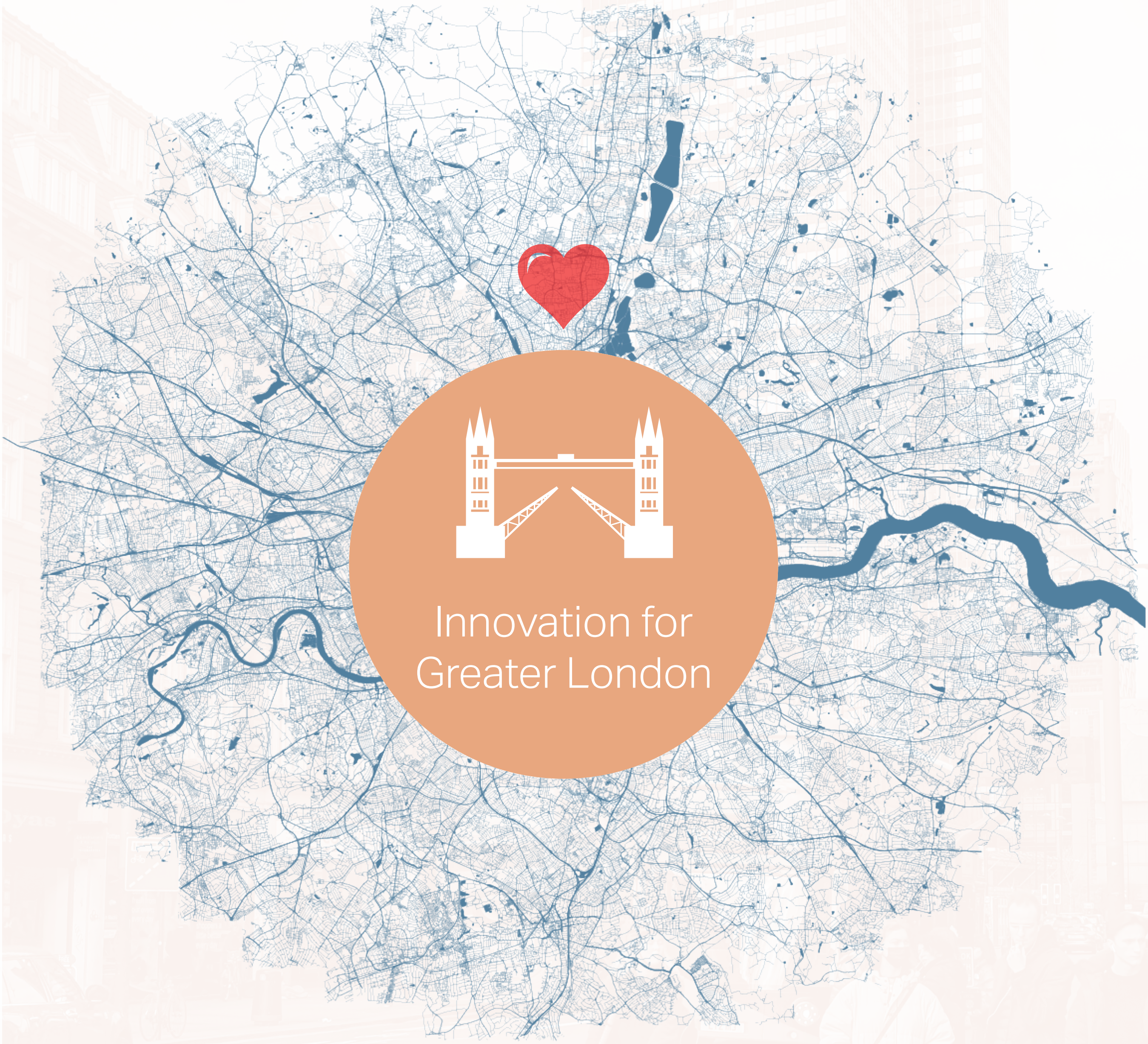


Figure 3.28 Lessons from the proposed development can help the industry to accelerate its transition to a circular economy

4

Euston Tower

Upcycling Catalogue

4.1 Introduction to Upcycling

4.1.1 General

Upcycling is a strategy for recycling which entails transforming products and materials into higher quality and/or higher value products and materials. The aim is to convert what would typically be waste into new products, by remanufacturing in ways that reduces demand for extracting raw materials from the natural environment.

As noted in Section 2, most of the existing interior fitout, finishes and services have already been stripped out of the existing building. The materials remaining in the building are therefore primarily the "hard-to-handle" material fractions such as concrete, steel, aluminium, and glass.

This Section focuses on the few items remaining in the existing building that have a potential for being reused, either directly or with some remanufacturing. It also presents ideas for developing products that can provide opportunities for storytelling about the circular economy narrative of the proposed development.

It is proposed to explore harnessing the existing materials in products that can create unique stories throughout the different areas of the building, where the user can see, touch, learn, and be inspired by these ideas. This is achieved by weaving existing materials into the narrative of the site, and allowing users to engage directly with these as part of that story.

The ideas presented in this Section are not commitments for the proposed development. Rather they are intended to explore what is possible when it comes to repurposing and upcycling waste. Should any of these ideas be furthered in the proposed development, they will require development and engagement with supply chains, to prove their technical, practical, and economic feasibility.

These are not regarded as standard solutions, but unique, progressive, and industry leading ideas which could put the proposed development at the forefront of building a circular future. In combination with the other strategies described in this document, this positions Euston Tower as a true circular economy pioneer.

“**‘Urban Upcycling’** is about creating the **material solutions** of tomorrow, with the **waste of today**”

Figure 4.1 (Opposite) Overview of upcycling process and opportunities

How To Upcycle Materials from Existing Buildings

Seek Didactics

See
Sculptural and decorative solutions

Touch
Interact with and touch the materials

Learn
Understand the material journeys and how to reduce environmental footprint

Inspire
Showcase how the “waste” of today can be the resources of tomorrow

Analyse and Reuse

- Identify reuse opportunities
- Develop upcycle opportunities
- Downcycle as a last resort

Development of comprehensive material reuse strategy for disused materials. May include ambitious and innovative project-specific ideas for pioneering reuse scenarios and/or bespoke upcycled design elements.

Implement

- Circular economy tracker
- Contractor’s WLC and CE clauses
- Prototypes & mock-ups

Secure the long-term environmental benefits and delivery, by ensuring the material reuse and circular economy ideas are specified in contract. Prototypes and mock-ups used to ensure quality of bespoke designs.

Upcycling Opportunities

- Concrete Slabs
- External Glass
- Internal Glass
- Wind Canopies
- Podium Tiles
- Sprinkler Pipes
- Waste Brick
- Terrazzo
- Timber Studs and Panels
- Timber Furniture

4.1.2 Upcycling opportunities overview

An overview of the upcycling opportunities presented in this Section are shown in Figure 4.2.

While some of the opportunities suggest a direct reuse of the items, others require some remanufacturing. This Section goes into detail of each of the opportunities, and provides initial considerations on the upcycling processes.

It should be noted that these are early ideas, intended to test the possibilities of what to do with the existing materials. They are not resolved design ideas and should not be considered as such. Where renders are included, they are shown as illustrative sketches. Where there is appetite for exploration, these ideas will be developed as the design of the proposed development develops.

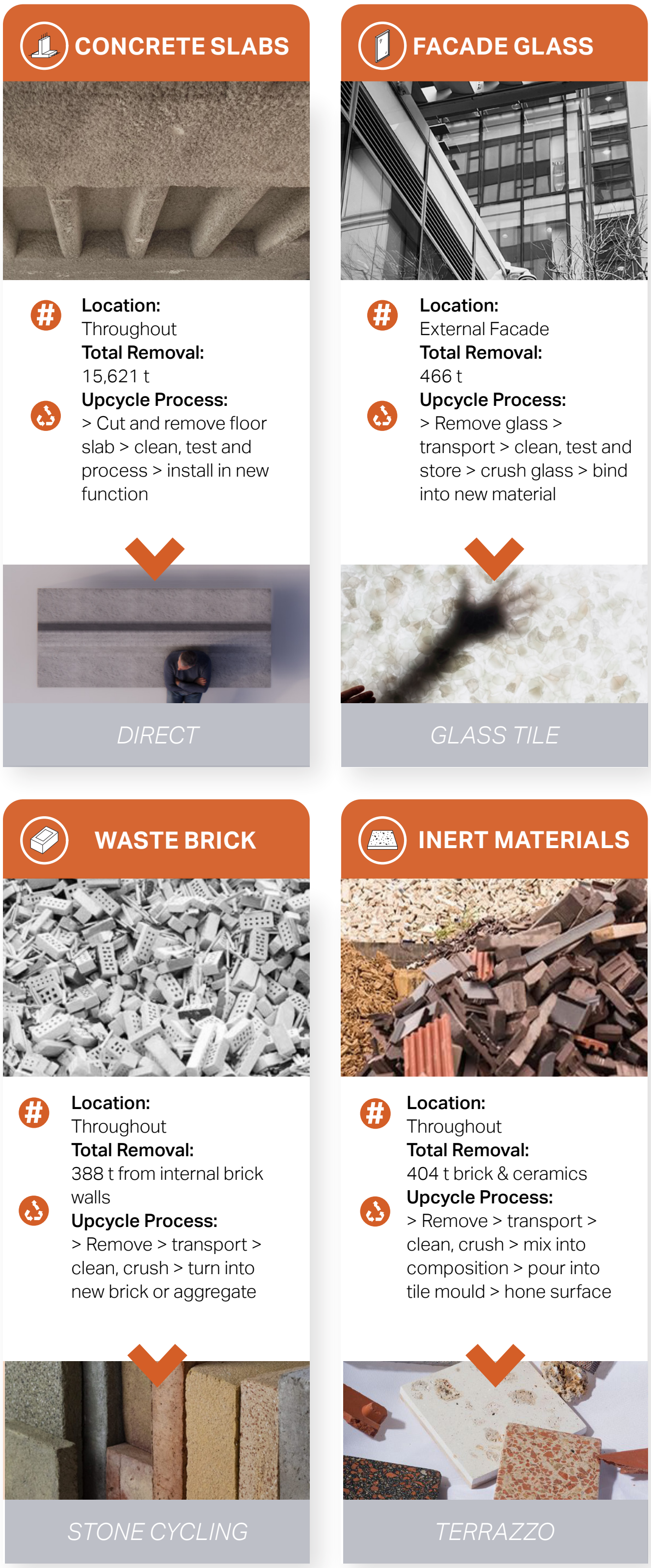


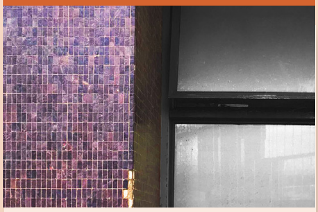
Figure 4.2 Overview of unique upcycling opportunities

INTERNAL GLASS

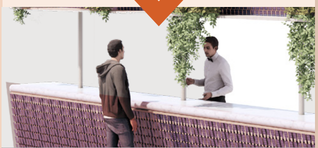
Location:
Ground Floor Level
Total Removal:
831 m²
Upcycle Process:
> Remove glass > clean, test and store > sell to external buyer or re-install as glass partitions

GLASS PARTITIONS

PODIUM TILES



Location:
Podium Exterior Columns
Total Removal:
131 m²
Upcycle Process:
> Remove from columns > clean, test and process > install in new function



REPURPOSED TILE

WIND CANOPIES

Location:
Wind Canopy
Total Removal:
16 t
Upcycle Process:
> Cut and remove canopy > clean and cut into fins > install in new function

CLADDING

SPRINKLER PIPES

Location:
Levels 1 and 2
Total Removal:
TBC
Upcycle Process:
> Cut and pipes > clean, test and bend > bend and fix into bike racks

BIKE RACKS

TIMBER STRUTS

Location:
Levels 3 - 34
Total Removal:
26 t
Upcycle Process:
> Remove > clean, cut, layout in tiles > fix and sand > install

END GRAIN TIMBER

TIMBER DOORS

Location:
Throughout
Total Removal:
4 t
Upcycle Process:
Direct reuse with reuse partner

TIMBER DOORS

SOFTWOOD

Location:
Timber joinery & doors
Total Removal:
4 t
Upcycle Process:
> Remove and clean > reform into furniture > deliver to user

TIMBER FURNITURE

4.2 Concrete Slabs

4.2.1 General

Concrete is the largest Key Demolition Product (KDP) identified in the existing building, estimated to be approximately 34,237 tonnes equivalent to 3,534 tCO_2e. This is from a number of sources, most of which is from the concrete floor slabs (16,922 tonnes).

As described Section 3, tests are being carried out to evaluate the feasibility of reusing cut out sections of the slabs in a structural application.

Alternative upcycling opportunities are suggested in this Section. These may employed if the slabs are not suited for a structural use, or indeed in combination.

Figure 4.3 Ribbed concrete slabs at Euston Tower

Concrete

	Volume	Weight	Impact
Floorslabs	5,064 m^3	12,153 t	1,252 tCO_2
Columns	1,815 m^3	4,355 t	449 tCO_2
Beams	1,681 m^3	4,034 t	416 tCO_2
Walls*	2,810 m^3	6,744 t	695 tCO_2
Ribbed slab	1,987 m^3	4,769 t	491 tCO_2

	Volume	Weight	Impact
Staircase	477 m^3	1,146 t	118 tCO_2
Roof deck	345 m^3	691 t	71 tCO_2
Blockwork	169 m^3	237 t	22 tCO_2
Mortar	53 m^3	101 t	20 tCO_2
Paving slabs	3 m^3	7 t	1 tCO_2

**Quantity differs from what is recorded in the Pre-demolition Audit as this document accounts for retention of the existing central core in the proposed development.*

Figure 4.4 Concrete component quantities in the existing building

Diagram for Removal of Concrete Slabs

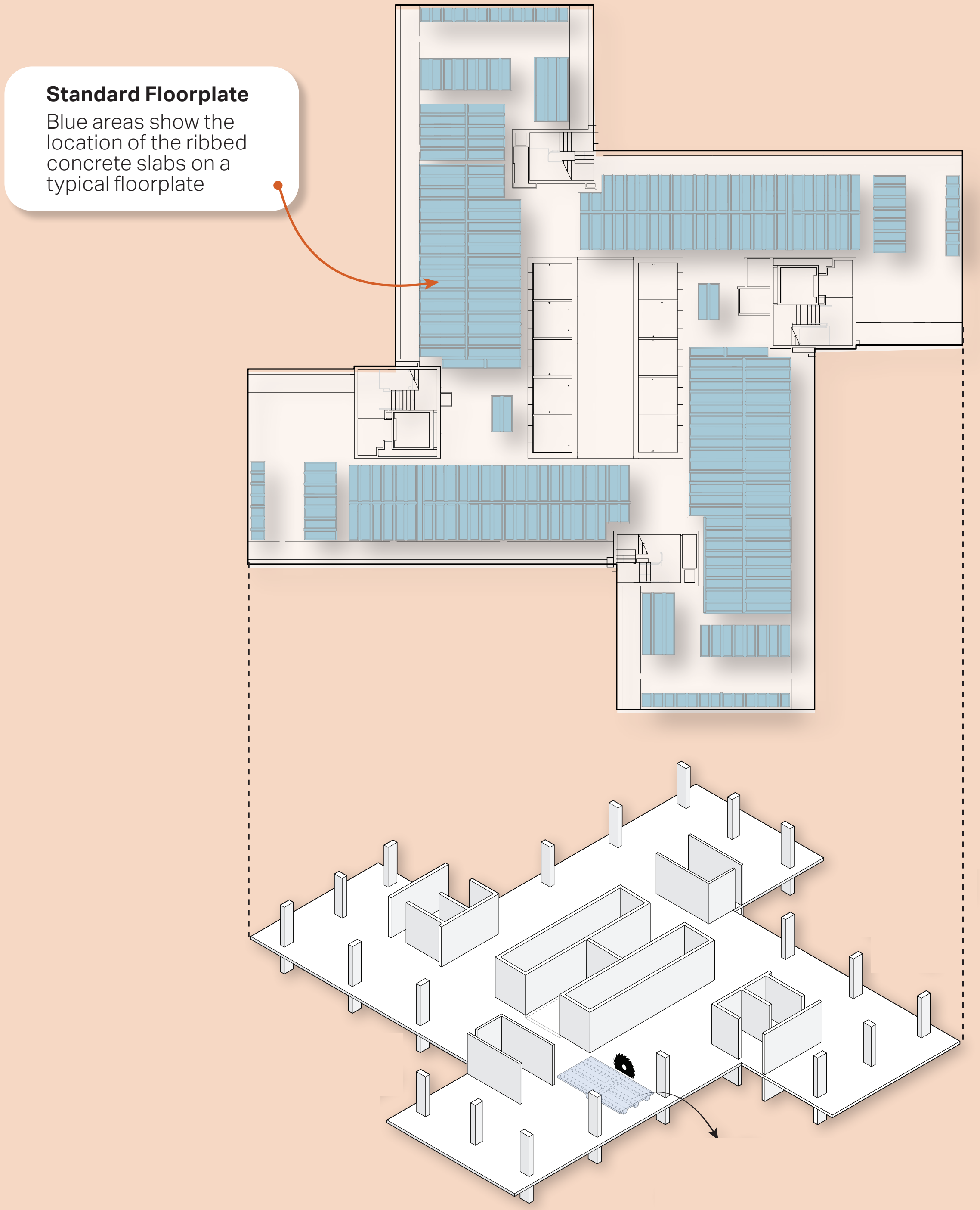


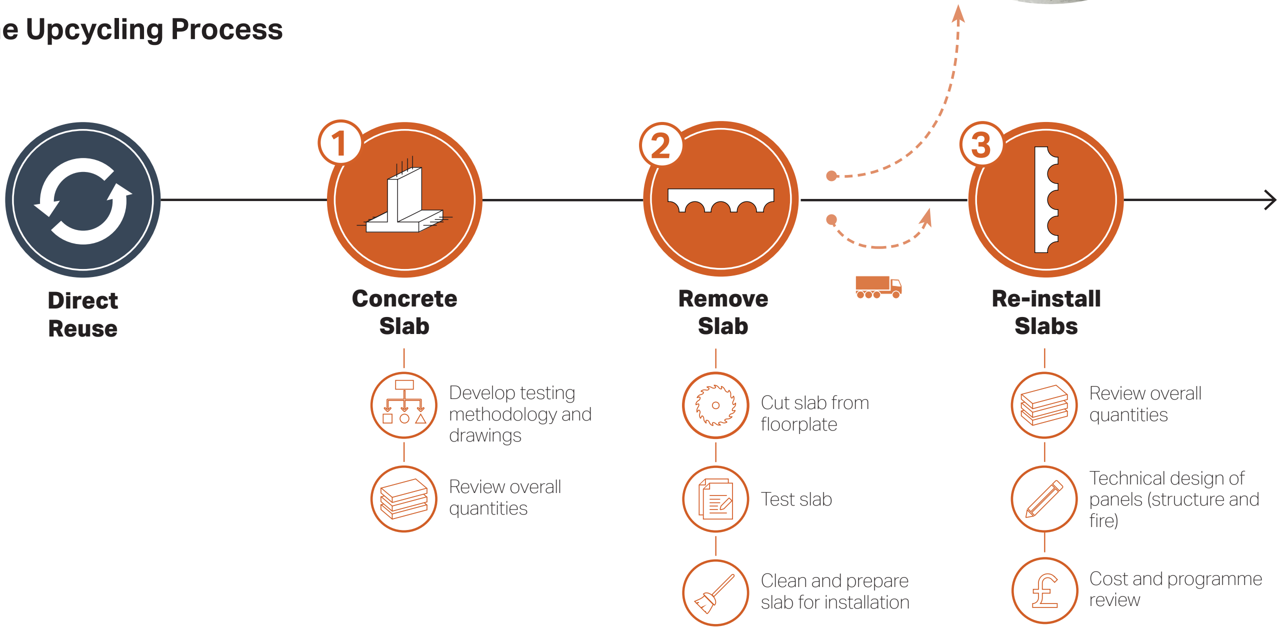
Figure 4.5 *Location of ribbed slabs and principles of removal*

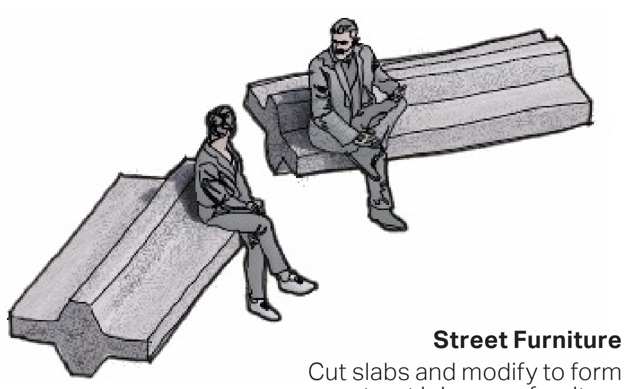
4.2.2 Upcycled concrete products

The ribbed slab elements could provide use in several non-structural applications: internal elements, street furniture, or as landscape items. Ideas are shown in the sketches in Figure 4.6 and Figure 4.7.

