Code of Practice

Pre-redevelopment audits

July 2017

SMARTWASTE
delivered by bre

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Contents

Introduction

This Code of Practice has been developed by BRE to provide guidance on carrying out pre-redevelopment audits in order to improve the quality and impact of these audits. It sets out the requirements for preparing an audit and how to use the results of an audit. The Code of Practice can be used by professionals who are carrying out audits and by clients, principal contractors, designers and demolition contractors who can use the results of the audits to minimise waste and improve waste management.

Acknowledgments

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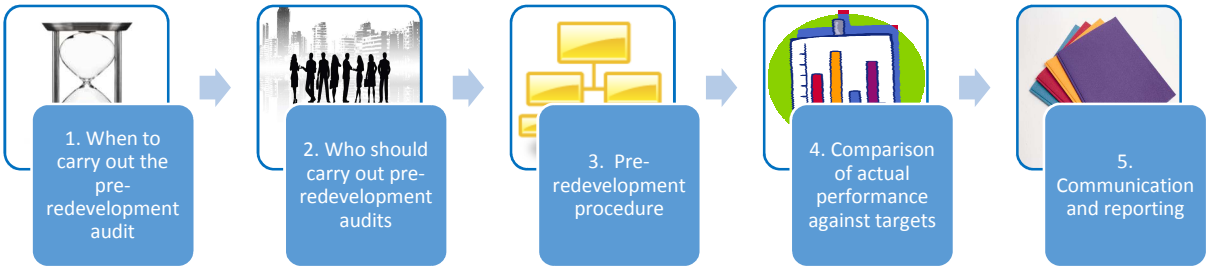
Pre-redevelopment audit Code of Practice

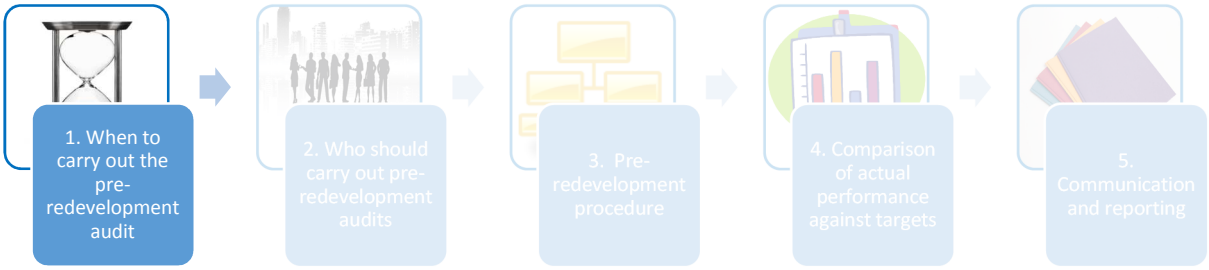
The aims of a pre-redevelopment audit include:

- Provide an understanding of the materials arising during the refurbishment and demolition phases of a redevelopment in order to help with development of a resource management plan.
- Identify products and/or materials that could be incorporated into subsequent development
- Ensure the management of material from the demolition/refurbishment process is in line with the waste hierarchy i.e. maximise reuse and closed loop recycling and minimise waste to landfill
- Minimise waste generation during redevelopment projects
- Provide evidence for any external assessment
- Comply with waste legislation where waste is generated.

The steps in the methodology are shown in the flowchart below and each step is then described in detail.



1.0 When to carry out the Pre-redevelopment audit



To get maximum benefit from the pre-redevelopment audit, it should be carried out as early as possible in the project. The audit should be carried out prior to the appointment of a demolition contractor and to maximise results it should be undertaken early in the design process i.e. concept design stage (Riba Plan of Work Stage 2[1]). This will greatly assist the following:

- Evaluate the feasibility of refurbishment as an alternative to demolition at an early stage.
- Explore potential for reuse of the structure and components by the client, cost consultant and design team as an essential part of the design process[2].
- Agree targets for reuse and closed loop recycling of materials with the demolition contractor.
- Realise more opportunities for closed loop reuse and recycling of materials, especially reuse of materials from the demolition/refurbishment process in the new development.
- Allow time to find a market for salvaged materials that cannot be reused on site.

It is preferable to carry out the audit while the building is unoccupied to ensure that all areas can be accessed. In some instances, for example, prior to refurbishment, it may be necessary to liaise with the building owner/occupiers to gather additional information about the building.

