



Circular Economy How-to Guide:

Reusing products and materials in built assets

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Lead Partner:

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Introduction



This guidance document contains a practical How-to Guide which is a follow up to the UKGBC Circular economy guidance for construction clients: How to practically apply circular economy principles at the project brief stage. This How-to Guide will explore Maximise reuse in more detail and set out actions for project teams to take forward during design and construction stages.



The following principles were identified in the UKGBC guidance for construction clients.



This guidance document addresses:

- How to create a product and material inventory to support reuse within an existing project
- How to reuse materials and products from another project
- How to send materials and products offsite for reuse on another project

The aim of this guide is to stimulate growth in the reuse market by encouraging and supporting construction project teams, including construction clients, project managers and design teams. A prioritisation of reuse onsite over offsite should be given where possible.

This How-to Guide takes project teams, working on demolition, deconstruction, refurbishment or fit out projects, through the process, roles and responsibilities for maximising reuse and reclaiming materials. This guide provides an understanding of what information is required, whom to involve and at which point in the programme.



Figure 1. Material flows in the reuse processes outlined in this guide.



This How-to Guide forms part of a Reuse Implementation Pack which has been developed through UKGBC's Circular Economy Programme. The pack also includes:

- Circular Economy Innovation Insights: Reuse and Products as a Service – Highlights solutions (product and service related) for supporting reuse and products as a service
- The why and what of reuse slide deck A set of slides setting out why PaaS is important and explaining the How-to guidance available to support project teams in the process of implementing LaaS in developments.

In the first instance, every opportunity should be taken to retain the existing structure. More information to support this can be found in UKGBC's Circular economy guidance for construction clients.

"Reclaimed (or reused) products and materials are those that have been taken from the waste stream and reused in their original form with minimal reprocessing. Examples include steel beams and whole bricks."* WRAP (2008)

WRAP (2008). Reclaimed building materials guide: A guide to procuring reclaimed building products and materials for use in construction projects. Available at: http://storage.googleapis.com/www.bioregional. com/downloads/Reclaimed-Building-Products-Guide WRAP 2008.pdf [Accessed: 23/01/2020]

1. How to create a product and material inventory to support reuse within an existing project





Figure 2. Material flows in the reuse processes outlined in this guide.

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MATERIAL AND PRODUCT INVENTORIES AND AUDITS 1.1

To stimulate an increase in the amount of material reuse within existing construction projects, an inventory of the materials and products within an entire site or portfolio should be created. This inventory will provide all parties with the information they require to make decisions on the second life of products and materials within the existing asset. For the purposes of maximising reuse, the inventory should be created before any proposals for redevelopment are taken forward. New construction projects should also develop inventories and plans for reuse. Whilst this is not explicitly covered here, key learnings can be taken from the process outlined below and applied to new construction projects.

The earlier this inventory is created the easier it will be to effectively design in the reuse of products and materials. In theory, the inventory can be created at any time as part of a strategic exercise to understand the materials 'banked' in the portfolios but should be done well in advance of any refurbishment or demolition activity taking place.

The inventory could be created in multiple ways depending on the asset's development stage:

- If the asset is still in development, the material inventory could be created as part of the hand-over documentation at completion.
- If information is required for an existing asset, the material inventory will need to be created by studying the as-built information available and supplementing this with onsite investigations.

There are multiple ways of storing the inventory data, including:

- A spreadsheet limited to primarily capturing product and material quantities.
- Online platforms/libraries these can be used by clients to store material information.
- Building Information Modelling (BIM) this is the process of creating and managing digital information about a built asset. However, BIM is more suitable for new construction projects and typically collects wider project data than just inventory data, making it more time consuming to apply in this context.