These could be used at the proposed development or elsewhere.

The Upcycling Process





Street Furniture
Cut slabs and modify to form street joinery or furniture

Figure 4.6 Upcycling process of ribbed slabs (above) and examples of transformation for use as street furniture (below)

Sketch Ideas for Reuse of Ribbed Concrete Slabs

Ribbed Wall Detail
The slabs can be directly reused as unique wall cladding elements

Joinery Detail
Cut and stack slabs to create a unique reception desk or bar joinery

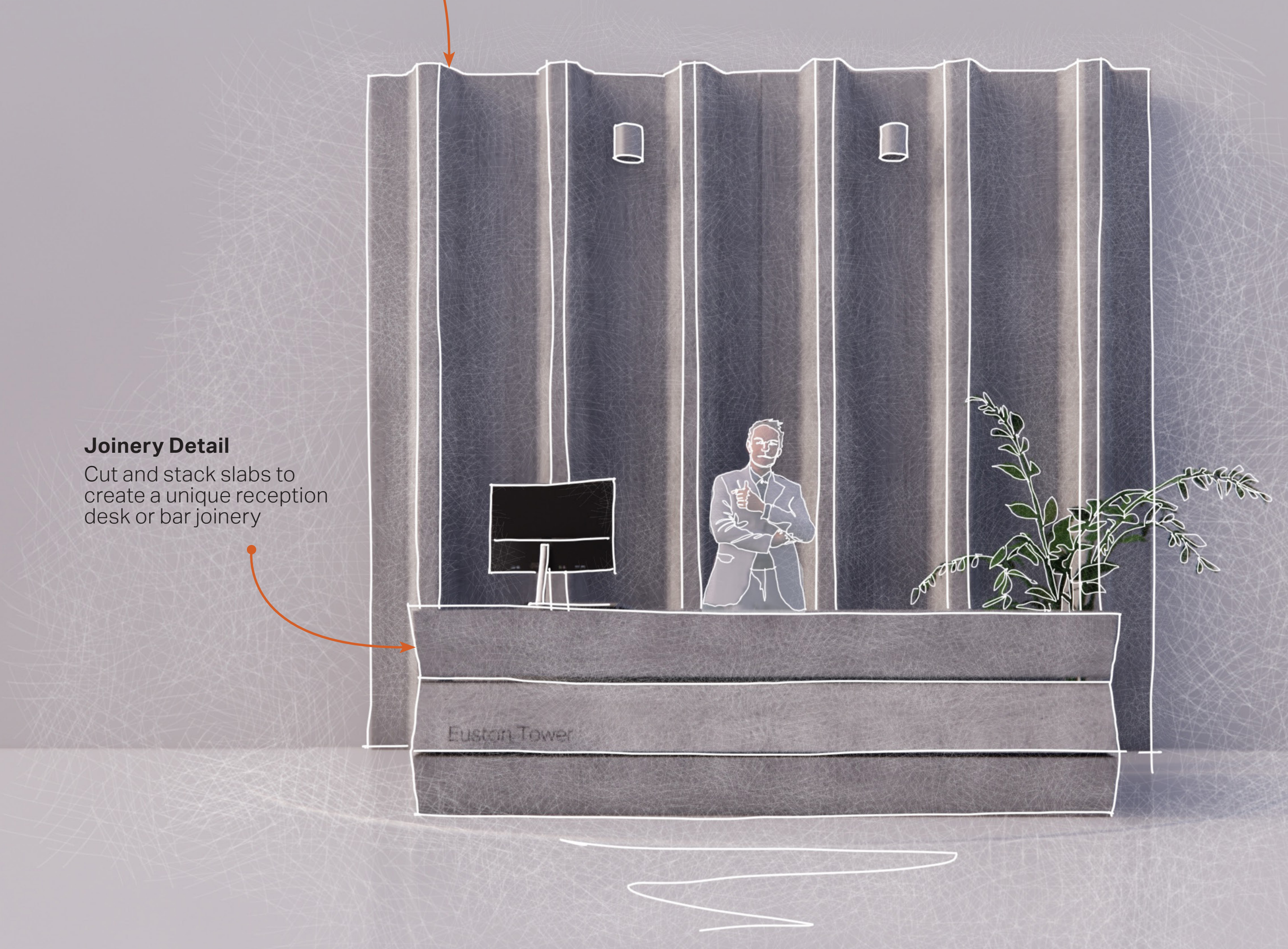


Figure 4.7 Example sketches of slabs as both a wall cladding and cut into pieces stacked as a furniture item (reception desk)

4.3 Facade Glass

4.3.1 General

With 378 tonnes of glass available from the deconstruction, the intention is to maximise the reuse potential of this valuable resource.

As described Section 3, tests are being carried out to evaluate the feasibility of recycling the predominant glass fractions back into high quality flat glass.

Alternative upcycling opportunities are suggested in this Section. These may employed if the glass recycling trials prove unsuitable, or indeed in combination.

Figure 4.8 Existing facade glass at Euston Tower

Overview of Existing Facade Glass

Roll Pattern Glazing

Rolled glass (plant room floors only)
Monolithic, 6mm thickness
(assumed Stippolyte)

No. glass panes per floor	75
Total glass mass (tonnes)	1

Secondary Glazing

Secondary glazing
Monolithic, 6 mm thickness
(assumed toughened with solar film)

No. glass panes per floor	150
Total glass mass (tonnes)	97

Vision Glazing

External vision glazing monolithic, 12 mm thickness (assumed toughened with solar film)

No. glass panes per floor	200
Total glass mass (tonnes)	279

Spandrel Glazing

Spandrel glazing
Monolithic, 6mm thickness
(assumed ceramic frit)

No. glass panes per floor	150
Total glass mass (tonnes)	89

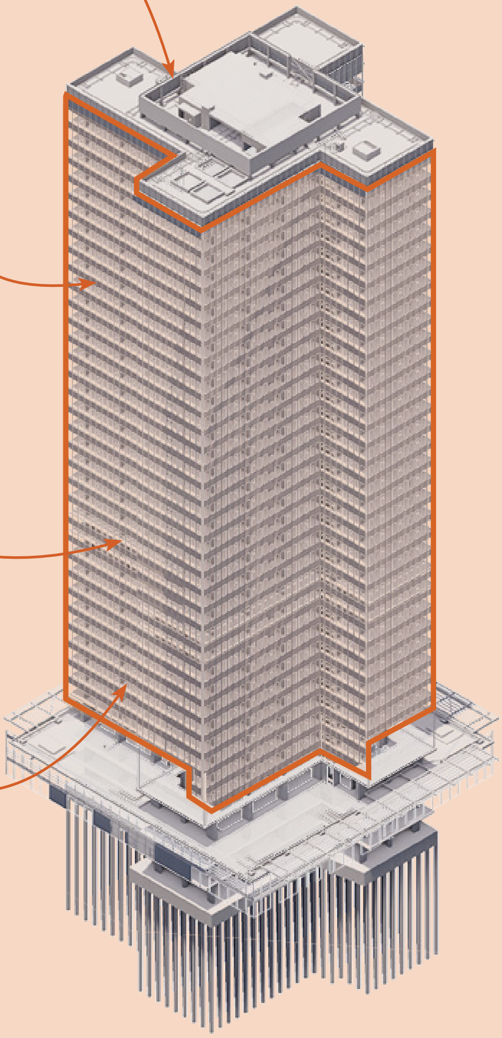


Figure 4.9 Primary glass quantities and qualities in the existing building

4.3.2 Upcycled Glass Tiles

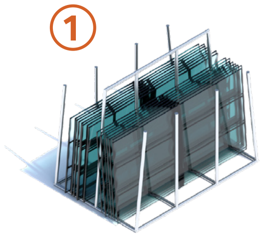
The glass elements could be upcycled into bespoke glass tiles used in a variety of applications, from wall finishes to joinery cladding. Ideas are shown in the sketches in Figure 4.11.

The upcycling process begins with the selective crushing of the reclaimed glass, to create glass cullet. This crushed glass is then arranged within custom tile moulds, and remelted to form bespoke glass tiles.

This process also holds the potential to create larger glass panels. These could be used at the proposed development or elsewhere.

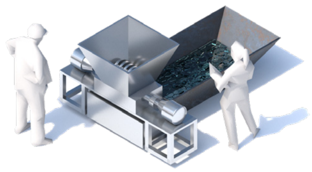
The Upcycling Process to Create Custom Glass Tiles

1



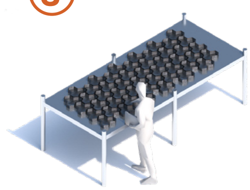
Glass stacked, transported, and stored

2



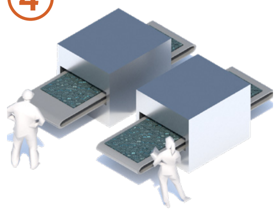
Sorted and crushed to cullet

3



Shaped into various tile shapes in moulds

4



Processed and remelted

Examples of Upcycled Glass Tiles

Material reference:
Pernille Bülow

Material reference:
Dr. Tyra Oseng-Rees

Material reference:
Magna Glaskeramik

Material reference:
Glass Brick

Figure 4.10 Upcycling process of glass tile (above) and material references (below)

Sketch Ideas for Using Upcycled Glass Tiles

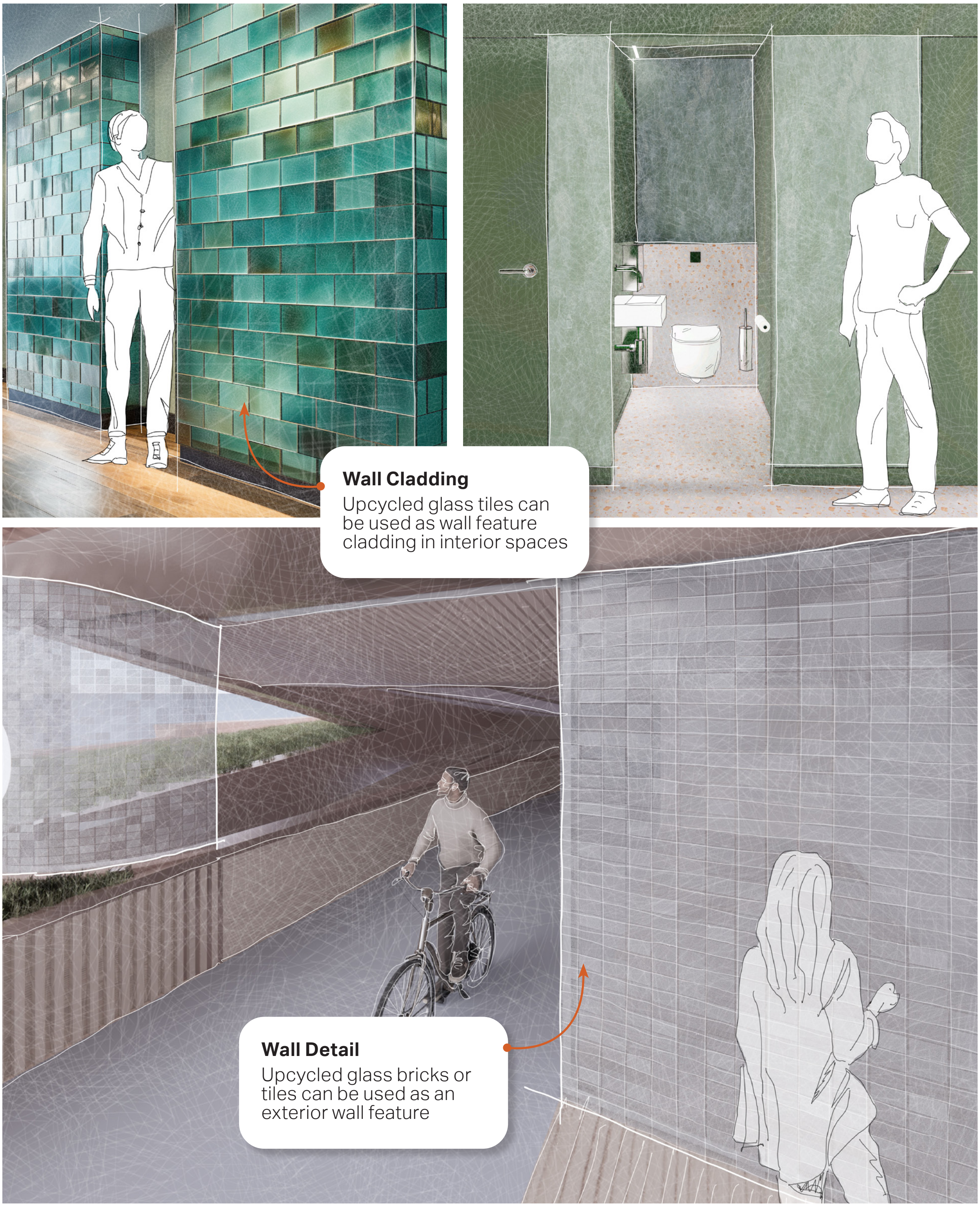


Figure 4.11 Sketch ideas for upcycled glass tiles used internally (above) and externally (below)

4.4 Internal Glass

4.4.1 General

The internal glazing should be directly reusable, where possible and where demand exists. Options for doing so include:

- **Option 1** Reuse internal glass directly within proposed development, for example for reception, offices, back of house, or WC areas
- **Option 2** Advertise the internal glass on distribution platforms for sale or donation.

For glass to be reused it needs to be dismantled carefully to avoid damage, collected on specialist steel A frame stillages, and handled and stored carefully. Should a reuse option be considered for the internal glazing, a more detailed audit of the panels should be undertaken. Additionally, a limited removal of some of the internal panels, by an appropriate contractor, will provide useful information on the ease of disassembly.

Figure 4.12 Existing internal partition glass at Euston Tower

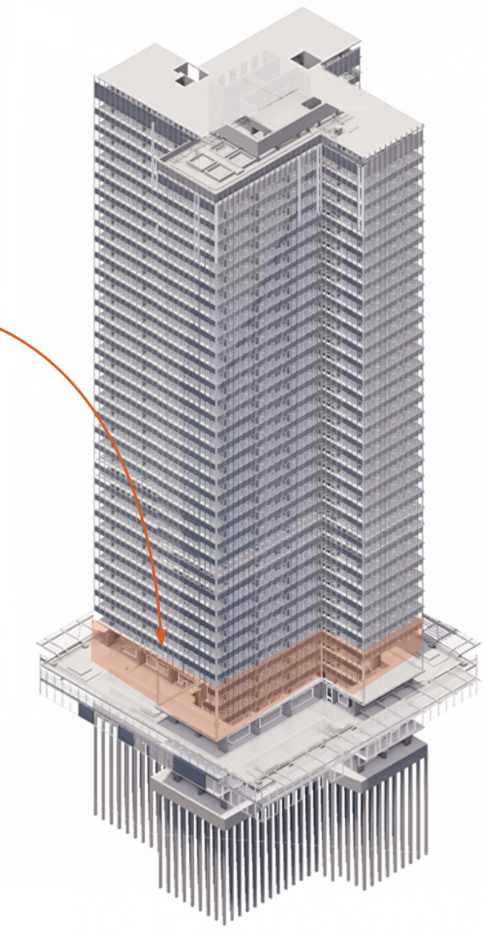
Overview of Internal Glass

Internal Glazing

Location
Levels 01 and 02

Quantity Area (m^2)	Thickness	Total
93	TBC	6.7 t

Reuse potential
High (either on site or elsewhere)



The Reuse Process

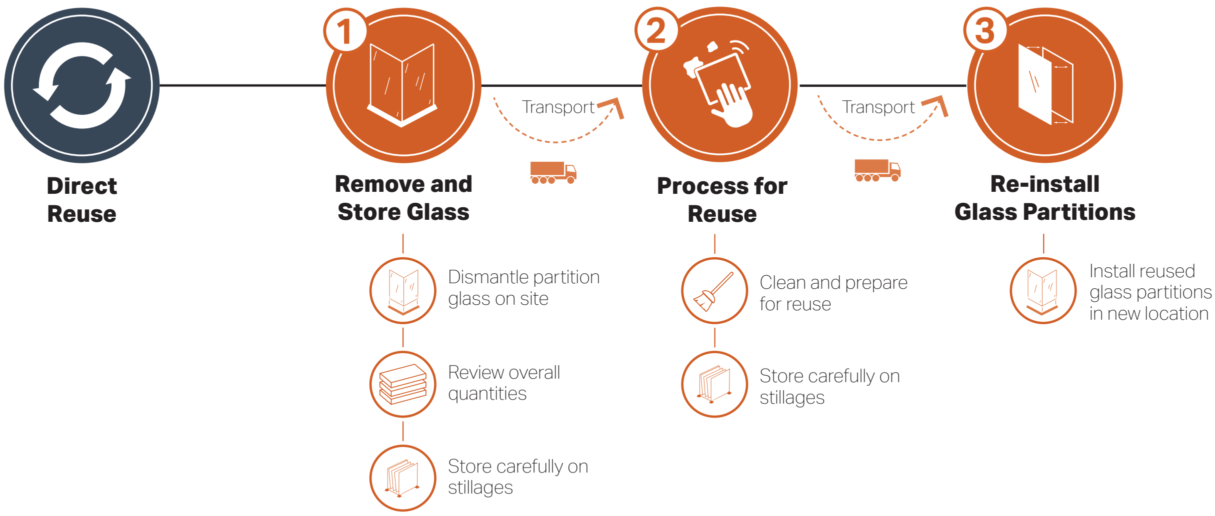


Figure 4.13 Location of internal partition glass (above) and reuse process (below)

4.4.2 Direct reuse applications

The glass partitions of high quality are directly reusable. For example, they could be used for creating new glass partitions for offices and meeting rooms, or as shower screens for use in the end of trip facilities. Sketch ideas are shown in Figure 4.14.