There are already a number of requirements for surveys when demolition or refurbishment is to be undertaken; these include:

- Control of Asbestos Regulations 2012 - Non-domestic property built prior to 1999 undergoing refurbishment, demolition or extension/reduction work needs to have a Refurbishment Survey undertaken. The HSE have guidance for this[3].

- Construction (Design and Management) Regulations 2015 – the client is required to provide pre-construction information to designers and contractors (to assist for bidding and planning).

- Green Overlay to the RIBA outline of work –Stage 2 (Concept Design) requires confirmation that ‘formal sustainability pre-assessment’ has been carried out and Stage 3 (Developed Design) requires that the design is ‘reviewed to identify opportunities to reduce resource use and waste’. A pre-redevelopment audit should be completed by Stage 3 to meet these criteria.

[1] https://www.architecture.com/files/ribaprofessionalservices/practice/ribaplanofwork2013overview.pdf
[2] See BS8895-2:2015 ‘Designing for material efficiency in building projects. Code of Practice for concept and developed design’ http://shop.bsigroup.com/ProductDetail/?pid=000000000030296208
[3] www.hse.gov.uk/pUbns/priced/hsg264.pdf

Key requirements

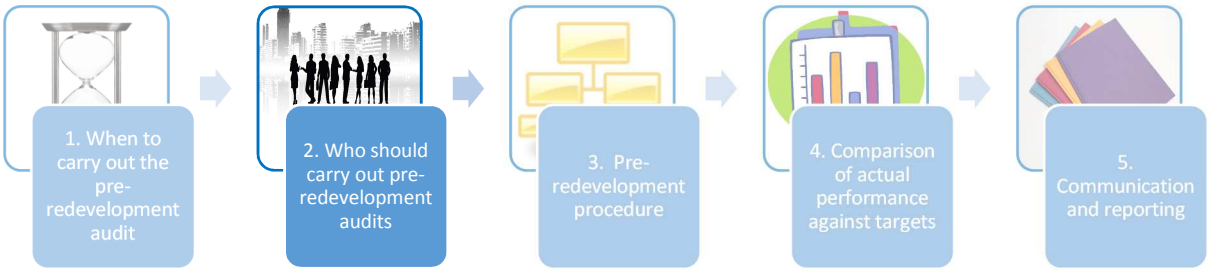
- The pre-redevelopment audit is carried out at concept design stage, where redevelopment is occurring

- The pre-redevelopment audit should be instructed by the client or if already appointed, the design team or project consultant.

Good practice

- The pre-redevelopment audits findings to be included within the pre-construction information pack

2.0 Who should carry out the Pre-redevelopment audit



The requirements for those carrying out pre-redevelopment audits are that they are independent of the client with sufficient knowledge of buildings and materials management:

Independence

The audit should be carried out by someone independent of the client and, if appointed, the design team or project consultants. The audit should summarise the best option for managing the demolition process in line with the waste hierarchy. Although costs and/or timescales are usually key priorities in any development, they should not overly influence the results of the audit.

Knowledge

It is important that those carrying out the audits have a basic understanding of the building process and the demolition process. In particular, it is important to be knowledgeable about the material management options available for reusable and recyclable materials.

Ideally, those carrying out the audits should be a member of a relevant Professional Institute or have appropriate training to ensure competence.

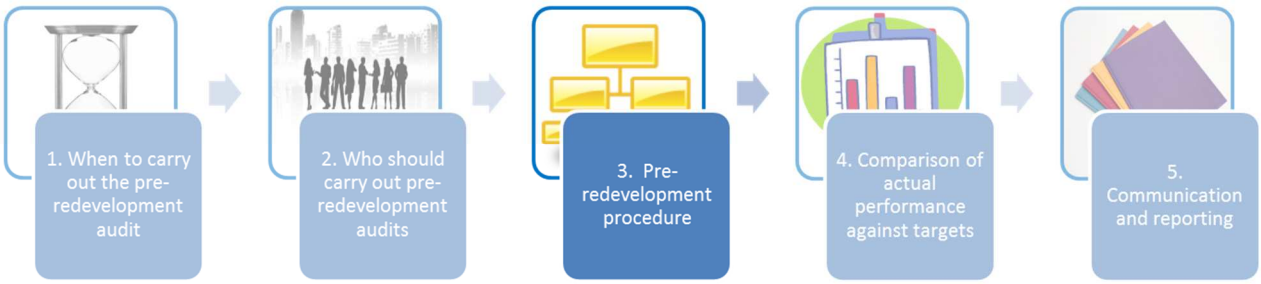
Key requirements

- The person undertaking the audit is independent of the project
- The person undertaking the audit has appropriate knowledge of buildings and resource management

Good practice

The person undertaking the training has some form of pre-redevelopment audit training and have membership of a relevant professional body.