Where it has already been decided that an asset needs to be redeveloped and an inventory has not yet been created, a pre-redevelopment audit (sometimes called a prerefurbishment audit) should be commissioned prior to the end of concept design stage (e.g. RIBA stage 2). This will allow the recommendations to be fed into the final concept design. Ideally, options for the refurbishment and the reuse of the existing structure should be prioritised, with demolition and rebuild seen as least preferable. The information contained in the asset's material and product inventory can feed into this audit, if this exists, but, if not, the auditor will need to quantify the materials and products contained in the asset in accordance with the Code of Practice: Pre-redevelopment Audits.**



^{**} Blackwell M., Adams K. and Hobbs G. (2017). Code of Practice: Pre-redevelopment Audits. Available at: https://condemwaste.org/ wp-content/uploads/2018/10/Code-of-Practice-Pre-redevelopmentaudit-July-17-V1.pdf [Accessed: 15/01/2020].

The inventory should record the following details of materials/ products within the site or asset:

- An estimation of material types/products, quantities and dimensions.
- An assessment of the materials/products suitability for reuse.
- Additional information required to facilitate reuse depending on material type/product such as condition of aesthetic finishes, size and strength for structural members, thermal and fire performance for insulation, fire ratings, acoustics, thermal comfort, sustainability standards, and embodied carbon.
- Photos and/or 3D images outlining the aesthetic quality of the existing material/product.
- For the appraisal of existing steel and iron, the Historic Structural Iron and Steel Sections can be used to inspect quality of steel and set out opportunities for reuse.
- Any information about specific deconstruction or disassembly that might be required.
- Proposals for amount of time required in programme to allow for disassembly and storage.
- Suggestions for storage options including location and requirements i.e. treat as fragile. Where materials/products cannot be reused onsite, solutions for onward reuse should be provided. See the second How-to Guide below for more support in this area. Onsite storage should be prioritised over offsite.

This information is not always easy to acquire, but the site/ facilities management team may be able to help, and a data storage system may already be in place.

ROLES. ACTIONS AND RESPONSIBILITIES 1.2

This section outlines a step-by-step process by which the project team can create an inventory of the products and materials within an entire site or portfolio. This can then be used to apply the reuse of materials/products within the existing asset - this could include fit-out, refurbishment, and new build with reuse of materials/products. The client and project teams are mapped against their corresponding responsibilities and actions. See Appendix 1 for the full list of roles and how they have been defined.





PROJECT STAGE: STRATEGIC DEFINITION	(E.G.	RIBA	STAGE (J)
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Role	Responsibility and actions
Client Delivery Team	 Set out strategic vision and project commitment around reuse, linking to resource optimisation, embodied carbon savings and cost saving. See UKGBC's <u>Circular economy guidance for construction clients</u>: How to practically apply circular economy principles at the project brief stage for more information and support around reusing the asset as a whole, and and disassembly for reuse as a secondary option. Start the process of commissioning a pre-refurbishment/pre-demolition
	audit if a product and material inventory has not been prepared for the development.
	• Ensure programme planning allows for materials to be removed, stored and retrieved for reuse. Timing will be dictated by the recommendations from the audit report that is commissioned and should be reviewed again at concept design stage after meeting with the demolition or refurbishment contractor.
	 Plan reuse activities in design reviews, ideally with an independent group of sustainability experts.
	• Establish a predesign tender service agreement with the design team to get their input in setting the brief for reuse. This would engage discipline experts from the design team to define targets for reuse of the existing asset based on the scheme. The service could include a site visit and sharing of the inventory data where the audit data is not available yet. The output from the design team should include targets for reuse, as well as comparison between reusing the entire asset versus using just parts or materials.
	• Agree budget allocation between savings upfront relating to reuse of products and materials which may, in operation, require maintenance, refurbishment or replacement and therefore additional contingency during operational stages. In many cases capex costs can be saved by reusing material from the existing site. However, it might be the case that a contingency budget is put aside for refurbishing or upgrading reused products/services during operation. Involve the Facilities Manager in these discussions.
	• Share the reuse information with the Quantity Surveyor (QS) and identify cost saving opportunities for the project i.e. cost benefit of material reuse. This should be factored into the overall cost analysis by the QS. The information could also demonstrate energy savings and/or carbon 'available' in the form of embodied carbon invested at time of original construction.