Reusing interior partition glass necessitates maintaining its original dimensions, as resizing is not typically a practical option, especially where glazing is used with its existing hardware. Consequently, applications should be sought where the glass can be installed in its existing state and size.

Sketch Ideas for Reusing for Existing Glass Partitions

Figure 4.14 Sketch idea for reused glass partitions for meeting rooms (above), shower screens (bottom left) and laboratories (bottom right)

4.5 Podium Tiles

4.5.1 General

Among the 6.6 m^3 of tiles available in the existing building, the red tiles from the external columns at the Level 02 podium, are suited to direct reuse in various applications.

These tiles could be effectively repurposed for cladding walls or flooring, using in terrazzo mixes, or incorporating into joinery.

The existing tile mortar is old and the individual tiles are lightweight, meaning the tiles are easy to remove by hand. Being lightweight also means the tiles are convenient to transport and store, resulting in reuse potential that is logistically straightforward.

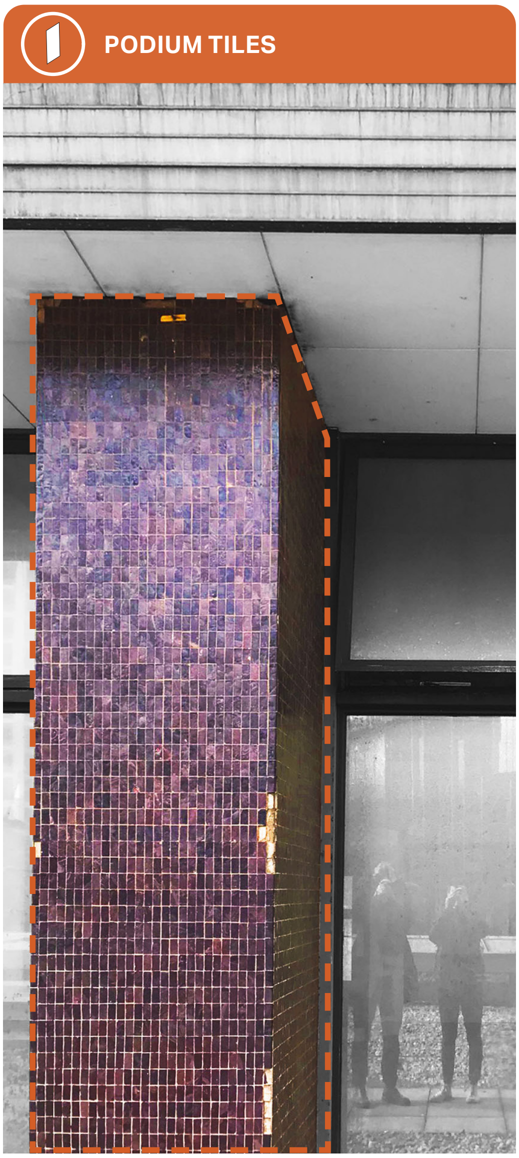
Thickness: 5 mm

Volume: Approx. 131 m^2

Disassembly: Easy

Location: Level 02 Podium

Reuse Potential: High



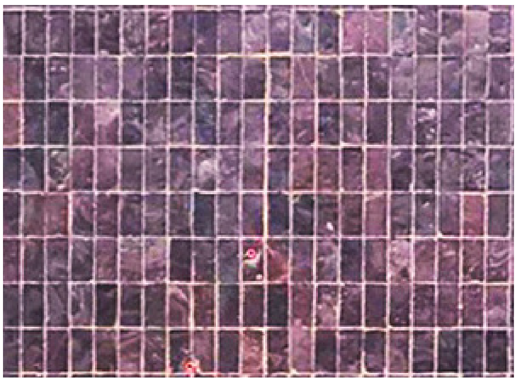
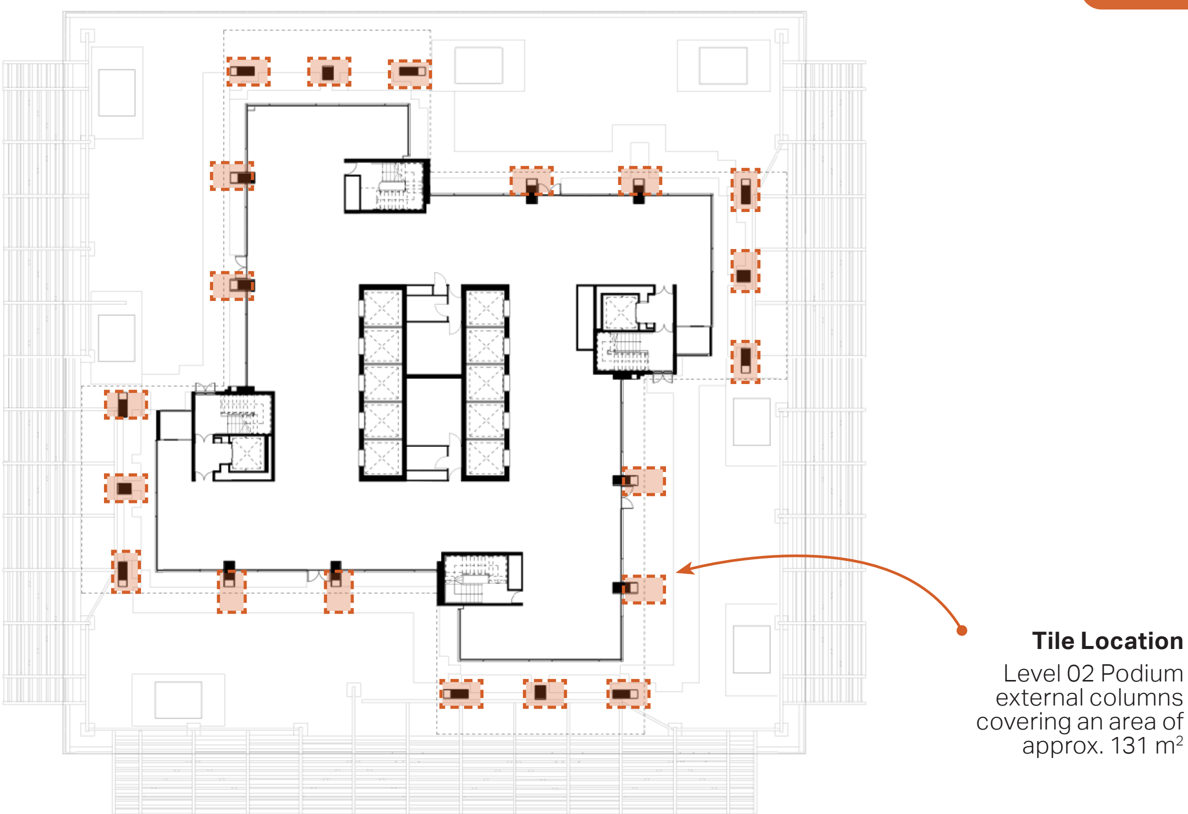


Figure 4.15 Existing red tiles on external podium at Euston Tower

Overview of Location of Podium Tiles



The Reuse Process

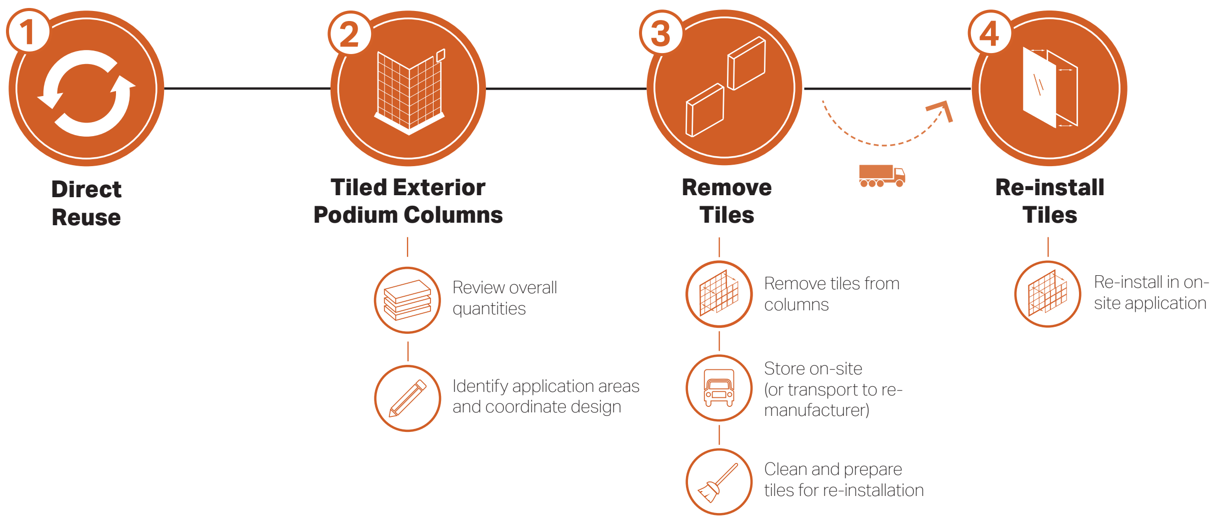
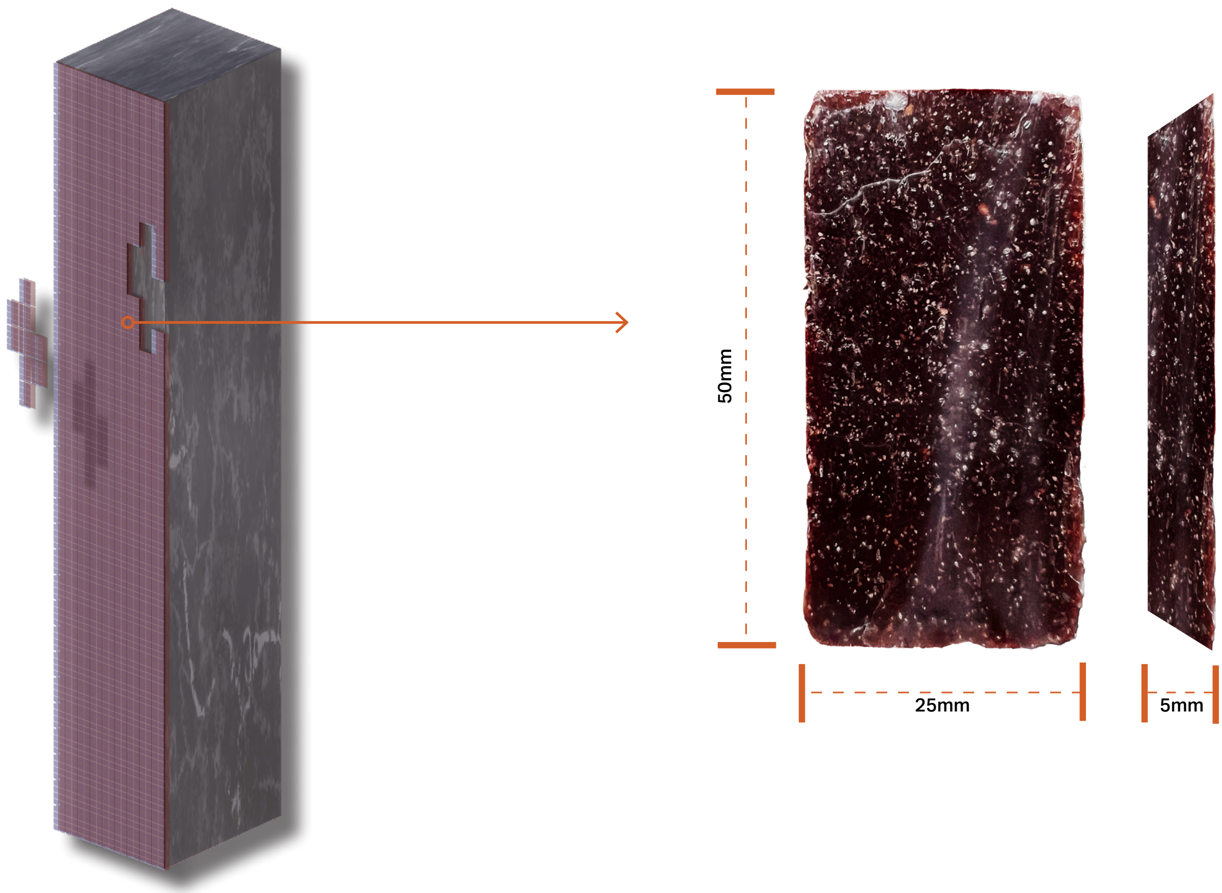


Figure 4.16 Location of the existing tiles on Level 02 podium (above) and the process for reusing the tiles (below)

Podium Tile Indicative Dimensions



4.5.2 Direct reuse applications

The tiles present an opportunity for versatile reuse. Their durability and adaptability make them ideal for repurposing in various aspects of the proposed development. These tiles could be effectively reused in an application similar to their in-situ condition — to clad walls or columns.

They could be similarly be integrated into joinery, serving as accents or features that showcase the resilience of these tiles and contribute to the ongoing circular economy narrative of the proposed development. This may be a better option for reuse as it avoids any weathering considerations.

These could be used at the proposed development or elsewhere.

Figure 4.17 (Opposite) Sketch idea for reused podium tiles in joinery

Sketch Reuse Idea for the Podium Tiles

4.6 Wind Canopies

4.6.1 General

The existing tower's wind canopies, made from aluminium fins, could find a new lease on life beyond their original purpose.

These robust, weather-resistant materials could be repurposed into furniture, innovative cladding features, or art installations. Any application would seek to harness the strength, durability, and quality of the existing materials.

Composition: Aluminium

Volume: 5.86 m^3

Disassembly: Medium

Location: Level 02 Podium

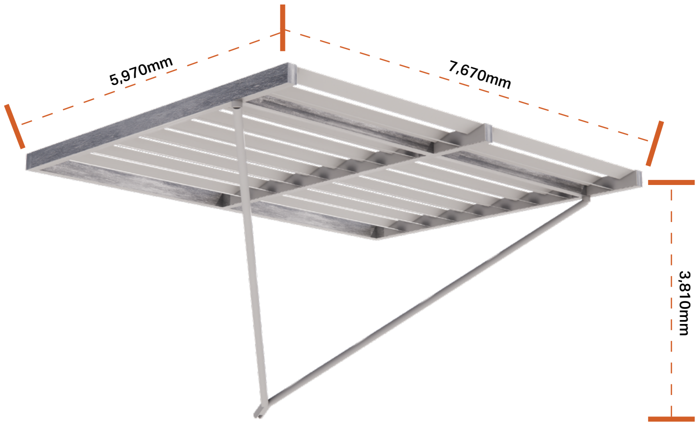
Reuse potential : High

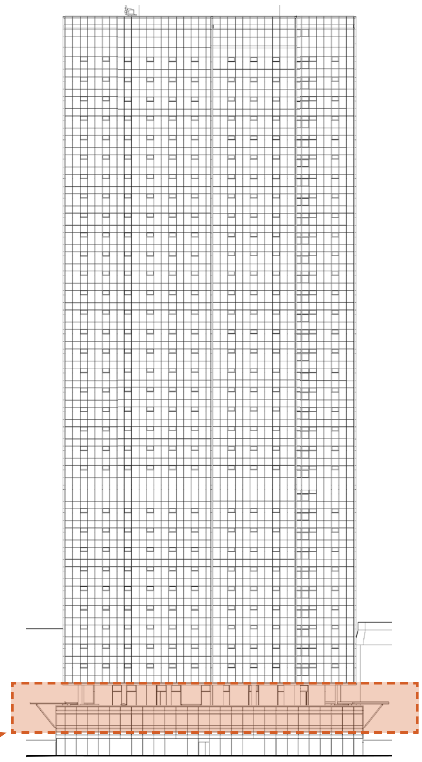
Embodied CO_2: 105 tCO_2

WIND CANOPIES

Figure 4.18 Existing podium wind canopy at Euston Tower

Location of Existing Wind Canopies





Wind Canopy Location
The wind canopies are located on exterior of second floor podium

The Upcycling Process

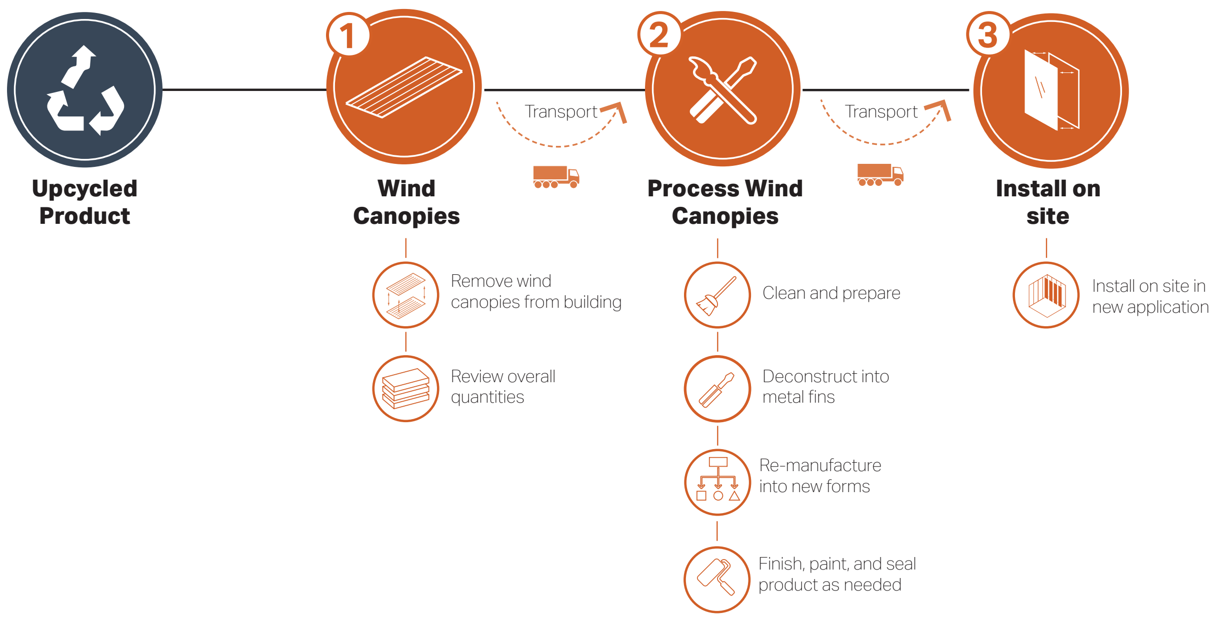


Figure 4.19 Location of the wind canopy on tower elevation (above) and the process for removing and remanufacturing the canopies (below)

4.6.2 Upcycling applications

The wind canopies could be re-purposed in a variety of ways, such as into joinery elements, wall cladding, or art pieces. See sketch ideas in Figure 4.20 and Figure 4.21.

These could be incorporated into the design of the proposed development or used elsewhere.