3.0 Pre-redevelopment audit procedure



The pre-redevelopment audit should follow the following steps:

1. Collection and examination of available information
2. Site visit to collect further information
3. Estimation of types and amounts of materials
4. Assessment of suitability of material for reuse/recycling/other waste management method
5. Recommendations for materials management and target setting

Each of these steps is explained in detail below and a template for the report is shown in Appendix A. These steps are in line with guidelines being developed as part of the EU action plan for the Circular Economy[4] as shown in Appendix B and the EU Construction and Demolition Waste Management Protocol[5].

Collection and examination of existing information

Information about the structures and materials that may be reused, refurbished and recycled should be gathered and analysed. The types and amount of information available will depend on the type and age of the building. Sources of information include:

- Site drawings/information models
- Site photographs
- Asbestos survey
- Structural engineers survey

The available information should be studied to provide an understanding of the age of the structure, the type of structure, the construction methods used and the condition of the structure. This will help inform the site visit in terms of where measurements and more detail is needed and specific Health and Safety requirements that may be necessary on site.

[4] Closing the loop – An EU action plan for the circular economy, http://ec.europa.eu/environment/circular-economy/index_en.htm

[5] EU Construction & Demolition Waste Management Protocol, http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8983

Site visit

A site visit should be carried out to gather further information about the types and amounts of materials present and the condition of these elements/components. The site visit should take place as early as possible following the decision to redevelop the building but also it is preferable to visit the building post-occupation to ensure that all the necessary information can be gathered. Where the building is still occupied (for example in refurbishment projects) there may be limited access to some areas so it will be necessary to use plans and gather information from building owners or users.

Prior to the site visit a site specific risk assessment and method statement should be prepared, and a site induction should be provided to those carrying out the audit. In addition, the guidance in the HSE Managing Health and Safety in Construction, Construction (Design and Management) Regulations 2015 Guidance on Regulations[6] must be followed.

The equipment required to carry out the audit will depend on the site but will include measuring equipment, recording equipment and safety equipment if appropriate.

There may be limitations to the information that can be obtained during the site visit due to limited access while buildings are still in use or due to safety considerations such as the presence of hazardous materials.

Estimation of types and amounts of materials

The aim of the site visit is to take detailed measurement of the different elements present and record information on the condition of the elements. Information on the fixtures and fittings (including furniture and computer equipment) should also be recorded in an element listing table as in Appendix C.

For audits prior to refurbishment, the existing site plans and the proposed floor plans can be used to determine which elements are to be removed as part of the refurbishment. For audits prior to demolition, measurements of all the elements present should be recorded. The dimensions, composition and condition of these should be recorded.

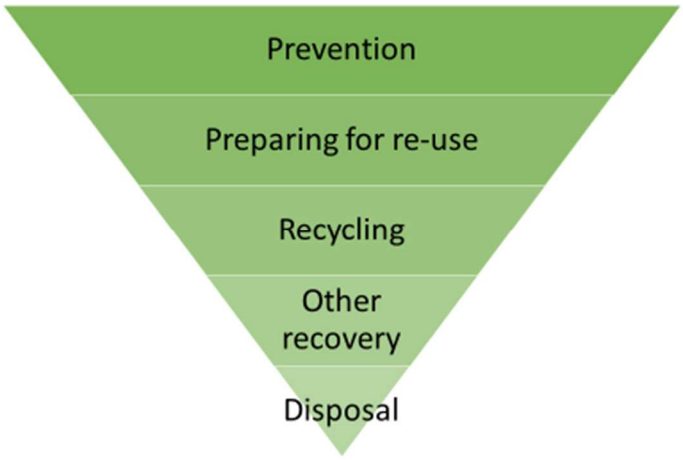
Using the measurements collected, the total volume of each different element should be calculated. This can then be converted to a total weight of material using conversion factors as detailed in Appendix D. A summary of the total weight of each material should be produced with a breakdown of the percentages of each waste type as shown in the Audit template in Appendix A.