PROJECT STAGE: PREPARATION AND BRIEF (E.G. RIBA STAGE 1)

Role	Responsibility and actions
Client Delivery Team – Procurement	• Ensure the asset inventory or au pack for the project team. If secu data, the client may want to con inventory data exists, the design of how reuse will be considered with the winning design team.
	 Ensure the procurement scoreca account those organisations who identify the best opportunities for designing to allow for disassemble Engage demolition contractors a demolition tender agreement. S audit data (if available)

PROJECT STAGE: CONCEPT DESIGN (E.G. RIBA STAGE 2)

Role	Responsibility and actions
Design Team	 Review material inventory da reuse targets. Identify potent Identify where further investi- reclaimed items within desig
	 Factor in opportunities for er materials allow for further di in the performance specification
Client Delivery – Procurement	• Ensure the asset audit data is team if not completed at Pre

udit data (if available) is included in the tender curity issues arise around the sharing of this nsider stating in the tender pack that the proposals should include a clear indication and that the inventory details will be shared

ard for reviewing submissions takes into no have the best track record of reuse and for reuse within the new project as well as bly.

and explore establishing an early pre-Suggest they review the inventory data or

ata (or audit data) and project brief with itial options for reuse within new scheme. igation or information is required. Incorporate yn.

ensuring that the reuse of products and lisassembly in future. This should also feature ations or structural engineer's scope.

is included in the tender pack for the project eparation and Brief.

Role	Responsibility and actions
Client Delivery Team	 Explore, with legal teams, contract arrangements to address risk i.e. warranty and liability for reuse products and materials. Suggested approach is that the responsibility of the product should sit with the client and responsibility of installation should sit with the contractor even where products are taken off site. This will be a commercial negotiation between the client and the contractor. Engage the facilities management team in the decisions to incorporate reuse into the new design so they are aware of proposals to reuse elements they may be in control of maintaining and servicing. As part of the design review process there should be every effort made to ensure reuse is incorporated and reuse targets are met. Challenge the design team on whether there are further opportunities for reuse. Where an asset is owned by a client and the future tenant is known, a contract should be created between the asset owner and the tenant to retain material within the asset. Where this is not possible look to reuse material and products. This process could be established through a green lease agreement. For a building where the end client/tenant is known, Virtual Reality can be used to conceptualise new designs for Cat B* fit out space. This will help ensure there is less change of materials and products due to dissatisfaction with design. * Category B (Cat B) fit out is a fit out conducted in a space where only the external walls and basic flooring, ceiling, M&E services, shared toilets, and lifts have already been installed.
Client Delivery Team, Project Manager, Demolition/ Refurbishment Contractor (if possible), Inventory Auditor	 A meeting should take place to review realistic reuse opportunities within the concept design: 1. Feasibility of reusable products and materials 2. Cost impacts 3. Impact on programme 4. Health and safety implications Develop logistics plan for bringing equipment and people on and offsite to allow for reuse

PROJECT STAGE: CONCEPT DESIGN (E.G. RIBA STAGE 2) (CONTINUED)

PROJECT STAGE: DEVELOPED DESIGN (E.G. RIBA STAGE 3)

Role	Responsibility and actions
Design Team	 Progress research into specific p to gain confidence in quantities condition, appearance and other could include fire testing, emission of hazardous substances. In some materials for reuse. See the <u>Salve</u> <u>Circular economy guidance for construct</u> Incorporate reuse products and in scheme to be submitted for p Identify if any further investigation needed. Identify if any samples or mock-to reclamation and reuse, and check detail ahead of the tender.
Client Delivery Team	 In the design review meeting as and if the strategic vision for reudesign team on whether there a If recoverable products cannot be inventory information should be see section 3 for how to send m

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products and materials to be reclaimed that realistically can be recovered, their er qualities relevant to their reuse. This sion testing and testing for the presence ne cases, it will not be necessary to test vo Website for more guidance and UKGBC's construction clients Appendix 4 for tion products.