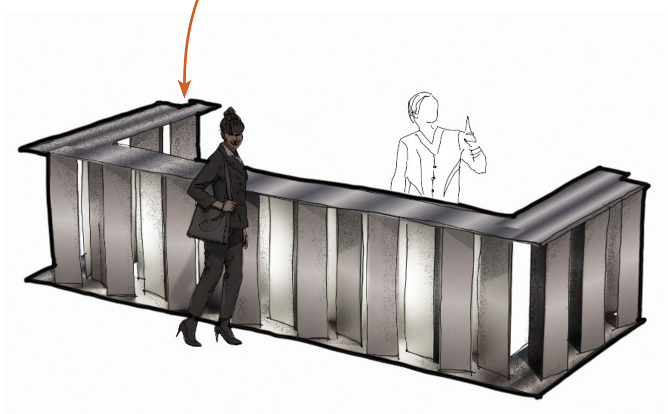


Figure 4.20 Sketch ideas for upcycled wind canopies in joinery or as cladding

Sketch Reuse Ideas for Wind Canopy

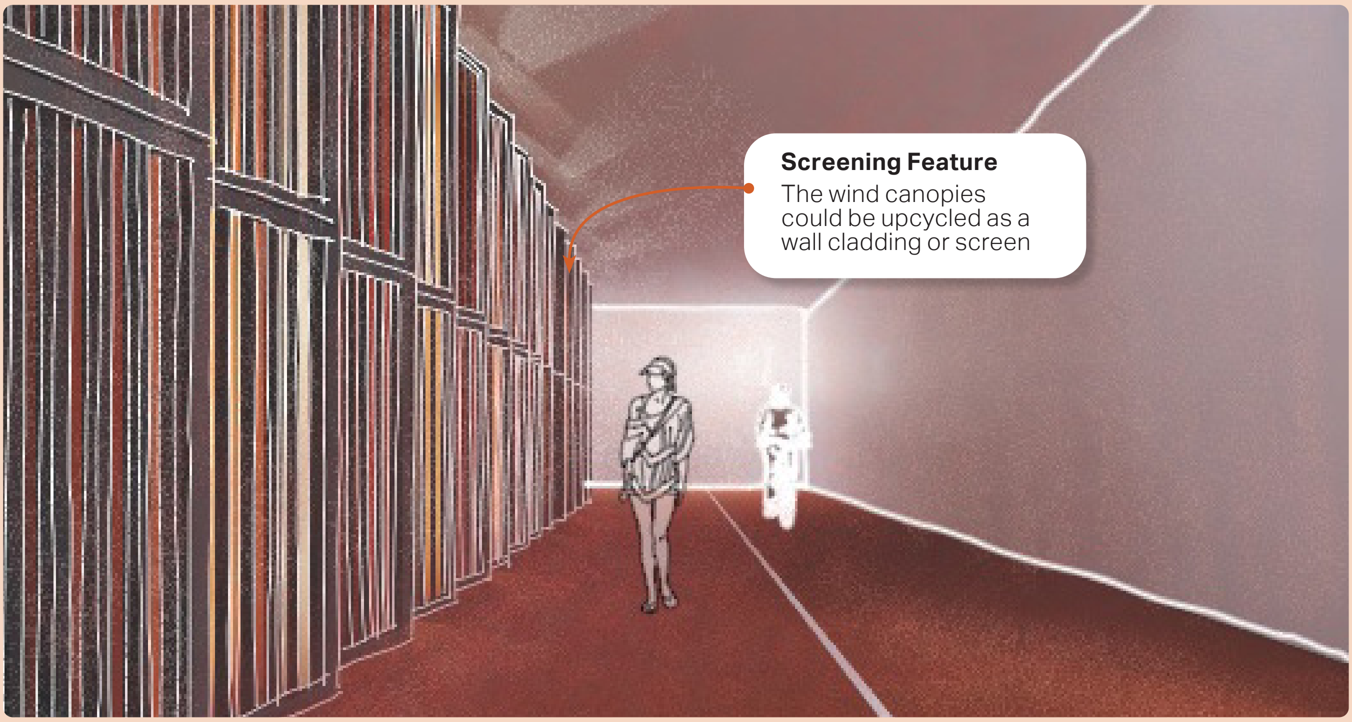


Figure 4.21 Sketch ideas for upcycled wind canopy as wall cladding (above) or art installation (below)

4.7 Fire Sprinkler Pipes

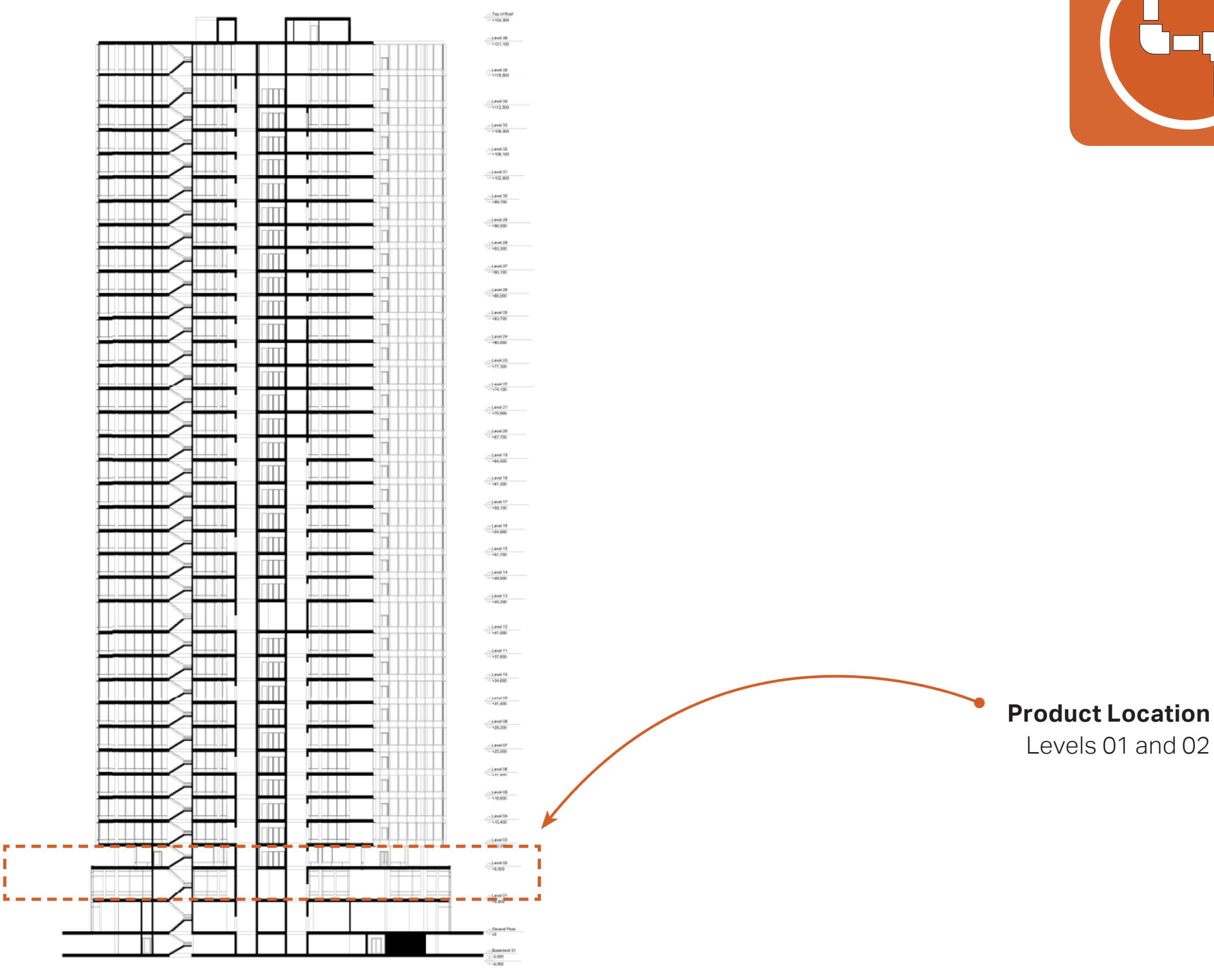
4.7.1 General

There are existing fire sprinkler pipes on Levels 01 and 02 of the building.

Sprinkler pipes are generally made from carbon steel, and there is a potential for remanufacturing the pipes for other uses.

Further surveys would be needed to evaluate the quantity and condition of the pipes, considering factors such as corrosion, integrity, and suitability for upcycling. Should they be used in an upcycling application, the pipes would need a degree of processing to clean them, remove coatings, paint, and other contaminants both internally and externally.

Figure 4.22 Levels 01 and 02 fire sprinkler pipes at Euston Tower



The Upcycling Process

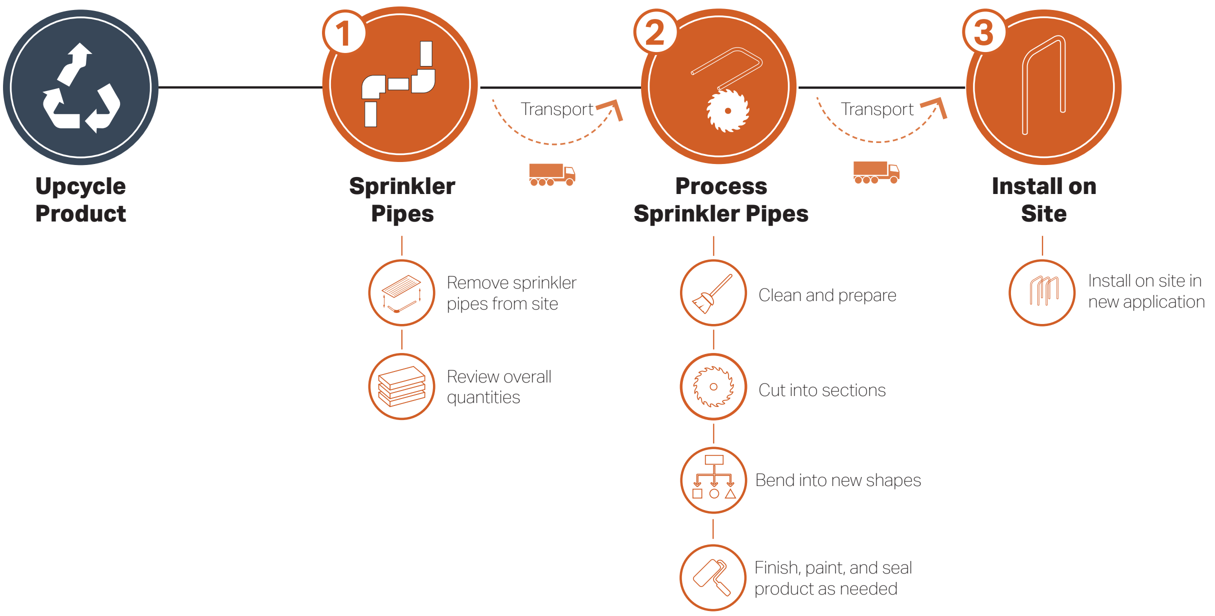


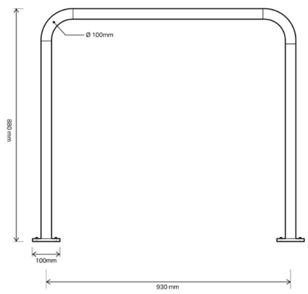
Figure 4.23 Location of sprinkler pipes in existing tower (above) and roadmap for the remanufacturing of sprinkler pipes (below)

4.7.2 Upcycled bicycle racks

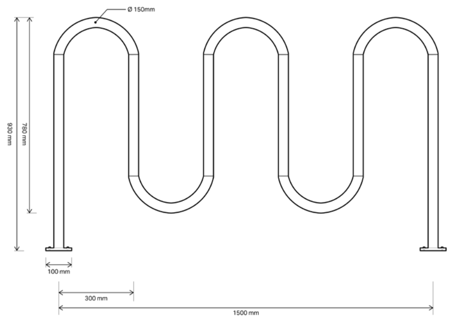
The sprinkler pipes could be remanufactured into bicycle racks. This would require close engagement with a manufacturer to clean and bend the pipes into shape for the bike racks.

Testing would also be required to ensure they are secure enough for use as bicycle racks.

This is an ideal opportunity to use in the proposed development, given the number of bicycle racks required by planning policy, especially for the short-stay spaces in the public realm, where the upcycled products can be on display. Of course, application could be found elsewhere.



Single Bicycle Rack



Multiple Bicycle Rack

Total Length: **2.5m**

Total Length: **5.6m**

Figure 4.24 Sketch ideas for potential resulting bicycle racks, shorter lengths are likely to be preferable

Figure 4.25 Render of the cycle facilities entrance in the proposed development

4.8 Waste-based Brick

Existing brickwork, glass, and mortar from Euston Tower could be repurposed using the innovative waste brick method pioneered by Stonecycling in the Netherlands.

Through strategic deconstruction and processing, these materials can be transformed into high quality upcycled bricks. This sustainable approach enables the salvage and reuse of the original materials, minimising waste and preserving virgin resources, and contributing to more sustainable and circular construction process.

Stonecycling's WasteBasedBricks comprised at least 60% waste, and upcycling approximately 90kg of waste per square meter.

Figure 4.26 Inert waste reference image from Stonecycling

Existing Brick Location

Brickwork used within existing cores at Euston Tower

Figure 4.27 Brickwork used within existing cores at Euston Tower

The Upcycling Process

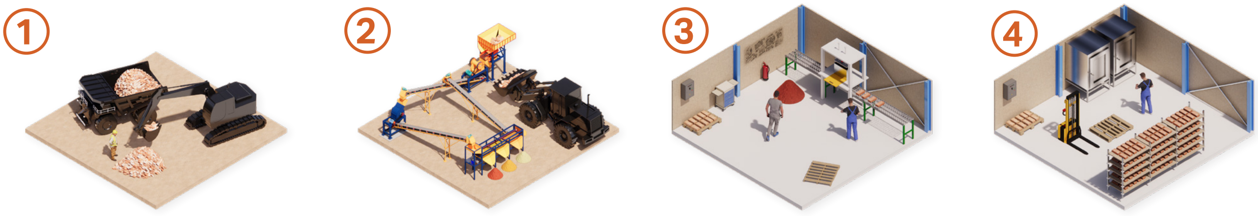


Figure 4.28 Process for manufacturing waste-based bricks from inert materials (above) and reference images of upcycled brick products (below)

4.9 Wasted-based Terrazzo

Creating terrazzo from waste brick, crushed concrete, and crushed glass is a sustainable and environmentally friendly construction material or design choice.

Terrazzo is a composite material made by embedding small pieces of various materials, like glass, stone, or metal, in a binder, typically cement or epoxy resin. Waste brick and concrete can be cleaned, crushed, and used as aggregate. Crushed glass should be crushed into small, consistent pieces which can be incorporated into the aggregate to give the recognisable colourful flecks that make up the iconic terrazzo look.

The design team has already engaged in trials for making basic terrazzo tiles using some inert materials from the existing Euston Tower. These will be developed as the design is progressed.

Terrazzo slabs and tiles are a versatile and durable material, and can be used as floor or wall cladding, in joinery, and in furniture design.

INERT MATERIALS

Figure 4.30 Terrazzo reference image from Lendager (Wasteland)

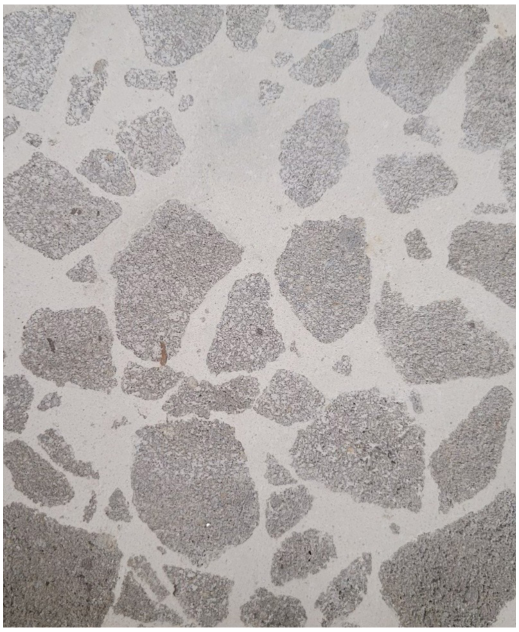
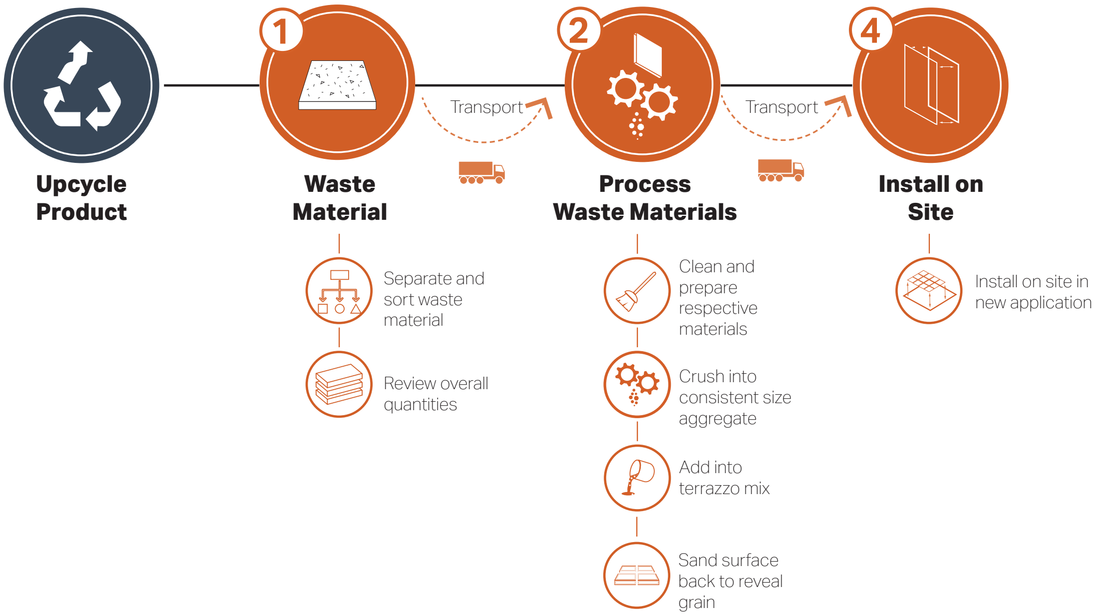