Assessment of suitability of products for reuse and recycling

For each of the types of materials likely to arise from the redevelopment, an assessment of the best management option should be carried out following the waste hierarchy[7].

[6] HSE Managing Health and Safety in Construction, Construction (Design and Management) Regulations 2015 Guidance on Regulations: 153, 2015. Web version http://www.hse.gov.uk/pubns/books/l153.htm

[7] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69403/pb13530-waste-hierarchy-guidance.pdf



- Reuse on site or off site: Reuse of the component without further processing. (Where reuse seems appropriate onsite, i.e. in the subsequent development, this should be highlighted.)
- Closed Loop Recycling: Recycling/reprocessing into the same component e.g. ceiling and carpet tile take back schemes
- Open Loop Recycling: Recycling/reprocessing into a different component e.g. the shredding of a pallet to produce wood chips for particle boards
- Recovery: Typically used to describe generic separation and recycling of materials (usually at a waste transfer station), but there may be occasions where this could describe biological treatment such as composting.
- Energy recovery: Incineration of waste to provide energy
- Disposal: Disposal of waste via landfill, incineration without energy recovery or other form of treatment/encapsulation (e.g. for hazardous/difficult waste).

The suitability of materials for different management options is based on the type, amount and condition of the material. Appropriate legislation has to be referenced in the audit report, particularly if materials are to be reused on site. This includes:

- The Waste (England and Wales) Regulations 2010 and amendments
- Environmental Protection Act 1990
- Environmental Permitting (England and Wales) Regulations 2016
- Hazardous Waste Regulations 2005
- The Waste Electrical and Electronic Equipment Regulations 2006
- The Waste Batteries and Accumulators Regulations 2009
- Relevant quality protocols

Please note other Regulations exist in Scotland and Northern Ireland

Recommendations for setting targets

Based on the information gathered about the types and amounts of materials and the potential for reuse and recycling, targets can be set for different waste management methods. A range of targets can be set for overall amount of materials reused on or off site in their original form, recycled on site, closed/open loop recycled off-site.

Costs benefit assessment, although not a requirement, can be undertaken to show the costs and benefits for key materials for reuse in original form, closed loop recycling and diversion from landfill. To undertake this assessment, it may be useful to contact local reclamation and waste management companies to identify current costs. It should be noted that demolition contractors often include the value of materials within their tenders; therefore making the costs of demolition lower than it would be if the materials were not present.

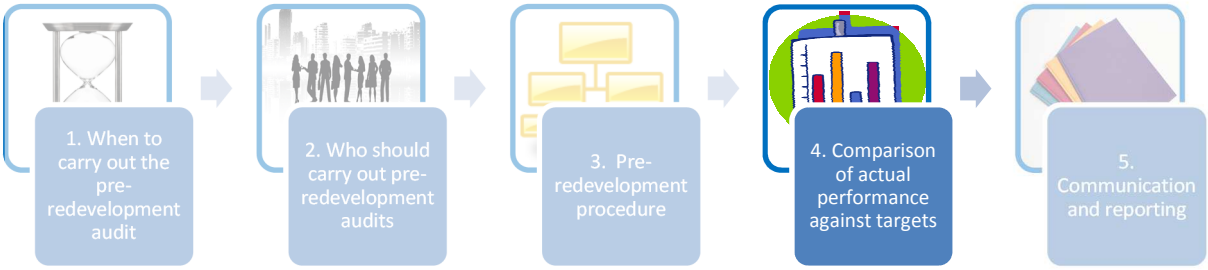
Key requirements

- Information is collected and analysed to determine the types and quantities of materials arising from the redevelopment based on elements and component listings
- Standard conversion factors are used to determine tonnages
- Key legislation is highlighted
- The waste hierarchy is followed as much as reasonably practicable
- Targets are set for materials reused on or off site in their original form, recycled on site, closed/open loop recycled off-site

Good/best practice

- A cost benefit assessment is undertaken on key materials
- Targets are set for specific materials/products for reuse and recycling

4.0 Comparison of actual performance against targets



Materials data

Data should be collected during the demolition/refurbishment stage about the actual material arising and the management routes for these materials. This can be recorded using a tool such as SMARTWaste (Appendix E) or a table such as that in Appendix F. When recording this data, it is important to ensure that material arisings from the demolition process is reported separately from those arising from the new build element of the project. The actual material arisings and the material diverted from landfill both overall and by individual material type can then be compared with forecasts and targets.