I materials into design proposals and include planning (if applicable).

on of reuse products and materials are

ups are required to test the process of ck appearance, robustness etc. of proposed

ssess whether reuse is being incorporated use is on course to be met. Challenge the are further opportunities for reuse.

pe reused in the new asset, the relevant e made available to others for onward reuse; naterials and products away for reuse offsite.

PROJECT STAGE: TECHNICAL DESIGN (E.G. RIBA STAGE 4)

Role	Responsibility and actions
Client Delivery – Procurement	 Include aspiration to maximise reuse including KPIs as per recommendations from the design team, and details of reclaimed products and materials to be used within the contract and demolition/refurbishment contractor tender documentation. When reviewing responses answers a time allowance has been made for reuse.
	where necessary.
	• A requirement should be made to the demolition/refurbishment contractor to review the audit and inventory data and provide comments. The products and materials that are to be carefully disassembled and stored for reuse within the development should be specified.
	• The contract with the demolition/refurbishment contractor should require a team is employed that is able to disassemble the identified products and materials for reuse. Their programme must account for reuse. This could be built into the mid-bid interview.
Design Team	• Under the Construction Design and Management Regulations, the principal designer should include information related to the proposed deconstruction and allowances for reclaimed materials in the Pre-Construction Information for tenderers as well as addressing health and safety risks.*
	 Include in the tender documents:
	 any elements that are to be carefully disassembled and stored for reuse within the development or for onward reuse elsewhere.
	 any requirements for preparation, processing or testing of recovered elements to make them ready for reuse.
	 detail of the proposed element reuse; note where allowances need to be made for size variations in recovered materials.
	 specify information for samples or mock-ups of reuse elements that are required for client approval prior to construction.

* UK Government (2015). The Construction (Design and Management) Regulations 2015. Available at: http://www.legislation.gov.uk/uksi/2015/51/contents/made [Accessed: 15/01/2020].

PROJECT STAGE: CONSTRUCTION (E.G. RIBA STAGE 5)

Role	Responsibility and actions
Demolition/ Refurbishment Contractor	 Recover products and material documents. Ensure all elements secure place. Provide toolbox talks on reuse photographs of the items to be drawings. Toolbox talks should For example, glass not to be deshould be removed such as national destructions. Statement briefings specific to be relements that are not being elsewhere, see the CIWM What waste or hazardous waste. Develop Demolition Refurbisht is a useful way of identifying of materials during demolition.
Contractor	 Carry out any mock-ups or sar gain client approval. Prepare, process and test reco documents to make them read Carry out reuse as specified in approved samples. Flag any potential issues early resolved. Keep accurate waste records.
Plan S	

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als for reuse as identified in the contract nts are intact, not damaged and stored in a

e. These could consist of a set of be recovered for reuse, along with location Id be specific to each project and material. contaminated by dust or if any material ails. These are usually included in the Method o each type of work.

ng recovered from reuse on the site or nat is Waste Guide to establish if they are

nment Information Data Sheets (DRIDS). This onward reuse and recycling opportunities for

mples required in contract documents and

overed elements as specified in the contract dy for reuse.

the contract documents and in line with

to the project manager so they can be



2. How to reuse materials and products from another project

PROJECT STAGE: HANDOVER AND CLOSE OUT (E.G. RIBA STAGE 6)

Role	Responsibility and actions
Design Team, Main Contractor, Project Manager	• Proposed deconstruction methodology should be included in the Operation & Maintenance manual along with final construction information indicating all elements in new asset. This will provide the basis for the material and product inventory. If BIM were used, the model should be included in handover.
Client Delivery Team	• Meet with whole project team to discuss lessons learned and share which elements were reused based on the original inventory info. Share these learnings with industry.
Asset Manager	• A clause can be added to the tenancy agreement whereby the tenant must notify the Facilities Estate Manager of any changes that will be made to the building during the lease. This process enables any unwanted materials to be sent for onward reuse and new materials to be added to the inventory.
	• Where the building is owned by a landlord and the future tenant is known, a contract should be created between the asset owner and the future tenant to retain materials within the building. Where this is not possible, attempts should be made to reuse material and products. This process could be established through a green lease agreement.
	• Virtual Reality can be used to conceptualise new designs for future Cat B fit out. This will help ensure there is less change of materials and products due to dissatisfaction with new designs.

