The Demolition Protocol:
Aggregates Resource Efficiency in Demolition and Construction
Volume 3. For Contractors
Who is this document aimed at?

The Demolition Protocol is a document providing a pragmatic set of methodologies to increase resource efficiency in construction & demolition (including refurbishment) projects. This document provides information on the Protocol’s methodologies and its benefits to one of the key target audiences: Construction & Demolition Contractors.

WRAP (the Waste & Resources Action Programme) has extracted and published this document from the full Demolition Protocol produced by EnviroCentre for the Institution of Civil Engineers (ICE) and London Remade.

What the Protocol does

The production of demolition material can be linked to its specification and procurement as a high value material in new builds. The Protocol describes how the demolition and design processes can be managed to ensure that resource efficiency is increased by minimising waste and maximising the displacement of primary materials where viable.

A key feature of the Protocol is the framework for action it sets out, providing a basis for negotiations and assessments which consider the viability of resource recovery, in terms of costs and supply potential.

Introduction to the Protocol

The Demolition Protocol is an effective tool for resource efficiency, especially when forming part of a contractual arrangement or planning process.

The demolition industry is already well established in terms of resource recovery and, as such, the Protocol makes little reference to standard demolition approaches. In addition, the management of hazardous material such as asbestos is not included in the Protocol’s remit, nor are general health & safety procedures, which are covered by existing legislation, standards and codes of practice.

Rather it describes pragmatic methodologies for the assessment of demolition material and the potential for specifying recovered (recycled & reclaimed) material in the new build.

Benefits of Adopting the Protocol

• Secure construction cost savings and avoiding Landfill Tax and Aggregate Levy charges through recycling of demolition and construction waste and the specification of recycled and secondary aggregates
• Offer clients an added value service
• Integration of resource efficiency principles within the design process
• Market differentiation, by demonstration to clients of added value provided by tangible ‘Green’ credentials
• Planning benefits for development as a result of increasing pressures on local authorities to drive a more sustainable construction industry through policies which achieve waste minimisation, resource efficiency and demonstrate good practice.
How the Protocol works

There are two key stages in the implementation of the Protocol

1. The Demolition & Refurbishment Stage

A demolition audit is required which provides a Bill of Quantities (BOQ) to summarise the tonnages of materials in the building earmarked for demolition. The Demolition BOQ also indicates what the recovery target will be, this target being influenced by the following:

- The potential for segregating desirable materials from contamination
- The waste produced from reprocessing e.g. fines produced from crushing processes
- The market available for purchasing the demolition materials

Key outputs then from this stage are the:

- Demolition Recovery Index (DRI) – the percentage of materials which can be recovered
- Demolition Recovered Material Potential (DRMP) – the tonnage of materials which can be recovered
- Demolition Recovered Material Target (DRMT – tonnes)

2. The New Build Stage

The design process requires the production of the New Build Bill of Quantities (BOQ), to summarise the potential for specifying recovered materials in new build components/applications. This potential is determined by standards and specifications. The New Build BOQ also has a column where the target for specifying recovered material is noted. This target is based on the following:

- The constraints set down by standards
- The potential for supply of recovered materials at competitive prices
- The culture of the implementing organisations i.e. is there resistance to departing from established ways of working?

Key Outputs from this stage are the:

- New Build Recovery Index (NBRI) – the percentage of recovered materials which can be specified in the design
- New Build Recovered Material Potential (NBRMP) as above, but expressed as a tonnage
- New Build Recovered Material Target (NBRMT – tonnes)

Driving Demand & Supply

The new build and demolition methodologies drive demand & supply as shown in the diagram on the right. This has significant potential for building local reprocessing capacity and creating jobs. This economic benefit derives from the Protocol’s framework for negotiating recovery targets, where a development team has a duty to assess the potential for procuring viable, cost competitive recovered materials. Where there is such a supply then the procurement of these materials is preferred. The Protocol also drives opportunities for the procurement of recycled materials in high value applications.
Tender & Contract Relationships

An important aspect of the designer’s role in the project may be the management of contractors. The figure below sets out the relationship to be established for tender and contract processes which facilitate rather than hinder the implementation of the Protocol.

**Tender**

**Tender Specification:**
- Construction
- Demolition
- Tender evaluation

**Design:**
- Bill of Quantities showing where recovered material can be specified
- Target for recovery set based on potential for cost effective supply

**Tender submission:**
- Describes how the protocol is built into the demolition & construction phases

**Demolition, Procurement & Materials Handling:**
- Materials procured on basics of design specification
- Material transfer notes submitted to client (and/or local authority if protocol used as result of planning conditions) as evidence of recovery from demolition & use in the new build

The adoption of the Protocol at the early stages of the design process is key to its successful adoption and implementation, with the resulting potential for making cost savings.
Demolition auditing

The completion of a Demolition Audit prior to works commencing enables materials capable of being recovered for recycling to be identified. The figure to the right identifies the most effective steps for carrying out the audit.