Environmental data

Different sets of environmental data can be measured such as impact of materials and waste transport and emissions from plant and machinery. The CO_2e emissions from these impacts can be calculated using the Government's Greenhouse Gas Conversion Factors for Company Reporting[8]: Additionally, CO_2e benefits can be shown for reducing transport impacts if materials are not moved from site, reuse instead of recycling and recycling instead of landfilling.

Cost data

Cost data can also be collected on the value of material reclaimed or sold for recycling and other materials management costs (costs of recovery, non-hazardous landfill and hazardous waste management) although this may be difficult to obtain from the demolition contractor. Cost benefits can be shown through using the cost of landfill as a baseline

Key requirements

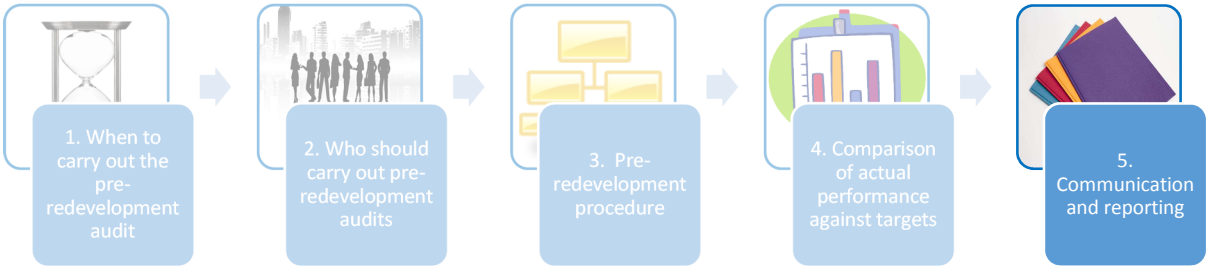
- Data is collected on the amount of materials arising from the demolition and refurbishment phase and its management route
- A comparison between actuals and forecasts/targets is undertaken

[8] https://www.gov.uk/government/publications/environmental-reporting-guidelines-including-mandatory-greenhouse-gas-emissions-reporting-guidance

Good/best practice

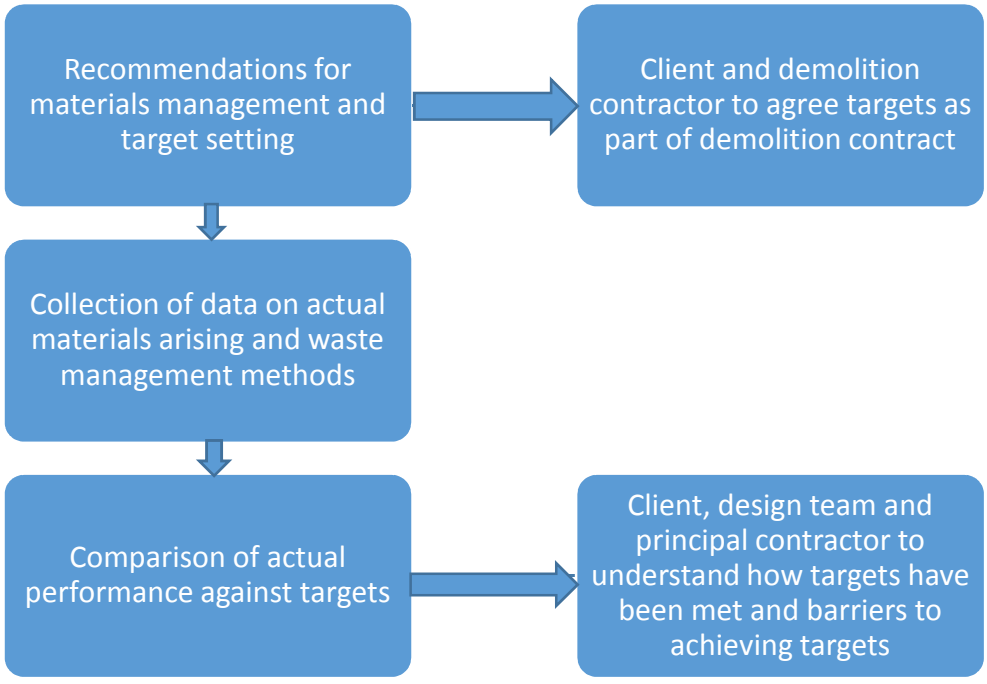
- The CO_2e emissions from transporting materials from demolition and refurbishment are measured (including potential savings from reuse onsite)
- The CO_2e emissions from reuse, recycling and recovering materials is measured (including potential savings)
- The cost/savings of the management routes used is calculated.