Figure 4.29 Trial terrazzo made using inert material from Euston Tower

The Upcycling Process



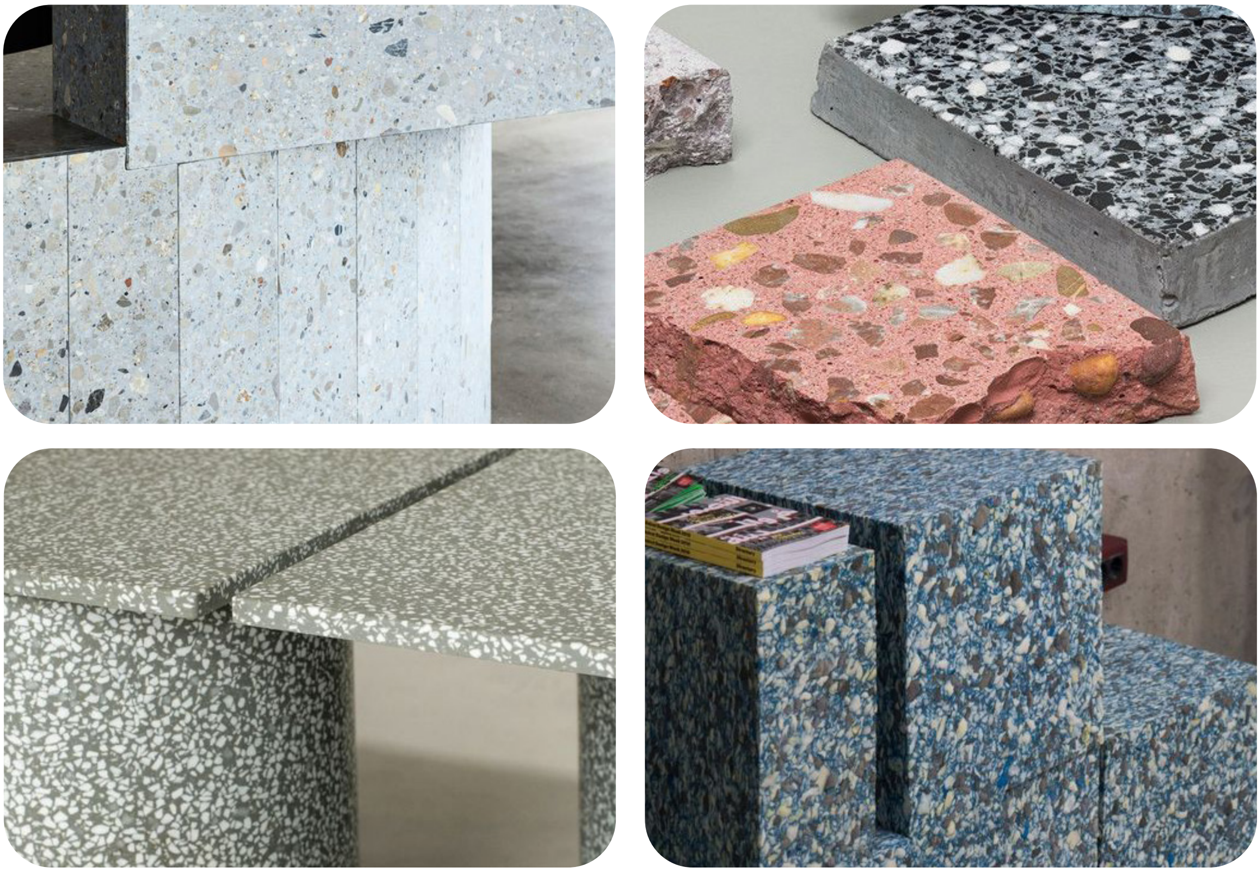


Figure 4.31 Process for manufacturing waste-based terrazzo from inert materials (above) and reference images of terrazzo products (below)

4.10 Timber

4.10.1 General

Timber is thought to be mainly present in the large number of doors throughout the existing building, as well as in the substructure for the secondary facade system. There is also a relatively small quantity of timber finishes which could be reused.

Theoretically, most of this timber is reusable. The recovery options are:

- Reuse in new development for good lengths of timber
- Advertise on distribution platforms to sell or donate
- Engage with a suitable third-party reclamation company, such as Community Wood Recycling
- Most of the solid timber can be recycled, usually into chipboard.

For any significant amounts of timber that seem to be coated or treated prior to 2007, it is recommended to test for preservatives containing hazardous substances.

Should a reuse option be further considered for the doors, a more detailed audit of the sizes available (and original suppliers, if possible) should be undertaken. They should also be classified in terms of whether they are fire doors or not, noting however that reuse would likely be in a non-fire door application.

A limited removal of some of the doors and frames will provide useful information on ease of disassembly and condition upon removal.

TIMBER

Figure 4.33 Existing timber doors at Euston Tower

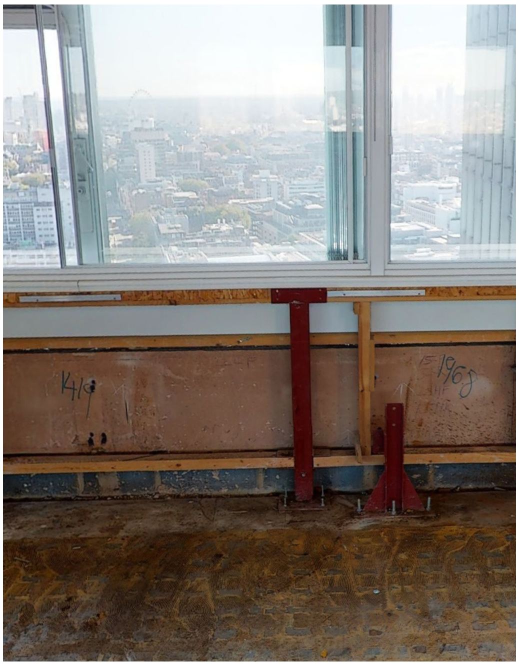


Figure 4.32 Timber in facade substructure at Euston Tower

Sketch Ideas for Timber Reuse or Recycling

Figure 4.34 Sketch ideas for either direct reuse or remanufacturing of existing timber elements

4.10.2 End grain timber flooring

End grain timber flooring could be made from repurposing timber from the existing building, as a sustainable and creative way to give extended life to these materials.

End grain is made by continuously cross-cutting or slicing timber into blocks or rounds, with the annual growth rings exposed on every piece.

Once installed, the end grain has a unique non-repeating appearance, is acoustically absorbent, and is a durable and resilient flooring finish. End grain timber flooring was used extensively across Europe and America in manufacturing factories, as it provided a hard-wearing and forgiving surface for dropped metal components.

The Upcycling Process

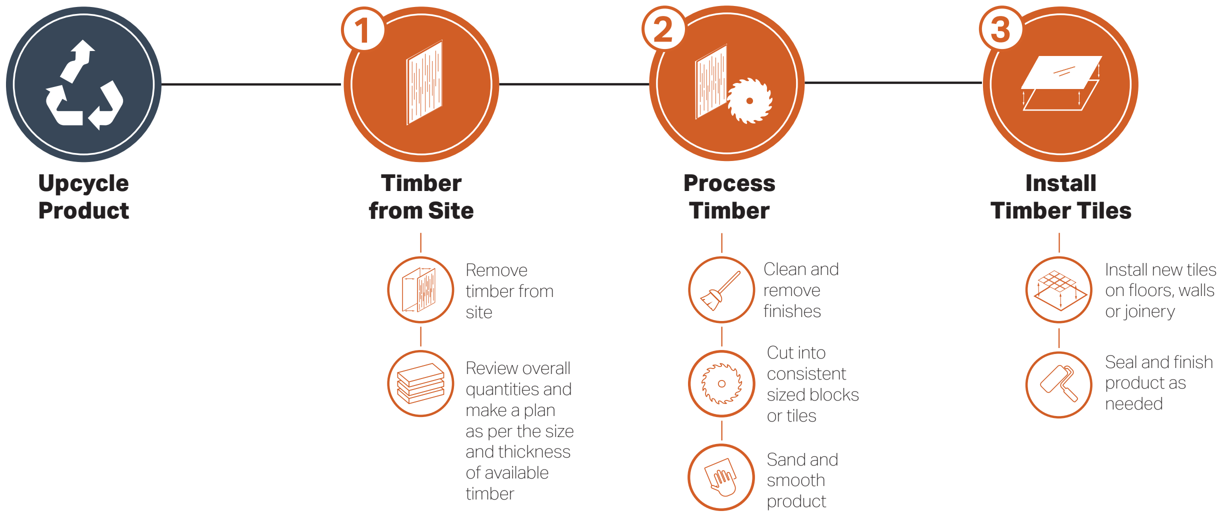


Figure 4.35 Process for remanufacturing timer into flooring (above) and reference images of end grain timber products (below)

4.10.3 Timber furniture

Where the quality of the existing timber is sufficient, it could be repurposed as bespoke furniture pieces, as a sustainable and creative way to give new life to these materials.

Like many of the more artistic ideas, this process could be given an informative function, and run as a series of upcycling workshops with the local community (e.g. as an upcycle cafe).

The resulting pieces could be used within select spaces in the proposed development, giving ownership and a sense of pride to members of the local community. Of course, the resulting furniture could be used elsewhere.

Upcycled Timber Furniture

Figure 4.36   Sketch ideas and reference images for upcycled timber furniture

4.11 Next steps

The early, sketch ideas described in this Section are intended to test the possibilities of what can be done with the existing materials. They are not resolved design ideas and should not be considered as such. Where renders are included, they are shown as illustrative sketches only.

Where there is appetite for exploration, these upcycling ideas would have to be further developed and evaluated.

Figure 4.37 illustrates a roadmap for the evaluation and mock-up process as the next step for developing these ideas.

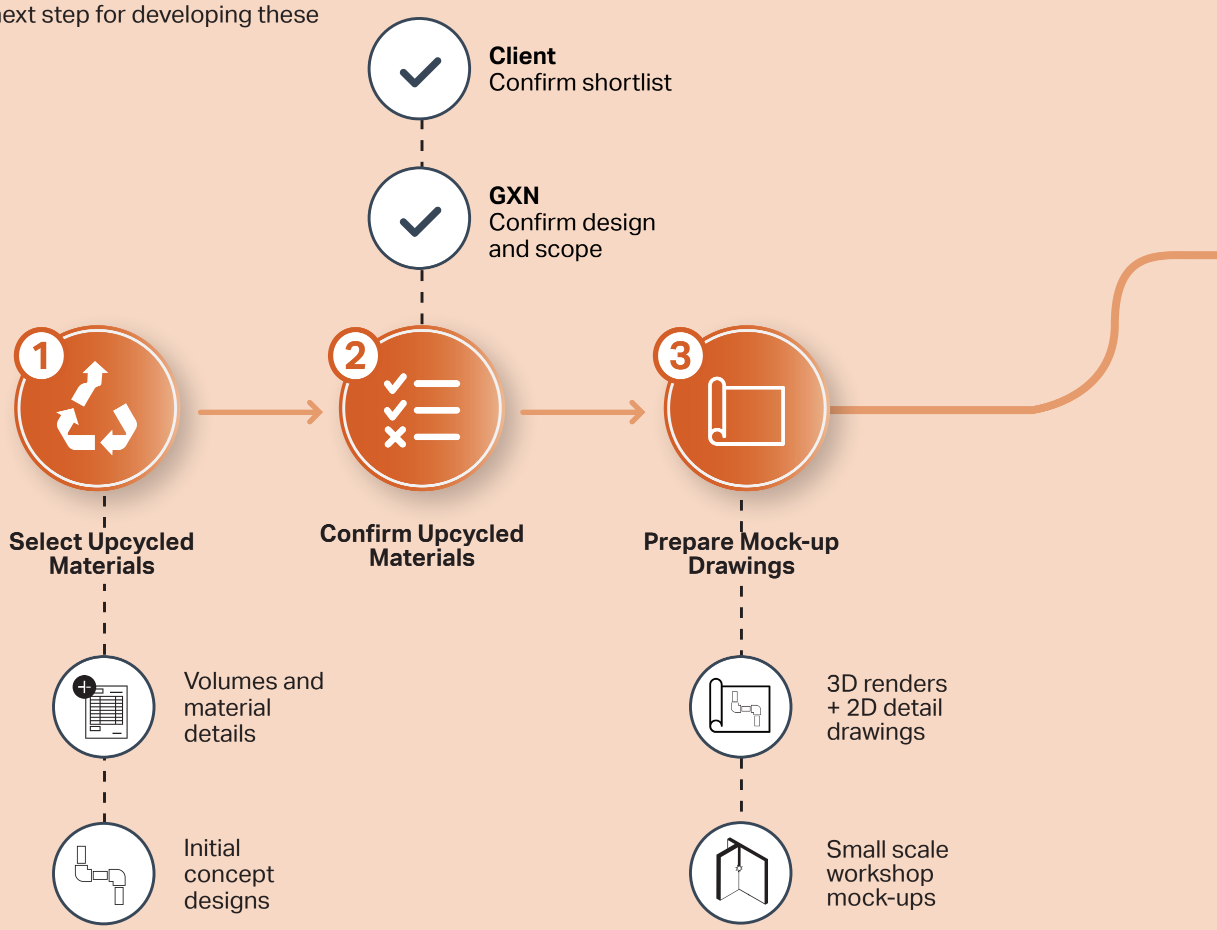
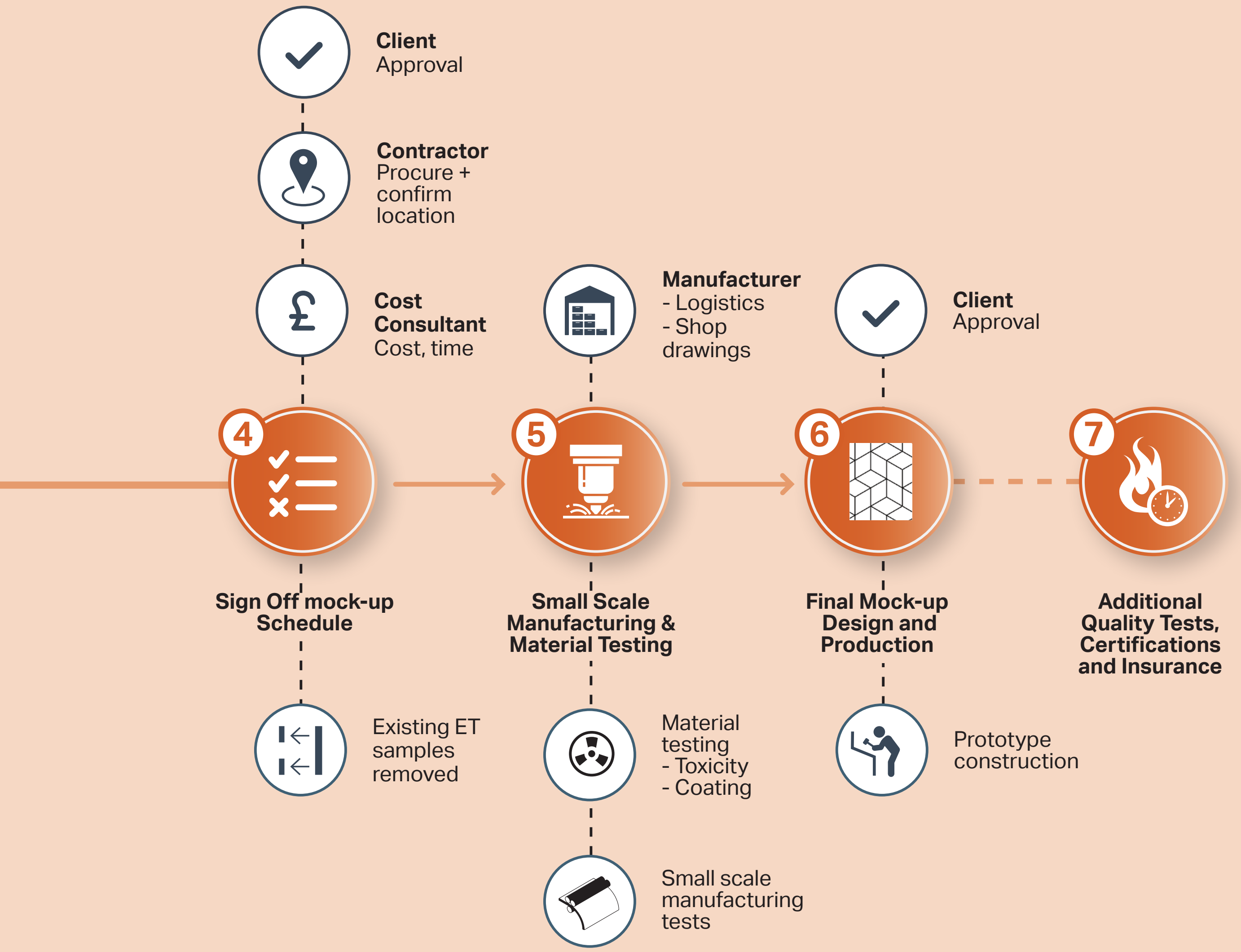


Figure 4.37 Roadmap for next steps in the upcycling process


Client
Approval
Contractor
Procure + confirm location
Cost Consultant
Cost, time
Manufacturer
- Logistics
- Shop drawings
Client
Approval
4
5
6
7
Sign Off mock-up Schedule
Small Scale Manufacturing & Material Testing
Final Mock-up Design and Production
Additional Quality Tests, Certifications and Insurance
Existing ET samples removed
Material testing
- Toxicity
- Coating
Prototype construction
Small scale manufacturing tests

Euston
Tower

3xn.com

GREATER**LONDON**AUTHORITY

Detailed Application Stage - Circular Economy Statement

Project details	
Project name	Euston Tower
Planning application reference number (if applicable)	British Land Property Management Limited
Applicant	
London Borough	London Borough of Camden (LBC)
Brief description of the project	Redevelopment of Euston Tower, including the partial retention (retention of existing core, foundations and basement), disassembly, reuse and extension of the existing building, to provide a 32-storey building for use as offices and research and development floorspace (Class E(g)) and office, retail, café and restaurant space (Class E) and learning and community space (Class F) at ground, first and second floors, and associated external terraces. Provision of public realm enhancements, including new landscaping, and provision of new publicly accessible steps and ramp. Provision of short and long stay cycle storage, servicing, refuse storage, plant and other ancillary and associated works
Author/s	GXN
Date of assessment	Nov-23
Number of Use Types	3
Use Class / Type	**Floor Area by use type (m2)**
Office (Class E(g(i)))	*74791*
Retail (Class E)	*748*
Retail/Community Space (Class E/F)	*2003*
Overall GIA (m2)	77542.00

Circular Economy Design Approaches

Circular Economy Design Approaches for Existing Structures / Buildings	Applicant Response
Is there an existing building on the site?	Yes
Is it technically feasible to retain the building(s) in whole or in part?	Yes
Is the existing building, or parts of the building, suited to the requirements for the site?	Yes, in part
The preferred strategy is:	**PARTIAL RETENTION and REFURBISHMENT**

Circular Economy Design Approach	Phase/Building/Area/Layer	Strategic Response
Refurbish	N/A	An extensive three-part feasibility study has been carried out, to evaluate the technical feasibility and viability of retaining the existing building on site, and to which degree the existing building can be retained and still suit modern requirements for the proposed development. This has been independently reviewed by a third-party. Feasibility Study Volume One, supported by a number of both intrusive and non-intrusive surveys, concludes that the existing services and facade system are no longer fit for purpose in line with current guidelines. It furthermore establishes that, despite the superstructure being in good condition, the extent of the upgrades that are required to bring the existing tower up to current building regulations and standards are extensive. The extent of upgrades required, and the quality and quantum of compromised space delivered, would make the resulting product challenging in the leasing market. Feasibility Study Volume Two concludes that in order for the existing tower to support alternative uses (those other than office use) substantial structural alterations are required to deliver the necessary upgrades to accommodate modern services and lift requirements. Considering the technical challenges in providing the necessary upgrades, as well as the resulting compromised space, low quality units, and policy non-conformance, the existing tower was shown not be appropriate for alternative uses. From the two studies it is concluded that a full retention and retrofit is not considered feasible either for continued office use or alternative uses, but that the existing substructure and parts of the superstructure could be retained.
Repurpose	Substructure, Superstructure	The existing tower foundation, basement and central core are retained as part of the proposed development. A range of options for re-purposing and retaining the existing tower has been considered in Feasibility Study Volume Three. It has been shown that an option that retains the existing foundation and basement, as well as the central core, provides the best balance of structural retention and quality, flexibility, adaptability and buildability, and whole life-cycle carbon emissions.
Disassemble / Deconstruct and Reuse	Superstructure, Space	A material strategy has been developed to ensure that the deconstructed materials and products are retained at the highest possible value. This includes identifying materials that could be suited for direct reuse or upcycling. The proposed development has a pioneering approach to material recovery through prototyping innovative approaches for reuse/recycling of difficult-to-handle materials like concrete and glass from the deconstruction. Early tests are being conducted to test innovative approaches to cutting out and reusing parts of the existing ribbed slabs. Refer to the Strategy for Material Recovery for more information. The existing fit out and finishes have already been stripped out and sent for either reuse or recycling. Refer to the Pre-demolition Audit for more detail.
Demolish / Deconstruct and Recycle	Services, Superstructure, Facade, Space	The development is committed to a 98% diversion from landfill of all demolition waste related to the scheme. Furthermore, a material strategy has been developed to ensure that the deconstructed materials and products are retained at the highest possible value. This includes ensuring that the materials that cannot be directly reused or remanufactured are carefully separated and recycled at the highest value possible. Refer to the Strategy for Material Recovery. The services and interior finishes from the existing building have already been stripped and the elements that were unfit for direct reuse have been treated for recycling. Refer to the Pre-demolition Audit for more detail.