Material recovery potential of different building types

The table below gives two examples of the potential of different building types to provide recoverable resources, where the concrete framed building provides the most potential in terms of recycled aggregates.

This table demonstrates the benefits of carrying out audits, in terms of the potential resources available and the level of material segregation required to achieve this potential.

**Demolition Audit**

<table>
<thead>
<tr>
<th>Material Composition</th>
<th>4 storey concrete framed office development</th>
<th>4 storey traditional masonry residence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>%</td>
<td>Tonnes</td>
</tr>
<tr>
<td>High Value Aggregate: RCA*</td>
<td>91.8</td>
<td>2,581</td>
</tr>
<tr>
<td>Medium value Aggregate: RA#</td>
<td>0.7</td>
<td>20</td>
</tr>
<tr>
<td>Recyclable Steel</td>
<td>5.9</td>
<td>166</td>
</tr>
<tr>
<td>Recyclable Hardwood, glass</td>
<td>0.1</td>
<td>3</td>
</tr>
<tr>
<td>Total Physical Contamination</td>
<td>1.5</td>
<td>3</td>
</tr>
</tbody>
</table>

*RCA (Recycled Concrete Aggregate), as specified in standards, can be specified in structural concrete applications.

RA (Recycled Aggregate), as specified in standards, is produced from a mixture of masonry materials and can be specified in concrete, but subject to more consideration than RCA.
The Protocol methodology for demolition

The table shows a section of a Bill of Quantities with the details to be provided for calculating resource potential (in terms of specifying recovered material) and targets. The “Recovery Index” percentage is determined through consultation and methodologies agreed with the demolition contractor.

<table>
<thead>
<tr>
<th>Concrete Components</th>
<th>Recovery Potential</th>
<th>Units</th>
<th>Total Material Weight (Tonnage)</th>
<th>Demolition Recovered Material Potential (Tonnes)</th>
<th>Demolition Recovery Index (DRI)</th>
<th>Demolition Recovered Material Target (Tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blocks</td>
<td>RCA</td>
<td>2000</td>
<td>10</td>
<td>8</td>
<td>80%</td>
<td>TBD*</td>
</tr>
<tr>
<td>Ceiling soffits</td>
<td>RCA</td>
<td>20</td>
<td>10</td>
<td>8</td>
<td>80%</td>
<td>TBD*</td>
</tr>
<tr>
<td>Floor slabs</td>
<td>RCA</td>
<td>40</td>
<td>40</td>
<td>32</td>
<td>80%</td>
<td>TBD*</td>
</tr>
<tr>
<td>Foundations</td>
<td>RCA</td>
<td>N/A</td>
<td>200</td>
<td>160</td>
<td>80%</td>
<td>TBD*</td>
</tr>
<tr>
<td>Quantified</td>
<td></td>
<td></td>
<td></td>
<td>260</td>
<td>208</td>
<td>208</td>
</tr>
</tbody>
</table>

Demolition Recovery Index (DRI) \(\% = \frac{\text{Recovered material potential}}{\text{Total material weight}} = 80\%\)

* Target is determined from consultation with reprocessors and the market place

Potential for specifying recovered materials

The most significant opportunity for specifying recovered materials in the new build, in terms of tonnages, involves recycled aggregates. The tables below reflect this, but, also describe other potential opportunities (more information is provided in the protocol document itself).

<table>
<thead>
<tr>
<th>Material</th>
<th>Recycling Options</th>
<th>Background Information</th>
</tr>
</thead>
</table>
| Recycled Aggregate       | As an unbound engineering fill, capping or sub-base for roads and structures, plus pipe-bedding, etc. | The Construction Products Directive has introduced European Standards (replacing British Standards) where recycled aggregates can be specified on par with primary material.  
The Specification for Highway Works has been updated in recent years and, as a result, recycled aggregates can be specified for all applications. |
| Flate glass              | As an aggregate, new glass, foam glass, bricks, or component of concrete, and asphalt | Manufacturing infrastructure, at time of writing, is limited with respect to the reprocessing of flat glass. However, this will grow, as a result of the pressures to achieve improved resource efficiency, supported by WRAP (see www.wrap.org.uk) |