5.0 Communication and reporting



It is important that the results of the pre-redevelopment audit are communicated to the appropriate people to ensure that maximum benefit can be realised. The flowchart below shows how the results of the audit should be disseminated.

If appropriate the design team, should also see the audit report, to ascertain if any of the materials could be retained on the same project or used on other projects.



Following the comparison of actual performance against targets, a summary of the deviations from the targets and the reasons for these deviations should be recorded. The barriers to using the 'best' management methods should be recorded and a list of actions that could be taken on future projects should be produced in order to improve performance on future projects.

Appendix A Pre-redevelopment audit report template

1.0 Project details

Project reference	
Project location	
Project type	Demolition/refurbishment
Structure type	Housing/education/healthcare/office/industrial/other
Approximate age of structure	
Client details (company requesting the audit)	
Floor area of demolition	
Cost of demolition	
Scope of demolition/refurbishment	Summary of what parts of structures to be demolished/refurbished

1.0 Information available

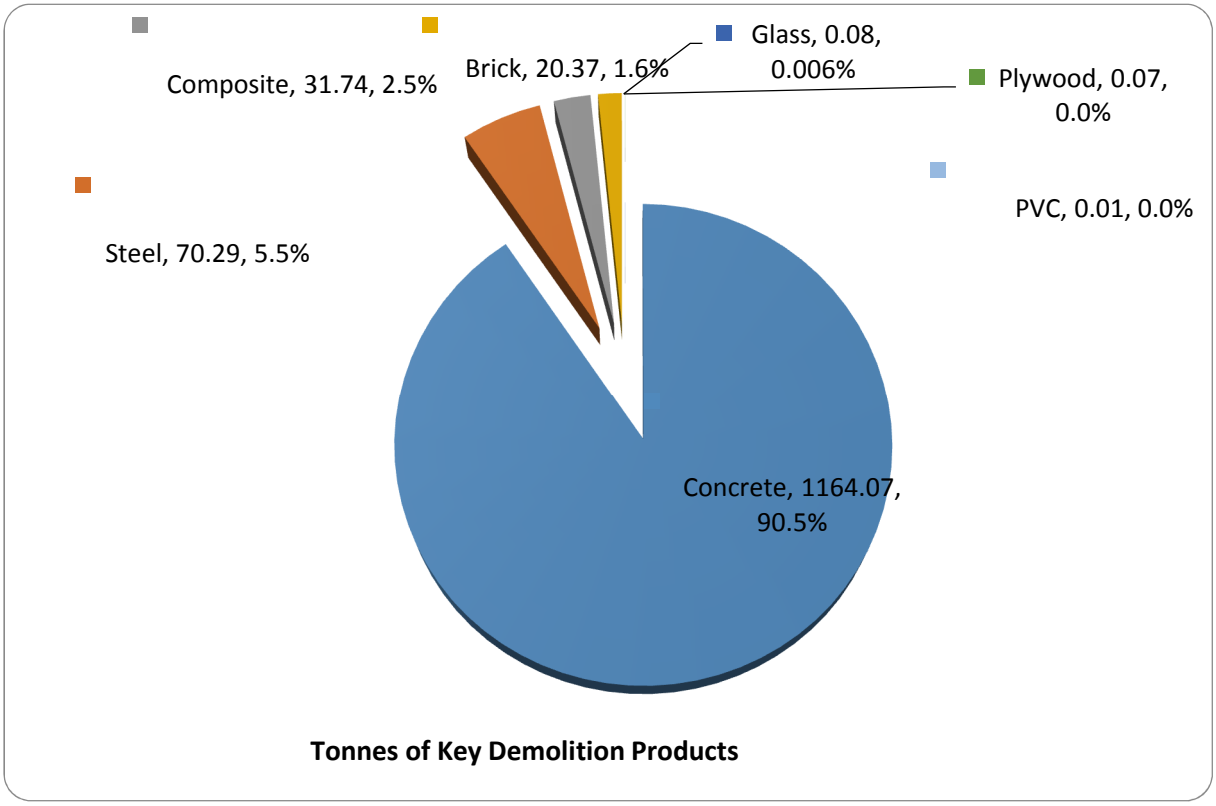
Information	**Available (Yes/No)**	**Details**
Scaled drawings: floorplans	*Yes*	*Drawings AC001/03-08*
Scaled drawings: elevations		
Scaled drawings: sections		
Photographs		
Asbestos survey	*Yes*	*Survey report by X, date, reference*
Structural engineers survey		
Other (provide details)		