Circular Economy Design Approaches for New Buildings, Infrastructure and	Applicant Response
Is the whole building designed to have a short life on its current site? (e.g. less	No
Is it foreseeable that the building will need to change use/function within its design life?	No
All developments should apply the 6 Circular Economy principles, including:	**Designing for DISASSEMBLY and ADAPTABILITY, MATERIAL REUSE ON-SITE and/or RECYCLING should be maximised**

Circular Economy Design Approach	Phase/Building/Area/Layer	Strategic Response
Building relocation	N/A	Not applicable according to decision tree (CE statement guidance figure 5) because the proposed development is expected to have a long life.
Component or material reuse	N/A	Not applicable according to decision tree (CE statement guidance figure 5) because the proposed development is expected to have a long life.
Adaptability	Superstructure, Shell/skin, Services	Adaptability is considered in the design of the superstructure, facade, and services. The structural system aims to allow for future adaptability, both regarding short term changes such as vertical connectivity, as well as medium-long term changes such as changes in building geometry or functionality. This is achieved with a soft core, regular structural grid, and an adaptable floorplate system. The facade enables this adaptability through a component-based construction with mechanical fasteners that can be non-destructively decoupled from the structure.
Flexibility	Superstructure, Space, Services	[illegible]
Replaceability	Services, Facade, Space	[illegible]
Disassembly	Superstructure, Shell/skin, Services, Space	[illegible]
Longevity	Substructure, Superstructure, Shell/skin	[illegible]

Circular Economy Design Principles by Building Layer

[illegible]

Bill of Materials

[illegible]

Recycling and Waste Reporting table

			PRODUCT AND CONSTRUCTION STAGE (MODULE A)						
1	Demolition Waste	Pre-demolition Audit	37420	0.483	3rd Quartile	0%	0%	0%	
2	Excavation Waste	Site Waste Management Plan (SWMP)	30408	0.392	2nd Quartile	0%	0%	0%	
3	Construction Waste	Site Waste Management Plan (SWMP)	5,185	0.067	2nd Quartile	0%	0%	0%	
			USE STAGE (MODULE B)						
3	Demolition / Strip-out Waste		0	0.000	-				
4	Construction Waste		0	0.000	-				
			Overall Waste (tonnes/annum)	Overall Waste (tonnes/annum /m²)	Performance Indicator (LPG Appendix 1)	Reuse Onsite (%)	Reuse Offsite (%)	Recycle Offsite	
5	Municipal Waste	Operational Waste Management Strategy (OWMS)	2927	0.038	3rd Quartile	0%	0%	0%	
6	Industrial Waste (if applicable)			-	-				
			MODULE A - MODULE C						
			Overall Materials (tonnes)	Overall Materials (Modules A-C) (tonnes /m²)	-	Reuse Onsite (%)	Reuse Offsite (%)	Recycle Offsite	
7	Total Materials		0	0.000	-				

Circular Economy Targets

Circular economy targets for existing and new development	Policy Requirement	Target Aiming For (%)	Policy Met?	Explanation (How will performance against this metric be secured through design, implementation and monitoring?)
Demolition waste materials (non-hazardous)	Minimum of 95% diverted from landfill for reuse, recycling or recovery.	98%	Exceeds Policy	The various demolition protocols and waste hierarchy will be followed. If feasible, a strategy of re-use on site will be pursued. Where materials cannot be recycled or re-used on site, the Principal Contractor will identify opportunities for potential re-use of materials off-site. The applicant will refer to the London Waste Map to consider opportunities for using local sites to manage materials and waste. A Site Waste Management Plan (SWMP) has been produced. The Principal Contractor will include information on the pre-demolition audit in the final SWMP. The demolition contractor will put procedures in place for segregating and storing demolition waste prior to collection by a licenced waste contractor.
Excavation waste materials	Minimum of 95% diverted from landfill for beneficial reuse.	95%	Yes	There will be some excavation works associated with the construction of foundations and basement. Where feasible (in accordance with specific physical and chemical composition) this material will be reused off site for beneficial reuse, including quarry restoration or as material fill. A Site Waste Management Plan (SWMP) documenting measures to reduce construction, demolition and excavation waste has been produced. The contractor for below grounds work will put procedures in place for segregating and storing excavation waste prior to collection by a licenced waste contractor.
Construction waste materials	Minimum of 95% diverted from landfill for reuse, recycling or recovery.	96%	Exceeds Policy	A Site Waste Management Plan (SWMP) has been prepared for the proposed development. Construction waste will be separated into recyclable waste streams before removal from site for reuse or disposal. A range of measures will be investigated to facilitate the minimisation of waste generation. The volume/tonnage of waste generated (or sent off site) as well as the percentage or volume/tonnage reused, recycled or disposed will be recorded throughout the construction phase. The Principal Contractor will provide a monthly report to the applicant on the progress of the Waste Management Strategy. Monthly reporting of all construction waste data throughout the project checked against what would be expected based on the stage of the project, invoices, etc., to validate completeness of waste reporting data.
Municipal waste	Minimum 65% recycling rate by 2030.	65%	Yes	A dedicated bin store accommodating recycling and refuse bins will be provided for the proposed development. The development will be designed with adequate, flexible, and easily accessible storage space and will support the separate collection of dry recyclables. Space will also be provided to allow for storage of food waste and glass waste prior to collection. This will demonstrate how the development has taken into account sustainable methods for waste and recycling management during its operation in order to meet requirements from the London Plan and London Borough of Camden policies and all applicable legal requirements. Tenanted areas will be provided with suitable segregated waste receptacles which will support the separate collection of residual waste, dry mixed recyclables (e.g. plastics, metals, glass etc.), mixed paper, card and cartons, glass waste and food waste. On site FM or staff will be required to transport the waste from tenanted areas to the commercial waste store, located at basement level and segregate the waste into the appropriately labelled bins. The commercial waste store will accommodate sufficient storage for residual waste, dry mixed recyclables, mixed paper, card and cartons, glass waste and food waste. Residual waste and recycling will be stored in 1,100L Eurobins, with food waste and glass waste will be stored in 240 L wheeled bins. The municipal waste recycling rate has been calculated using the estimated weekly waste generation which is based on metrics extracted from BS5906:2005 per class use. It is anticipated that the proposed development will generate significantly less waste than estimated due to lower occupancy rates associated with life sciences and recent trends towards paperless offices and hybrid working practices. The developer will be contractually responsible for all operational waste reporting for the Proposed Development. This reporting will be based either on number of container lifts per waste stream, or collection weight data if available. Data requirements and reporting methods will be agreed with the relevant authorities once all elements are occupied. Refer to Operational Waste Management Strategy (OWMS) for further details.
Recycled content	Minimum 20% of the building material elements to be comprised of recycled or reused content.	25%	Exceeds Policy	New materials to be tracked as part of BREEAM sustainable procurement process.
Additional requirements	**Policy Requirement**	**Please acknowledge acceptance for a planning condition**		**Please set out an indicative timescale and responsible party for the provision of this information**
Post-Construction Report	A CE Statement is required at post-construction (i.e. upon commencement of RIBA Stage 6 and prior to the building being handed over, if applicable. Generally, it would be expected that the assessment would be received no more than three months post-construction)	It is accepted that the Post Construction Reporting will be conditioned		The post construction report will be completed within 3 months of practical completion of the project. This will be included in the Principal Contractor's prelims.

Adaptation & Disassembly Guide - BREEAM

Euston Tower – Stage 2

Contents

1 Introduction

This document is intended to summarise the strategy and proposed actions at RIBA Stage 2 to promote the functional adaptability and design for disassembly of the Euston Tower development, in line with the requirements set out in the BREEAM 2018 Wst06 section and ISO 20887:2020. Included in the following pages are recommendations and design measures that facilitate the potential for future change of use of the development. The report is required to be reviewed and updated at RIBA Stage 4 with supporting evidence and information to confirm that the measures have been implemented in the final design.

This document is populated by a number of different consultants (primarily architects and MEP consultants), and therefore, to ensure that this document is robust and can be used as BREEAM submission evidence to meet the BRE QA quality control requirements, the email from each contributing consultant that contains the return of this report will be included as evidence to demonstrate chain of custody. The BREEAM assessor will compile the responses into a single master report which will be submitted as evidence to the BRE.

There is clear value in undertaking such an exercise for new developments, and it is important that this exercise is undertaken during the early concept. design stage to ensure that best-practice thinking on the relevant subjects is considered from the earliest stage.

ISO 20887: 2020 provides a framework for disassembly and adaptablity principles and key issues that should be considered, particularly by the designers.

The following has been established to help direct the subsequent design and service life planning process:

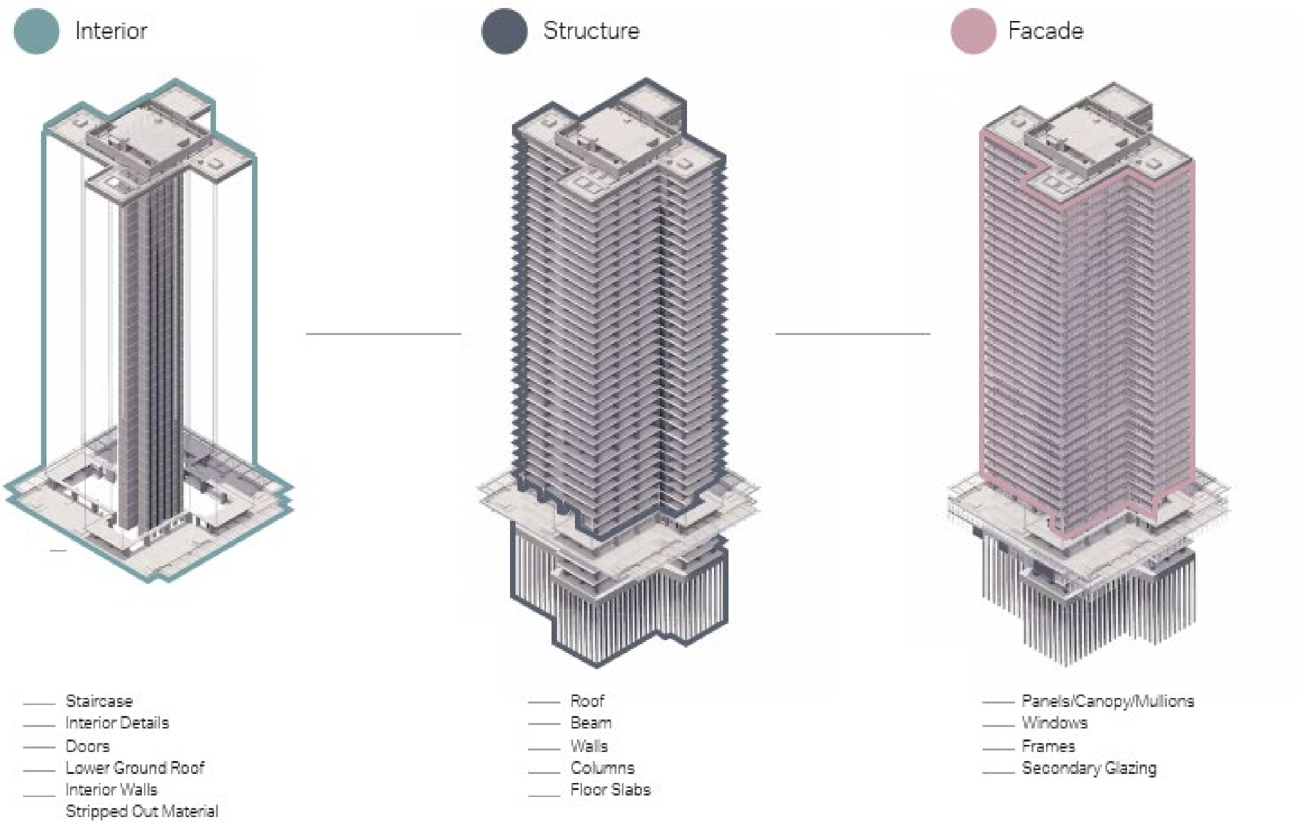
- required service life of the construction works — this can be highly variable from a temporary structure to infrastructure with several-hundred-year service life requirements;
- expected use(s) of the construction works over its required service life — is it going to be a single use type, such as a dwelling; or is there likely to be multiple use types, such as commercial, retail and leisure;
- consideration of staged development to meet the changing demand or alternative uses;
- ownership of the asset — for example, a public sector long-term infrastructure asset versus a speculative commercial building with multiple tenants; this could also be relevant if leasing of products or systems form part of the business model;
- operation of the asset — who will maintain the asset and be responsible for documentation storage and transfer of information;
- any specific options, targets, benchmarks and objectives relating to adaptability, disassembly or outcomes depending on these, such as re-use potential or reduction of life cycle impacts;
- review of the regulatory and policy environment, including compliance requirements and incentive programs;
- review of foreseeable economic and market risks; — likelihood of obsolescence;
- length of supply contracts.

Please note this document is in DRAFT format. The final document will be completed before handover and the relevant supporting documentation will be included.

2 The Development

Office with Research and Development

BREEAM ‘Outstanding’



Project description Project description

3 Functional Adaptation

3.1 Feasibility

Feasibility is necessary to accommodate changes in use type, demographics, or user needs. The initial cost may be balanced against the future cost of adaptation. The needs of users might also change with respect to limitation of physical abilities during the course of time. Also, adaptations can be sequential, occurring over time, or parallel, able to perform various functions, typically repeatable over a period of time. Specific adaptations in both parallel and sequential modes are less abstract and more clearly defined in functional requirements and typically take precedence over general adaptations. If the principles of universal design are taken into account at the outset (e.g. by respecting the space needed for manoeuvring a walking frame or wheelchair, the door width, the absence of thresholds or the installation of ramps and lifts), it can avoid the need for costly conversion at a later date.

Content Requirement

The likelihood to contain multiple or alternative building uses, area functions and different tenancies over the expected life cycle, e.g. related to the structural design of the building.

Design Strategy

Euston Tower has been designed as a best-in-class office with provision for both traditional office and laboratory-enabled spaces to leverage its position in the Knowledge Quarter. The tower is located at the South-east corner of the Regent's Place Campus. The current scheme provides approximately 30,000 m2 NIA of office space and 14,000 m2 NIA of lab-enabled space supported at ground by a multi-level podium comprising a mixture of programmable spaces for both the local community and building occupiers.

In the current scheme, approximately 30% of the floors are designed to support future use as potential laboratory space. This is enabled through additional allowance in terms of MEP design and a structural design that can meet the higher vibration criteria. A baseline lab-enabled specification is proposed, with possibility for operators to retroactively increase specification should they require (e.g. additional structural hangers to improve vibration performance).

The core and floor layouts have been designed to accommodate various tenant scenarios with a range of single tenants over several floors, to multiple tenants sharing a single floor. In the lower stack (lab-enabled), up to two tenants can be accommodated. In the mid and upper stacks, up to three separate tenants can be accommodated on a single floor all with direct access into the core.

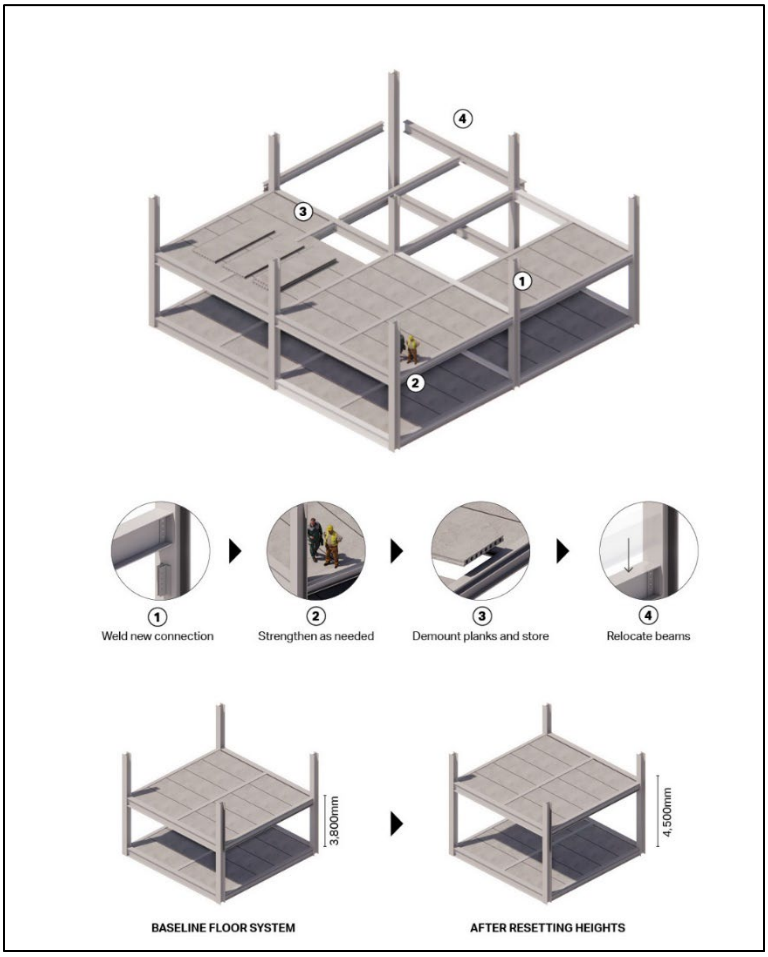
The design team has carried out a detailed study on the feasibility of the existing tower to support alternative uses, including residential, hotel and student accommodation. This study sets out the potential of how the site could be suited for alternative uses and interventions required for the existing tower to support this. The feasibility study highlights the challenges of adapting the existing tower with alternative uses. In the proposed design, considerations have been made to ensure that these challenges are not inherited in the new design. The following structural measures have been taken:

- Regular structural grid that allows for future flexibility that would require changing of the floor layout
- Soft core that is not part of the global stability system that enables low-intervention future changes to the functionality of the core
- Adaptable floor plates through a disassemble floor system.