PROJECT STAGE: IN USE (E.G. RIBA STAGE 7)

Role	Responsibility and actions
Facilities Estate Manager/ Inventory Auditor/ Client Delivery Team	• Regularly maintain the inventory and update the data management tool (spreadsheet, online library, BIM). This should be updated with reuse from maintenance and the space plan such as furniture.



Inventories **Reuse onsite**

Figure 3. Material flows in the reuse processes outlined in this guide.

ROLES, ACTIONS AND RESPONSIBILITIES 2.1

This section outlines a step by step process by which construction teams can bring reuse onto site. Construction teams are mapped against their corresponding responsibilities and actions. See Appendix 1 for the full list of roles and how they have been defined.



Role	Responsibility and actions
Client Delivery Team	 Set out the strategic vision and project commitment around reuse, linking to embodied carbon savings and resource optimisation. See <u>UKGBCs Circular economy guidance for construction clients: How to practically apply circular economy principles at the project brief stage for more information and support around bringing reclaimed materials and products onto site.</u> Decide whether the function and use for the reclaimed material is for structural, functional or aesthetic purpose as this will significantly impact material selection i.e. the look and feel of the project may mean some reclaimed materials will not work within the scope such as doors and fittings/fixtures but reclaimed material may be suitable for hidden structural elements such as steel beams.
Client and Design Team	 Identify which parts of the design have the potential to incorporate reclaimed products and materials.
	 Develop a plan for the reuse of materials and products based on the types and quantities of reusable products and materials available. Where materials are not yet available plans can be made for when they are. Information on reuse can be acquired from the organisations in the UKGBC Innovation Insights: Reuse and Products as a Service. If possible, ensure that during the 6-month period before demolition/ deconstruction/refurbishment any structural (or other) testing occurs to prove the fitness for purpose of the materials. This could include fire testing, emission testing and testing for the presence of hazardous substances. Initial design plans and sketches should be developed and reiterated as required to include reclaimed materials. Create a reuse material contingency plan in the event of materials no longer being available or meeting required specifications. This can be a subset of the reuse plan.
	• To increase reuse on the project the Contractor should not be subject to penalties for respective design changes as a result of reuse materials becoming available at a later stage. For this the Client could add a clause to the contract between the Contractor and the Client.
	 Agree a conceptual design plan and issue instructions to the Asset Owner of the donor site for the specifications of what needs to be removed and how. In this the following should be specified: agree the amount that will be paid by the client of the receiving project, establishing acceptable thresholds for the condition of materials supplied this way, agreeing how much cleaning and preparation the supplying party will do, and agreeing timescales. Design around known available products and materials or ensure flexibility is left in both the design and subsequent specification.

PROJECT STAGE: STRATEGIC DEFINITION THROUGH TO TECHNICAL DESIGN (E.G. RIBA STAGE 0 – 4)

PROJECT STAGE: CONSTRUCTION (E.G. RIBA STAGE 5)

Role	Responsibility and actions
Contractor	 Once the materials and produce demolition/refurbishment con some cases, stored (on or offs)



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ucts are cleaned and prepped for reuse by the ntractor they need to be transported and, in site) before the installation takes place.

3. How to send materials and products offsite for reuse on another project





Figure 4. Material flows in the reuse processes outlined in this guide.

3.1 **ROLES, ACTIONS AND RESPONSIBILITIES**

This section outlines a step by step process by which clients and construction teams can send products and materials for reuse offsite. Construction teams are mapped against their corresponding responsibilities and actions. See <u>Appendix 1</u> for the full list of roles and how they have been defined.