3.0 Site visit

Site visit undertaken	
Date of site visit	
Site visit undertaken by	
Limitations	Detail any access limitations e.g. plant rooms, loft spaces, roof spaces, areas still in use, areas containing hazardous substances or other safety issues

4.0 Audit findings summary

Demolition product	Volume (m^3)	Weight (Tonnes)	Percentage by weight
Concrete	485.03	1164.07	90.48
Steel	7.65	70.29	5.46
Composite	29.94	31.74	2.47
Brick	11.98	20.37	1.58
Glass	0.03	0.08	0.01
Plywood	0.09	0.07	0.01
PVC	<0.01	<0.01	<0.01
Grand Total	**534.73**	**1286.62**	



5.0 Recommendations for waste management of demolition products

The recommended waste management options for the various components/materials are summarised by material type.

Concrete		
Component	**Amount (tonnes)**	**Recommended waste management option**
Stairs	3	Reuse in original form off-site (if pre-cast) Segregate and crush on site and use as recycled concrete aggregate in new development. Environmental permit needed to stockpile on site.
Blocks	5	Segregate and crush on site and use as recycled concrete aggregate in new development. Environmental permit needed to stockpile on site.
Foundations	200	Not suitable for reuse due to very different footprint of new construction. Segregate and crush on site and use as recycled concrete aggregate in new development. Environmental permit needed to stockpile on site.

Metals - steel		
Component	**Amount (tonnes)**	**Recommended waste management option**
Frame	60	Reuse of steel beams offsite
Reinforcing	5	Send to metal reprocessor for recycling
Pipework	4	Send to metal reprocessor for recycling

Timber		
Component	**Amount (tonnes)**	**Recommended waste management option**
Floors	20	Suitable for reclamation and reuse
Doors	4	Suitable for reclamation and reuse
Windows	2	Send to reprocessor as in poor condition

Etc for other materials found on site

6.0 Recommendations for targets

	Overall target for diversion from landfill	Targets for diversion from landfill by material type	Targets for reuse and recycling
Standard practice	√	–	–
Good practice	√	√	–
Best practice	√	√	√

Based on the information collected during the audit, the following targets have been set based on '*Good practice'*:

Target	**Level**
Overall diversion of waste from landfill	95%
Overall reuse	30%
Metals diversion of waste from landfill	100%
Concrete diversion of waste from landfill	100%
Other	

7.0 Actual waste arisings and waste management methods used

How have waste arisings been recorded?: e.g. SMARTWaste, Net Waste tool, other

By: e.g. Principal Contractor, Client, other

Date:

Material	Total amount (Tonnes)	% reused		% recycled		% recovered	% sent for energy recovery	% landfilled/ disposed of
		On-site	Off-site	On-site	Off-site			
Concrete								
Bricks								
Metals								
Timber								
Steel								
Non-ferrous metals								
Plastic								
Glass								
Plasterboard								
Other (specify)								

8.0 Comparison of recommendations/actuals

The actual waste arisings and waste management methods used are compared with the recommendations following the site visit and performance against target assessed.

By material type

Material	Predicted waste arisings (tonnes)	Actual waste arisings (tonnes)	Target % reused	% reused	% recycled	% recovered	% landfilled/ disposed of	Target % diversion from landfill	Actual % diversion from landfill
Concrete			-					100	
Metals			-					100	
Timber			-					-	

Overall

Target % diversion from landfill	Actual % diversion from landfill
95%	

Deviations from targets:

Explain here the reasons why the targets have not been achieved i.e. why it was not possible to follow the recommended waste management routes.

Targets met:

Explain here how the targets have been achieved.

Lessons learnt:

Add any information here that may aid future demolition/refurbishment projects.

Appendix B Proposed pre-demolition assessment guidelines for the construction sector

Construction and Demolition is a priority sector for the EU action plan for the circular economy and a key action is to develop pre-demolition guidelines. Currently, pre-demolition audits are mandatory in some EU member states but requirements vary. Guidelines under development include:

- qualitative and quantitative assessment of materials (waste/material type, amount, segregation required and quality),
- proposals for segregation and management of materials (possibility for reuse and recovery onsite, off-site recovery, availability of facilities and costs),
- quality assurance of the audit process (knowledge and skills of auditor, conflict of interest, comparison of audit results to actual) and
- reporting requirements.