The ability to reset floor to floor heights in a non-destructive way would be of great benefit in designing a new structure for longevity, helping to ensure that it does not become obsolete prematurely.

The proposed structural system would, in theory, allow the floor levels to be reset, in a way that cannot practically be achieved in in-situ concrete systems that rely on continuity.

The diagram below illustrates indicatively the steps that would be required. Here it is assumed that the facade and vertical transportation and circulation would be replaced at the same time.



Drawings & Reports

- Programming stack
- Multi-tenant layout diagram.

3.2 Accessibility

Ease of access in design allows for a material, component, or connector of an assembly, especially those with the shortest anticipated life cycle, to be easily approached, with minimal damage to and impact on it and adjacent assemblies. Ease of access reduces replacement time and the generation of unnecessary waste during the replacement or maintenance of materials or components. Ease of access is closely related to independence and is often related to uncoupling "layers" of a building or components of construction works that have significantly different lifespans. Ease of access to parts and components of the building or civil engineering works should be provided for ease of disassembly and adaptability. If possible, recovery of components without the use of specialized equipment should be allowed for.

Exposed connections are left accessible for disassembly or modification of components, assemblies, or systems within a constructed asset. By making the connections more visible, it will be more apparent where steps have been taken to promote ease of disassembly. Where such connections are not visible, there is an increased risk that disassembly techniques which optimise material and product re-use will not be planned or subsequently adopted in deconstruction or strip out of the construction works.

Content Requirement

Design aspects that facilitate the replacement of all major plant within the life of the building, e.g. panels in floors and walls that can be removed without affecting the structure, providing lifting beams and hoists. Accessibility also involves access to local services, such as local power, data infrastructure etc.

Design Strategy

The design strategy at this stage facilitates the replacement of major plant within the life of the building through a number of strategies:

- Goods lifts from Ground serve the L30 plant room and are appropriately sized to accommodate the largest sections of plant when broken down, for end of life replacement.

- A platform lift allows transfer of equipment and plant sections between the L30 plant room and L31 roof.

- Basement access routes have considered for main plant and equipment, primarily using the existing loading dock. However large elements of plant shall be replaced via access hatches to lift out the basement using temporary lifting equipment e.g. generators and transformers.

Drawings & Reports

- Stage 2 Report and associated deliverables include Access & Maintenance Strategy Drawings

3.3 Versatility

Versatility is the ability to accommodate different functions with minor system changes. Versatile structures and spaces facilitate alternative uses over the course of a day or week with minor system changes. In designing for versatility for specific adaptation, it is important to consider the needs of the targeted users. For example, having one space that accommodates many uses can reduce the overall building footprint, required floor area, costs, and resources. For general adaptations, leading to potential future adaptations, it is possible to look beyond the boundaries of the current user/owner immediately occupying the space to seek potential partnerships with outside interests that could use it at times when it would otherwise go unused, potentially cutting costs and reducing the need to construct more single-use structures and assets. This type of versatility can result in measurable benefits by increasing building utilization. One of the aims of versatility is to reduce strip-out and fitout over the life cycle.

Content Requirement

The degree of adaptability of the internal environment to accommodate changes in working practices.

Design Strategy

The large, open floorplates and core layout provided in the scheme are designed to allow for various tenant scenarios with a range of single tenants over several floors, to multiple tenants sharing a single floor.

The design furthermore includes potential for a wide range of current and future workplace fitouts from traditional cellular layouts to a large open plan space. This versatility is further strengthened by a logical and uniform structural grid and a core layout.

The double height amenity spaces distributed across the perimeter of the tower are designed to provide and promote a versatile working environment with areas of different interior and potentially exterior environments and furniture.

Versatility is also delivered in the scheme through the lab-enabled areas that are designed to allow lab users to fit out and occupy the space with both write up space and laboratory equipment.

The MEP systems have been developed against a basis of design that is thinking about flexibility for the future, with fresh air rates that are exceed current Building Regulations, and a decentralised ventilation system that enables total separation between tenancies.

Drawings & Reports

- Base Build Definition Rev06 (BBD)
- Multi-tenant layout diagram.

3.4 Adaptability

Adaptability is necessary to accommodate changes in use type, demographics, user needs or due to the need for adaptation to external factors, such as climate change, for resilience or future proofing. The initial cost may be balanced against the future cost of adaptation. The needs of users might also change with respect to limitation of physical abilities during the course of time. In case of residences, an adaptable building can enable users to live an independent life in their familiar surroundings for as long as possible. Also, adaptations can be sequential, occurring over time (often non reversible), or parallel, able to perform various functions, typically repeatable over a period of time. Specific adaptations in both parallel and sequential modes are less abstract and more clearly defined in functional requirements and typically take precedence over general adaptations. If the principles of universal design are taken into account at the outset (e.g. by respecting the space needed for manoeuvring a walking frame or wheelchair, the door width, the absence of thresholds or the installation of ramps and lifts), it can avoid the need for costly conversion at a later date.

Content Requirement

The potential of the building ventilation strategy to adapt to future building occupant needs and climatic scenarios.

Design Strategy

The proposed ventilation strategy employs on-floor Air Handling Units supplying fresh air at a rate of 16 l/s/person. The on-floor strategy increases flexibility for tenants to adapt the provision to their requirements and is also a lower embodied and operational carbon approach.

There is scope for a tenant to increase this if required, through the installation of a larger AHU with their demise, additional louvre space has been designed in to accommodate this.

The additional louvre space could also be used by a tenant to install their own auxiliary ventilation equipment if required. For example, a small extract fan to provided dedicated extract of a kitchenette or printing area.

A mixed mode strategy is also proposed, with openable façade panels, to allow increased levels of fresh air in the perimeter zone if desired by a tenant. This will be further developed in later design stages.

Drawings & Reports

- Stage 2 Report and associated mechanical strategy drawings.

3.5 Convertibility

Convertibility is the ability to accommodate substantial changes in user needs by making modifications. In regard to buildings, convertibility is related to versatility, in that both principles involve using single spaces for multiple uses. However, convertibility is achieved by designing the space or fit-up to facilitate minor, non-structural modifications to interior spaces (e.g., partitions, ceiling, and finishes) or furnishings to suit changing needs, either on an infrequent or irregular basis or at a future point in time. Convertibility for multiple uses can improve the profitability of a space, as well as reducing the need for other facilities, thereby reducing resource and energy use. Convertibility can be related to versatility in civil engineering works, however, conversions are more often sequential, and rarely revert back to the original use (e.g., coal fired power plant being converted to natural gas).

Content Requirement

The degree of adaptability of the internal physical space and external shell to accommodate changes of use.

Design Strategy

The scheme is focused on accommodating office use and lab-enabled space. In principle the tower is designed to support a wide range of uses with minimal architectural intervention. The core has been designed to provide all vertical transportation, emergency egress and some of the riser space as a central function of the tower, and has been designed as a “soft core” (see Feasibility). The air handling units are provided on a floor-by-floor basis which supports the convertibility of the MEP system to changes in use across the tower. Converting the office spaces to other uses would require the following considerations:

- Existing lift provisions would be an overprovision for residential or hotel use,
- The depth of the floorplates would make for an inefficient arrangement of residential or hotel use, but a perimeter arrangement could be suitable.
- The installation of lightweight finishes for high end hotel or residential use.

Given the different requirements considered for the alternative use, a higher degree of intervention is required to adapt the façade. The façade is designed to be modular in construction which would support potential changes required for converting the building use.

The structural floor system for the tower comprises a steel frame with precast concrete planks, supported on shelf plates and recessed within the beam depth. Unlike a typical in-situ concrete system which relies on continuity across the slabs, this system does not rely on continuity across the individual planks. This means that, within reason, a proportion of planks could be removed without affecting the structural integrity of the frame.

Consideration should be given to the practicality of removing pre-cast units within an occupied building, due to weight and scale of the elements. This could be achieved through strategic openable façade panels and dedicated lifting equipment.

Together with a system that is designed to be demountable, this enables short-term adaptability in a relatively non-destructive (and reversible) manner:

- It is possible to form new (larger) risers for potential future changes to the MEP servicing strategy by removing planks
- New lifts could be added by removing planks to accommodate potential changes in the vertical transportation strategy
- Double height spaces and/or new inter-storey connections could be created by removing planks.

Figure 5.1 Sketch of structural floor system components

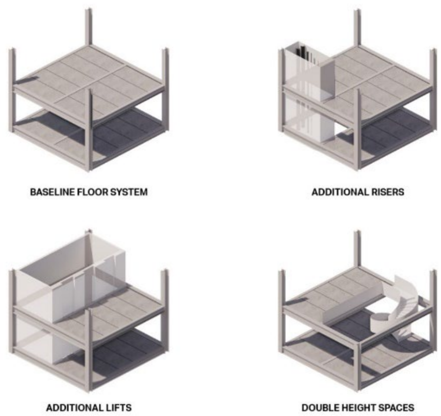


Figure 5.2 The structural system is adaptable to a variety short-term changes

Drawings & Reports

- Residential test fit

3.6 Expandability

Expandability is the ability of a design or the characteristic of a system to accommodate a substantial change that supports or facilitates the addition of new space, features, capabilities and capacities. In regard to buildings, expandability involves designing to allow for either vertical or horizontal additions in floor space. Expanding vertically can require consideration of structural allowances in the foundation and superstructure to bear larger loads or allow for the ability to easily increase the load bearing capacity of the structure without major disruptions to the occupants. For expanding horizontally, the design shall facilitate the disassembly of existing walls, envelope, or partitions so that space can be expanded without significant damage and materials can be re-used, either on the existing project or another. Designing in this way will also facilitate the reduction of space, as necessary, as well as evaluating the potential for increased space requirements in the future. Designing for expansion can require redundancy, e.g., foundation allowances for vertical and horizontal expansions (additional loads and footprint size, respectively).

Content Requirement

The potential for the building to be extended, horizontally or vertically.

Design Strategy

The site layout puts restriction on future potential for expandability.

The building height is constrained by the historic viewing corridors (LVMF 19A), so any possibility of future vertical expansion is unlikely. Therefore, the building structure has not been designed to be expanded vertically. Similarly, expansion to the West is limited by protection of the view from Parliament Hill to the Palace of Westminster (LVMF 2A.2).

On the South and East, the site is bounded by Euston Road and Hampstead Road respectively, both of which are TfL red routes meaning significant expansion is unlikely on these major throughfares. To the North of the site, the proximity to the buildings on Brock Street limit potential expandability in this direction.

Drawings & Reports

- Site constraints
- Site location plan.

3.7 Refurbishment Potential

Refurbishability is the ability to restore the aesthetic and functional characteristics of a product, building or other constructed asset to a condition suitable for continued use. The refurbishing of products can reduce the consumption of natural resources. Depending on the intended design life of the construction works, refurbishability can also help reduce operating and maintenance costs. The supplier shall make information available on how a product is refurbishable. The use of construction components that can be refurbished, allowing for an increase in their service life, shall be considered.

Content Requirement

The potential for major refurbishment, including replacing the façade.

Design Strategy

Several measures have been included in the design to simplify potential refurbishment of the tower. Two large goods lifts within the main core and a large loading bay ensure that future refurbishment work can be carried out efficiently, effectively, and non-intrusively.

Following the principle of design in layers, the façade is designed to be modular and divorced from the primary structure. This means that individual elements of the façade can be removed / replaced at end of life, without affecting the primary structure which is expected to have a significantly longer service life.

A maintenance and replacement strategy has been developed to better enable future maintenance and refurbishment of the façade. This strategy will mainly be reliant on the BMUs located on the roof of the tower with sufficient reach and lifting capabilities to reach all elements of the proposed façade.

Through specifications and designs, the materials comprising the structure will be protected against corrosion and deterioration and through regular maintenance, the components of the structure will endure beyond the building's intended design lifespan. The pre-cast plank system furthermore allows for dismantling and refurbishment of individual parts of the structure, should this be required.

Drawings & Reports

- Typical layout showing goods lifts
- Indicative façade sketch showing connection to structure (TT SK 001)
- Façade A&M strategy summary

4 Ease of Disassembly

4.1 Durability

Materials with a high durability rating that require less frequent maintenance, repair, or replacement should be selected. In some cases, however, it might be possible to reduce overall environmental burdens by designing for a shorter life, and for easier disassembly and re-use of components and materials (e.g., with temporary structures). The durability of materials or subsystems within the context of the design life of the constructed asset shall be considered. If the expected design life is short, the importance of durability can be offset by other principles (e.g., accessibility, independence, simplicity, ease of re-use, and recyclability). Assess the service environment to determine the factors that could influence the rate of material or assembly deterioration and determine resilience requirements. Manufacturers' warranties can be used to provide a marginal measure of a product's durability.

Content Requirement

Use materials which require less frequent maintenance, repair or replacement, considering them within the context of the life span of the building.

Design Strategy

The current revision of this report is carried out for the scheme at the end of RIBA Stage 2. Specific material finishes have yet to be confirmed with British Land. The intentions are to consider materials of a high robustness for internal finishes.

In high trafficked areas such as the lobbies, publicly available spaces, amenity spaces, and WCs there will be an enhanced focus on robust and durable materials such as natural/composite stone, ceramics and metals.

From an MEP perspective, emphasis will be placed on the specification of durable equipment and distribution, and the systems designed to minimise the operational maintenance required. BMS monitoring systems will facilitate interaction between FM teams and the systems, ensuring that operational aspects such as plant cycling, duty/standby load transfers and identification of failures are optimised to increase the service life of any equipment to the maximum possible duration.

Drawings & Reports

tbc

4.2 Exposed and Reversible Connections

Ease of access in design allows for a material, component, or connector of an assembly, especially those with the shortest anticipated life cycle, to be easily approached, with minimal damage to and impact on it and adjacent assemblies. Ease of access reduces replacement time and the generation of unnecessary waste during the replacement or maintenance of materials or components. Ease of access is closely related to independence and is often related to uncoupling "layers" of a building or components of construction works that have significantly different lifespans.

Reversible connections can be disconnected and/or disassembled for easy alterations and additions to structures. The use of reversible connections instead of fixed fasteners to connect products or components can allow for easier disassembly. Not only can the material be used again but the connectors (e.g., screws, bolts) can also be re-used. Other methods of disassembly include selecting materials that are fastened by a tongue-and-groove connection rather than by an adhesive compound, which can produce a permanent connection that contaminates the material and affects its re-use and ultimate recyclability. By making products easier to take apart, so that constituent components are not harmed, elements can be re-used directly, so long as they meet performance requirements. Materials can also be readily separated by material type and then serve as inputs for other products through recycling processes. Poured and welded (wet, chemical, or fixed) connections of otherwise demountable elements decrease the potential for disassembly.

Content Requirement

Making the connections more visible provides opportunities to optimise material and product reuse. Welded connections prohibit disassembly and it is preferable to use screws and bolts to allow for disassembly and material reuse.

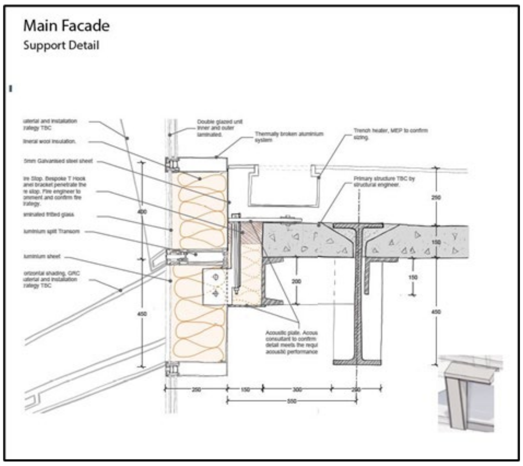
Design Strategy

Finishes

Proposals for finishes and details are still at an early stage and will be further evaluated at a later stage with considerations of exposed and reversible connections.

Façade

Following the principle of design in layers, the façade is designed to be modular and divorced from the primary structure. The façade is connected to the primary structure by a bolted connection to a cast-in channel. This connection is accessible beneath the raised access floor, meaning the façade can be decoupled (and therefore replaced) without impacting the primary structure.



Structure

In the current scheme the structural floor system of the tower comprises a steel frame with precast concrete planks, supported on shelf plates and recessed within the beam depth. Unlike a typical in-situ concrete system, the proposed steel and precast plank structural floor system is constructed using a series of pre-fabricated parts. The intention in the design is to assemble these parts in such a way that facilitates largely non-destructive disassembly. Currently, the planks are designed to be grouted together to act as a rigid diaphragm. Studies are carried out to evaluate the potential of using bolts as a means of connecting the planks to the steel frame, to further aid future disassembly of the structural system.

The diagram in Figure below illustrates indicatively the steps that would be required to disassemble the floor system. It is anticipated that the sequence could happen for a portion of a floor, a full floor, or the entire building.

From an MEP perspective, in later design stages the design team will investigate all possibilities to optimise material reuse and demountability through the specification of non-welded connections, pipe coupling systems and other strategies.

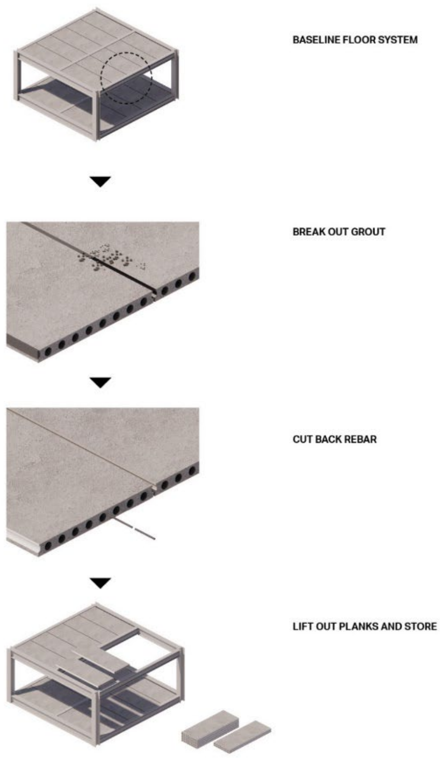


Figure 5.4 The structural system is designed to be demountable in a non-destructive way

Drawings & Reports

- Indicative sketch showing structural disassembly
- Sketch showing façade bolted connection to primary structure (TT SK 001)

4.3 Layer Independence

Independence is the quality that allows parts, components, modules and systems to be removed or upgraded without affecting the performance of connected or adjacent systems. Maximizing independence of the functional requirements of parts, components, modules and systems is key for optimizing disassembly for both re-use and upgrade. Modularization overlaps between adaptability and disassembly when modules achieve functional independence. Independence has to do with designing building systems or "layers" to stand independently, to facilitate the removal, adjustment, replacement, or upgrade of components. It is particularly important to think in terms of "layers" when planning from a temporal perspective for functionality and upgrades. Components of constructed assets have different design lives, and these variations need to be factored into the design. For example, the shell might require a service life that varies from 50 to 100 years, while the services might be expected to last 15 years and the interior fit-out elements perhaps 5 years.

Content Requirement

Designing building systems and components in layers so that removal, adjustment or replacement of some elements is feasible, especially when different components have different life spans and maintenance needs.