PROJECT STAGE: STRATEGIC DEFINITION THROUGH TO TECHNICAL DESIGN (E.G. RIBA STAGE 0 - 4)

Role	Responsibility and actions
Client Delivery Team	 Set out strategic vision and projoff site for reuse, linking to embooptimisation, where materials can see <u>UKGBCs Circular economy</u> practically apply circular economy practically apply circular economy products for onwards reuse. Start the process of commission audit if one has not been carried for more information around de Ensure programme planning all retrieved for reuse. Timing will be the audit report that has been carried for more information and support that has been carried for more information around de
	 at Stage 2. Make products available for test fitness for purpose of the mater testing and testing for the prese Contact organisations that can sinventory data with them and if Innovation Insights: Reuse and Fiservices. Explore, with legal teams, contrand liability for reuse of product

PROJECT STAGE: CONSTRUCTION (E.G. RIBA STAGE 5)

Role	Responsibility and actions
Contractor	 Once the materials and product demolition/refurbishment contrast some cases, stored (on or offsite and installation takes place in the lf materials cannot be reused, li opportunities for sending them product suppliers for down cyclinto carpet or furniture back into Insights: Reuse and Products as

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ject commitment around sending material odied carbon savings and resource annot be used within the existing site. guidance for construction clients: How to my principles at the project brief stage for around sending reclaimed materials and

ning a pre-refurbishment/pre-demolition d out for the development. See section 1.1 eveloping inventories and audits.

lows for materials to be removed, stored and be dictated by the recommendations from commissioned and should be reviewed again

sting by the receiver of materials to prove the rials. This could include fire testing, emission ence of hazardous substances.

support onward reuse and share audit/ necessary, with end user. See the UKGBC Products as a Service document for these

ract arrangements to address risk i.e. warranty ts and materials.

ts are cleaned and prepped for reuse by the ractor they need to be transported and, in e) before they are passed onto the project he new location.

ike for like, on commercial projects, explore to local community projects or back to ling into the same product i.e. carpet back o furniture. See the UKGBC Innovation a Service document for these services.

Appendices

APPENDIX 1: CONSTRUCTION TEAMS DEFINED

Table 1. Construction teams defined.

Construction Team	Definition
Client Delivery Team	The internal team of the tenant/developer/landlord/asset owner (i.e. the client) of the development.
Client Delivery Team – Procurement	Includes the team responsible for procuring goods and services for the client.
Client Project Team / Manager	The project management team employed by the client to oversee the development.
Contractors (refurbishment or main)	The contractor employed to oversee and carry out construction works, whether refurbishment or new build.
Demolition Contractor	The demolition contractor employed to deconstruct the elements that will be reused.
Design Team	The architects and engineers employed to develop the design.
Facilities Estate Manager	The team that operates and maintains the building while occupied.
Inventory Auditor	The organisation employed to conduct an inventory of the site/asset/ portfolio to understand the materials that are existing and 'banked' and that can be reused.

APPENDIX 2: FURTHER READING

Building with Reclaimed Components and Materials: A Design Handbook for Reuse and <u>Recycling</u> by William Addis

Circular economy guidance for construction clients: How to practically apply circular economy principles at the project brief stage by UKGBC

Design for a Circular Economy by the Greater London Authority

From Waste Management to Component Management in the Construction Industry by Rose C. and Stegemann J.

Maximising Re-use of Materials On-site by Resource Efficient Scotland

Practical solutions for sustainable construction: Reclaimed Buildings product guide by WRAP

Proceedings of the Institution of Civil Engineers – Engineering Sustainability by Rose C. and Stegemann J.

Resource efficiency through BIM: a Guide for BIM Users by Adam Mactavish, Ash Turner and Nahim Igbal, Dave March for WRAP

Resource Salvation: The Architecture of Reuse by Mark Gorgolewski

Systems for Reuse, Repurposing and Upcycling of Existing Building Components by Rose C.

The Draft London Plan by the Greater London Authority

The Re-Use Atlas: A Designer's Guide Towards the Circular Economy by Baker-Brown D.

Contributors

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