Waste type			Recommendations		Actuals					Reasons for deviation from recommendations	Support documents
Waste type	LER code	Hazardous/ non-hazardous/ inert	Forecast from audit	Recommended route/segregation	Amount generated	Reuse on site	Reuse off site	Recovery	Disposal		

Appendix C Element listing

	Location	Element/ Component	Material	Number	Length (m)	Depth (m)	Height/ Width (m)	Square area	Volume	Conversion factor (tonnes/m3)=	Tonnes	Notes	Condition
Lower ground floor	Floors	Floors (Internal)	Timber	1	8.000	0.020	5.300	42.400	0.848	0.400	0.339	Pine floorboards assume 2 cm thick	Good
First floor	Front Windows	Windows	Timber	2	15.000	0.050	0.050	0.750	0.038	0.400	0.015	Profile of 5*1m and 4 *2.5m = 15m	
First floor	Front Windows	Windows	Glass	16	0.520	0.005	0.42	3.494	0.017	2.460	0.043		
First floor	Floors (bedroom)	Floorcovering (internal)	Carpet	1	4.200	0.008	5.200	21.840	0.175	3.900	0.681	Assume 8 mm thick	Poor
First floor	Floors (bedroom)	Floorcovering (internal)	Underlay	1	4.200	0.009	5.200	21.840	0.197	0.100	0.020	assume 9 mm thick	Not accessible
First floor	Internal doors	Doors	Timber	4	2.000	0.760	0.040	6.080	0.243	0.400	0.097		Good
Rear Garden	Rear Wall	Wall (external)	Brick	1	5.500	0.250	1.500	8.250	2.063	1.700	3.506		Bricks with lime mortar

Appendix D Conversion factors for common materials arising from demolition projects

Material	Tonnes/m^3
Aggregates	1.8
Aluminium	2.7
Asphalt	2.1
Bitumen	1.0
Blocks	2.0
Bricks	1.7
Cables (not hazardous)	2.3
Carpets	3.9
Cement	1.5
Chipboard	0.7
Clay roof tiles	1.9
Copper	8.9
Expanded Polystyrene insulation	0.0
Glass	2.5
Glass fibre insulation	0.1
Glass Reinforced Plastic	2.0
Hardboard	1.0
Hardwood	0.8
Internal building tiles	2.2
Iron	7.6
Lead	7.4
Low density fibre board	0.6
Medium Density Fibreboard	0.7
Mild steel	7.0

Material	Tonnes/m^3
Mineral wool insulation	0.1
Mortar	1.7
Oriented Strand Board	0.6
Paving	2.3
Polyethylene	0.1
Plaster	0.7
Plasterboard	0.7
Plywood	0.8
Polypropylene	0.9
Polyurethane insulation	0.0
Poly Vinyl Chloride	1.4
Render	2.3
Ready Mix Concrete	2.3
Roof tiles	2.5
Slate	2.9
Softwood	0.4
Stainless steel	7.8
Stone	2.5
Structural Concrete	2.3
Tin	7.3
Vinyl flooring	1.4
Waste paper insulation	0.0
Wool fleece	0.0
Zinc	4.0

Appendix E SMARTWaste

SMARTWaste® is a web-based membership tool allowing users to measure and monitor construction-site impacts.

The tool can be used for:

- Preparing, implementing and reviewing SWMPs or RMPs
- Online measuring and reporting on
    - Waste (aligned to defined waste groups)
    - Site energy, fuel and water use
    - CO_2e production from energy usage
    - Procurement of certified/sustainable timber
    - Transport impacts from materials deliveries, waste removal and staff travel to and from site
- Industry waste benchmarks

This membership tool is frequently updated and offers the user flexibility, reporting and support. Templates are available to meet the latest BREEAM credits and can also be downloaded. More information is available at www.bresitesmart.com/products/smartwaste.

Appendix F Recording actual waste arisings

Material	Total amount (Tonnes)	% reused		% recycled		% recovered	% sent for energy recovery	% landfilled/ disposed of
		On-site	Off-site	On-site	Off-site			
Concrete								
Bricks								
Metals								
Timber								
Steel								
Non-ferrous metals								
Plastic								
Glass								
Plasterboard								
Other (specify)								