Design Strategy

The building structure is designed to be mutually exclusive of the building skin, so that the skin can be removed without compromising the structure. The structure is designed to tolerate the process of removing the facade.

Similarly, the services can be altered / removed without compromising the structure. The building is designed generally to allow for exposed services, or services below a raised access floor, which allows for easy access for maintenance.

The on-floor air handling unit strategy facilitates much simpler upgrade paths and unit replacement when compared to centralised equipment, allowing a tenant to upgrade the equipment to suit their requirements.

Drawings & Reports

- Sketch showing façade bolted connection to primary structure (TT SK 001)

4.4 Avoidance of Unnecessary Toxic Treatments & Finishes

Choice of finishes can limit the options for reusing or recycling the substrate, particularly if potentially hazardous substances are included. To support disassembly, finishes that can prevent the substrate from being re-used or recycled should be avoided. Finishes should serve a specific purpose, e.g. for fire and/or corrosion protection. There might be recyclable or reusable materials that can be used either on the exterior or in the interior of a constructed asset that will have suitable inherent finishes in their “natural state”, so that there is no need to use paint, veneer, or other finishes.

Content Requirement

Some finishes can contaminate the substrate in a way that they are no longer reusable or recyclable. This should be avoided unless finishes serve a specific purpose.

Design Strategy

Proposals for architectural finishes and details are still at an early stage, however it is the ambitions that all material selection will be carried out with high focus on avoidance of unnecessary toxic treatments and finishes.

As part of their Sustainability Strategies, British Land have developed a robust series of policies that identify materials that cannot be used in their developments. This information has been shared with the Design Team and will be reviewed at the outset of RIBA Stage 3. It is the intention to apply the British Land material schedule as a list of criteria for material selection.

The project is also targeting WELL which has strict conditions on material health and toxicity.

Drawings & Reports

- BL Material Schedule

4.5 Standardisation

Standardisation is concerned with the use of common components, products, or processes to satisfy a multitude of requirements. Standardised parts, which make it easier for contractors to disassemble structures while using efficient and repetitive techniques, should be considered. Standardization can support aspects of simplicity, adaptability and further re-use. Standardised parts can also allow for easier transportation, storage, and re-use. Due to the interchangeability of standardised parts and components, standardization facilitates simplicity, adaptability and further re-use in both design and the various phases of constructed assets. Selecting standard-size material can accommodate re-use and upgrading, since materials can be purchased with greater ease (and more cost effectively) when they are of standard dimension. Standard sizes also cut down on the creation of on-site off-cut waste for everything from timber, plywood, masonry, and insulation panels to floor tiles. Using standard dimensions needs to be reconciled with the client's requirements and the sizing requirements imposed by logistics, ergonomics, and functional needs. Design should consider optimisation of materials such as modular construction or prefabrication to reduce materials use. Prefabricated elements or components and a system of mass production should be used to reduce site work and allow greater control over component quality and conformity.

Content Requirement

Standardisation can accommodate reuse and upgrading. It involves aspects such as dimensions, components, connections and modularity. The dimensions of key building elements such as brickwork, blockwork, raised floor systems and doors will be standardised where possible.

Design Strategy

The scheme is based on two fundamental structural grids: 9x9m in the offices and 4,5x9m in the lab-enabled spaces. These structural grids work with a typical planning grid of 1.5m, in all areas. This planning grid is widely adopted in the UK and allows for standard systems to be used in the internal space planning.

The structural system is designed with a steel frame in a uniform grid and modular plank system. It is possible that the structural frame will mainly be from standard rolled steel sections facilitating future reuse.

The façade is designed in modules with focus on standardising the sizes across the individual modules to accommodate manufacturing efficiency and implementation of future upgrades. The façade will be designed to fit within the 1.5m planning grid.

The project's approach to standardisation will be subject to focused review as the design moves into RIBA Stage 3.

In later design stages the design team will assess all opportunities for employing Modular Methods of Construction and Design for Manufacture and Assembly principles to enhance off-site construction potential which is proven to be more efficient in terms of waste generation and material usage.

Drawings & Reports

- Structural grid and planning grid (BBD)

SWECO BREEAM 2014 & 2018 Wst05 Data Collection Tool

BREEAM Project Number	BREEAM-0097-4394
Development Name	Euston Tower

RIBA Stage 2 Management & Evidence Log

Key milestones	Date	Email evidence ref. in Wst05 folder
Date Wst05 tool sent to design team	31.10.2022	-
Date tool received from architect	05.05.2023	-
Date tool received from structural	20.06.2023	-
Date tool received from environmental assessor	11.09.2023	-
Date tool received from MEP	20.06.2023	-






SWECO

BREEAM 2014 & 2018 Wst05 Data Collection Tool

Responsibilities Matrix

Consultant	Abbreviation
Architect	A
Structural	ST
Flood Risk Assessor	FRA
Building Services	MEP
Climate Change Consultant	CC

	Structural stability of the development	Structural robustness	Weatherproofing & detailing	Material durability	Health & safety of building occupants	Impacts on contents/business continuity
Changes in temperature & solar radiation	ST	ST	A / MEP	A	A / MEP	CC
Flood risk	ST / FRA	ST / FRA	A / FRA	A / ST	FRA	CC
Precipitation	ST	ST	A	A	A / FRA	CC
Drought	ST	n/a	A / CC	A	A	CC
Air Pollution	n/a	ST	A / MEP	A / MEP	MEP	CC
Wind Speed & Storm Events	ST	ST	A	A	A	CC

	Risks posed by hazard to...					
Hazard	**Structural stability of the development**	**Structural robustness**	**Weatherproofing & detailing**	**Material durability**	**Health & safety of building occupants**	**Impacts on contents/business continuity**
Potential risks posed to the development by changes in temperatures and solar radiation	Increased differential thermal expansion between structural steel elements due to increased temperatures could lead to global building stresses which might compromise structural stability.	Likewise, increased differential expansion between steel components due to increased temperatures could give rise to increased local stresses which might compromise structural robustness	Solar radiation may affect any exposed waterproofing membranes.	Materials changes and degradation due to extreme hot and cold temperatures in the UK.	Overheating risk (through poor façade design and lack of passive design measures employed) - **this is the key item**. Poorly designed building services which are unable to deal with potential future variations in internal conditions.	Loss of staff days for businesses caused by excessive internal temperatures. Uncomfortable internal working conditions can decrease staff productivity. Financial implications of replacing weather-damaged facades. **Note:** very few studies have considered the impacts of higher temperatures on productivity in the UK so there is considerable uncertainty on this subject.
Proposed mitigation measures for this development	Increased differential thermal expansion between structural steel elements due to increased temperatures could lead to global building stresses which might compromise structural stability.	Likewise, increased differential expansion between steel components due to increased temperatures could give rise to increased local stresses which might compromise structural robustness	All waterproofing membranes will be protected from direct sunlight as follows: - Gravel ballast and paviours for Level 31 roof. - Decking for external terraces. - Green roof build up for podium roof. Exposed pipes, ducts and services may be affected by extreme temperatures. All waterproofing membranes will be protected from direct sunlight by employing the following mitigations: - Installation of plant on raised plant deck - Application of paving or gravel - Installation of PV and associated supporting structure - Application of green or blue roof systems where applicable Suitability and location of the above mitigations and strategies will be confirmed in later design stages All exposed services will be clad with suitable materials accounting for the expected weathering and sunlight exposure - to be confirmed in later stages	GRC proposed for 50% of facades. The thermal mass will absorb temperature changes and even out the peak. Remaining 50% is glass combined with external solar shading device. Applied anodizing and/or powder coaating to be approved for outdoor use (UV-resistant). A UV-protecting varnish can be used on interior wood cladding and wood structures.. (Depending on wood type, change of color cannot be totally avoided)	External envelope designed as 50% solid/505 glass. Overal facade design balanced between window wall ratio, glass g-value and reveal depth and external solar shading device to reduce unwanted solar gains. Façade has been carefully designed to limit direct solar gains, with reduced overall glazing percentages, overhanding façade shading elements, low g-value glazing and set backs to amenity space heavily glazed areas. All MEP services are designed accomodate future weather scenarios which may impact on internal design conditions.	
Supporting drawings and documentation	To be included in the BBD. Not yet developed at this stage.	To be included in the BBD. Not yet developed at this stage.			Stage 2 report and associated drawings	

BREEAM Wst05
Flood Risk
Generally refers to the project flood risk assessment

SWECO

	Risks posed by hazard to...					
Hazard	**Structural stability of the development**	**Structural robustness**	**Weatherproofing & detailing**	**Material durability**	**Health & safety of building occupants**	**Impacts on contents/business continuity**
Potential risks posed to the development by flooding	Fluctuation of groundwater levels resulting in decreased stability of the ground. Changes in groundwater levels resulting in the overloading of retaining walls and lowest basement slab. Uneven weight/pressure distribution of the water if it floods basement areas.	Uneven weight/pressure distribution of the water if it floods basement areas. Inadequate drainage design resulting in increased probability of flooding on site. If the development is below the breach flood level AOD there would be a risk of flooding to site.	Lack of adequate waterproofing to basement and ground floor areas to limit the potential impact of flooding. Poor detailing resulting in water ingress in an extreme flooding event.	Degradation and damage to building materials caused by the site flooding under projected climate change conditions. **Note:** the flood risk assessment may well adequately explain how the flood risk is being mitigated and confirm low probability of flooding during the building's life	Loss of life through extreme flooding events Inability for occupants to escape the development in the event of the wider local area flooding (i.e. created an 'island') Hazardous and polluting substances stored in the building (oils etc.) entering the watercourse in a flooding event. Flooding causing damage to dangerous systems i.e. electrical equipment.	Office staff unable to reach the office and not able to work remotely, affecting productivity and causing a reduction in working days. Damage to building contents and fabric resulting in costly replacement and repair. Excessive flooding resulting in breakdown and poor operation of installed drainage systems.
Proposed mitigation measures for this development	Appropriate site specific flood risk assesment produced. Substructure designed to resist appropriate loading. Euston Tower will have deep foundations so damage is very unlikely. Provision of robust stability system.	Appropriate site specific flood risk assesment produced. Structural elements designed to appropriate exposure class. Appropriate products used to mitigate deficient weather resistance in retained elements.		Appropriate site specific flood risk assesment produced. Structural elements designed to appropriate exposure class. Appropriate products used to mitigate deficient weather resistance in retained elements. Final basement grade to be determined. Testing on exsiting elements in progress		
Supporting drawings and documentation	Not yet developed. Final detail to follow the Flood Risk Assessment.	Not yet developed. Final detail to follow the Flood Risk Assessment		Not yet developed. Final detail to follow the Flood Risk Assessment		

BREEAM Wst05
Precipitation

SWECO

	Risks posed by hazard to...					
Hazard	**Structural stability of the development**	**Structural robustness**	**Weatherproofing & detailing**	**Material durability**	**Health & safety of building occupants**	**Impacts on contents/business continuity**
Potential risks posed to the development by excessive precipitation	Risks mainly related to flooding and flash-flooding events caused by intense rainfall events. Changes in ground conditions (ground properties, increased water level) arising from flooding could cause ground movements and overstress the substructure.	Persitent ponding of water on roof elements leading to reduced design life for components such as membranes and seams. Undetected leaks could theoretically compromise local stability strucutre if not maintained.	Poorly designed façade resulting in moisture penetration of building fabric in the event of extreme rainfall events. Building drainage systems not sized appropriately to deal intense rainfall events and potential for flash flooding.	Material degradation in extreme rainfall events. Water stains on materials + rusting of exposed metals. Planted roofs (where applicable) - damage to soils caused by heavy & intense rainfall events Efflorescence of concrete, brick & natural stone materials causing degradation.	Increased risk of flooding (see previous section on flood risk for further details).	Impacts are related to an increased risk of flooding (see previous section on flood risk for further details).
Proposed mitigation measures for this development	Substructure designed to resist appropriate loads.	Design of the finishes to take into accound the deflecition of the strucuture to avoid ponding.	The facade will be designed to achieve British Standards regarding Water tightness. Openable elements form the weakest part in the system and will be selected to meet these standards. All main building entrances will have a canopy to potect the entrance area from rain. All roofs will be designed by the building services engineer to sufficient outlet capacity based on relevant storm events (SWECO to advise further). Attention to general geometries, detailing, vapor barriers, thermal bridges and sufficient insulation are pramount at this early stage.	All metal used in the facade will be either Aluminium, or where steel is required this will be either hot dipped galvanised or stainless steel. The extenal envelope will be designed to British Standards for water tightness to avoid water ingress into the building. Planted roof areas will be designed with adequate drainage layers to allow for water run-off in storm events (Arup to advise further).	All main building entrances will have a canopy or sit under building overhang to offer protection from rain.	
Supporting drawings and documentation	Not yet developed at this stage.	Not yet developed at this stage.	Not yet established at this stage.			

	Risks posed by hazard to...					
Hazard	**Structural stability of the development**	**Structural robustness**	**Weatherproofing & detailing**	**Material durability**	**Health & safety of building occupants**	**Impacts on contents/business continuity**
Potential risks posed to the development by drought / water shortages	Drying out of the subsoil layer resulting in retaining structures becoming unstable.	n/a	n/a	Excessive flow rates of specified water consuming components in the development, increasing the water stress in the local area.	Increased use through poor water efficiency in design may lead to local water shortages and lack of access to water in extreme events for building occupants.	
Proposed mitigation measures for this development	Substructure designed to resist appropriate loads.	n/a	n/a	not yet established. Specification of proposed components to be reviewed at stage 3.	Water consumption will be reviewed at the appropriate design stage. Also refer to water credits targeted under this assessment.	Climate consultant to confirm
Supporting drawings and documentation		n/a		Not yet established	Not yet established	

	Risks posed by hazard to...					
Hazard	**Structural stability of the development**	**Structural robustness**	**Weatherproofing & detailing**	**Material durability**	**Health & safety of building occupants**	**Impacts on contents/business continuity**
Potential risks posed to the development by air pollution	n/a	Chemical particles contained in the air and mixed with the rainwater can deteriorate the concrete and other exposed metal elements.	Chemical particles can deteriorate waterproof membranes and metal details of facades.	Specification of internal finishing materials (paints, varnishes, adhesives etc.) with high VOC content can adversely impact internal air quality. Impact of external air quality on façade materials - degradation & discolouration. Lack of durable materials/robust design used in building services equipment (pipework, ductwork, key equipment) resulting in degradation & leaks.	VOCs from building products & materials impacting on internal air quality. Lack of suitable monitoring and management of building services equipment (i.e. leak detection) resulting in compromised air quality.	Internal air quality influences health of occupants, leading to decrease in student productivity and increased potential for illness. Emissions to external environment may adversely affect the local air quality and health of wider community. Inability to meet local air quality regulations may result in fines or penalisation in the future.
Proposed mitigation measures for this development	n/a	Strucutral elements to be designed to an appropriate exposure class. Appropriate mitigation measures developed for retained elements which might be particulrly vulnerable. Protective paints or coatings to be specified for all steel structural elments of the frame.	A cleaning and maintenace strategy has been developed as part of the stage 2 design. This will be updated with detail added to ensure all exposed materials will be adequately maintained. Specifications of the external envelope will consider requirements for this. Louvres will be designed to prevent ingress of rain The bottom side of the ductwork immediately behind a louvre will slope towards the louvre with facilities for the drainage of any rainwater and will be coated to prevent corrosion All air handling equipment will be specified with appropriate levels of filtration in accordance with relevant statutory regulations, client requirements, industry guidance and best practice. Air pollution can cause poor internal air quality if sufficient filtration is not provided.	Internal finishes will be specified to ensure health and well being of the building users. This will include the use of low VOC paints and adhesives as well as limiting or fully excluding materilas with formaldehyde content. A cleaning and maintenace startegy has been developed as part of the stage 2 design. This will be updated with detail added to ensure all exposed materials will be adequately maintained. Specifications of the external envelope will consider requirements for this. Frames and blades shall be fabricated from galvanized mild steel or from aluminium alloy. All louvres shall be fully protected against corrosion. All materials used in building services shall be selected to be durable and facilitate ease of maintenance. Maintenance routes will be identified and early engagement will facilities managment providers will be encouraged	Bird/vermin screens shall be fitted to all external louvres and shall be removable for cleaning. Intake and exhaust louvre distances will be suitably separated to avoid polluting internal air as a result of re-circulation. Intake louvres will also be located away from other exhausts e.g. standby generators, WC vents. BMS will be used throughout the building to monitor and manage building services. Leak detection will be monitored by use of sub-meters and pressure statuses	Note that a life safety standby generator may be required for the development, although a dual utility power supply is being developed to remove the requirement for a life safety standby generator. Future generator for business contunity for essential lab loads is also being allowed for within the development. All generators to run on HVO fuel instead of diesel to reduce the NOx and particulate matter from emissions.
Supporting drawings and documentation	n/a	n/a	Cleaning and maintenance stragegy as part of the stage 2 report.	Cleaning and maintenance stragegy as part of the stage 2 report.		

	Risks posed by hazard to...					
Hazard	**Structural stability of the development**	**Structural robustness**	**Weatherproofing & detailing**	**Material durability**	**Health & safety of building occupants**	**Impacts on contents/business continuity**
Potential risks posed to the development by high wind and storm events	Increased wind gusts could overstress superstructure with increased lateral loading.	Increased high speed winds could overstress curtain walling, plant screens and rain screen cladding at a local level. Local structural robustness may be insufficient.	Damage to facades via high winds and storms by not providing adequate weatherproofing based on local project climatic conditions.	Excessive replacement of materials that are not durable and not able to withstand the impacts of high wind/storm events.	Risk of falling objects from facades/terraces. Risk of trees being taken down by high winds causing hazard to building occupants. Poor design/orientation of building in appreciation of surrounding buildings, resulting in wind speeds in certain areas of the development being potentially dangerous	Damage to external and internal materials through storm events is well documented - replacement of glass damaged by debris etc. If the development is not adaptable to storm events, it may be closed for long periods therefore impacting staff productivity and attendance levels.
Proposed mitigation measures for this development	Current standards include sufficient allowance for changes in wind patterns. A wind tunnel study could be carried out if deemed necessary which could increase the velocity pressure considered in the design. We will work with the wind consultant to manage this risk.	Current standards include sufficient allowance for changes in wind pattens. A wind tunnel study could be carried out if deemed necessary which could increase the velocity pressure considered in the design. We will work with the wind consultant to manage this risk.	Wind tests have been carried out to better understand general wind conditions of the building and surrounding public realm. Further tests will be carried out during stage 3 to further assess wind conditions to be expected on the facades. Resulting test data will inform the design. Wind loading to be intgrated into envelope requirements. Partial testing of facade will be carried out during construction.	Materials and detailing will be developed based on wind tunnel testing. This will be established during stage 3.	Wind tests have been carried out to better understand general wind conditions of the building and surrounding public realm. Further tests will be carried out during stage 3 to further assess wind conditions to be expected on the facades. Resulting test data will inform the design and detailing to respond accordingly.	
Supporting drawings and documentation	Not yet developed at this stage	Not yet developed at this stage	Wind test data as part of the planning submission by Arup Wind	Not yet established at this stage.	Wind test data as part of the planning submission by Arup Wind	

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