<table>
<thead>
<tr>
<th>Material</th>
<th>Reclamation Options</th>
<th>Background Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bricks, blocks, etc.</td>
<td>Depending on mortar type e.g. lime based is straight forward</td>
<td>At St Pancras and Kings Cross reclaimed bricks were sold at very profitable prices</td>
</tr>
<tr>
<td>Doors, architectural features, etc.</td>
<td>Reclamation yards hold a wide range of building materials.</td>
<td>The BedZed development in London used a variety of reclaimed materials.</td>
</tr>
</tbody>
</table>
Example of development in standards

BS8500, Part 2, describes the mix of materials which define Recycled Concrete Aggregate (RCA) and Recycled Aggregate (RA). This is key to understanding exactly when a material is contaminated or not. Material complying with these mixes can then be specified in concrete. For structural concrete this allows RCA to be specified in mixes of strength C50. RA requires more careful consideration and testing in this respect.

<table>
<thead>
<tr>
<th>Type of aggregate</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum masonry content Mass fraction %</td>
</tr>
<tr>
<td>RCA</td>
<td>5</td>
</tr>
<tr>
<td>RA</td>
<td>100</td>
</tr>
</tbody>
</table>

Risk assessments to minimise chemical contamination

To maximise recovery there is real value in assessing the risk of components being subjected to chemical contamination. This will provide additional confidence to reprocessors in particular with respect to the potential for specifying aggregates in concrete applications. Purchasers and specifiers require guidance on potential contamination associated with recycled materials and the testing required to prove conformance with British and European Standards. Risk assessment flowcharts are presented in the full Demolition Protocol (see the Further Information at the end of this document) which take the user through the process of identifying which parts of a building may have unacceptable levels of chemical contamination. The table below indicates the format for summarising the risks associated with demolition materials in terms of potential chemical contamination. This can be completed following a risk assessment of the materials and the nature of their exposure. A “high risk” entry will indicate that a material is likely to require a chemical test. A “low risk” entry indicates that a chemical test is unlikely to be required.

The assessment then informs the Demolition Audit stage of this Protocol and subsequent segregation approaches for recovering material.

<table>
<thead>
<tr>
<th>Building Components</th>
<th>Chemical Contamination Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sulphate</td>
</tr>
<tr>
<td>Floor slabs</td>
<td></td>
</tr>
<tr>
<td>Precast concrete slabs</td>
<td></td>
</tr>
<tr>
<td>Soffits</td>
<td></td>
</tr>
<tr>
<td>Lightweight block work</td>
<td></td>
</tr>
<tr>
<td>Dense concrete block work</td>
<td></td>
</tr>
<tr>
<td>Artificial stone block work</td>
<td></td>
</tr>
<tr>
<td>Columns</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Where “HR” is entered in a column, this material is likely to require the chemical test shown.
2. Where “LR”, is entered in a column this material is unlikely to require the chemical test shown.
Site layout planning to aid the recovery of segregated materials

Resource recovery efficiency may be improved through the effective management of space where this is available on site. The figure and table below demonstrate how a site could be laid out and the data required to plan this.

Government (ODPM) guidance for small sites (less than 1,000 m²), where dust & noise mitigation is difficult, states that “on-site aggregates recycling should be avoided in close proximity to sensitive receptors” e.g. residential areas. The guidance also states that the minimum area required to operate crushing and screening plant is approximately 0.1ha i.e. 1,000 m² (Controlling the Environmental Effects of Recycled and Secondary Aggregates Production – Good Practice Guidance – DETR publications, 2000, www.odpm.gov.uk/stellant/groups/odpm_planning/documents)

Determining Storage Space For Different Material Throughputs

<table>
<thead>
<tr>
<th>Materials</th>
<th>Area (sq m) Required For Throughputs Shown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>A - Building (inc foundations)</td>
<td>N/A</td>
</tr>
<tr>
<td>B - Demolition Rubble</td>
<td></td>
</tr>
<tr>
<td>C - Sorting area</td>
<td></td>
</tr>
<tr>
<td>D - Reprocessing equipment</td>
<td>N/A</td>
</tr>
<tr>
<td>E - Segregated RA / RCA</td>
<td></td>
</tr>
<tr>
<td>F - Segregated Metal</td>
<td></td>
</tr>
<tr>
<td>G - Segregated Wood</td>
<td></td>
</tr>
<tr>
<td>H - Mixed waste</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

Courtesy of Controlled Demolition Limited.
A case study: Implementing the Protocol at Wembley

The Protocol has been implemented in the first work package on the Wembley redevelopment. The Construction Management Scheme incorporated the Protocol, with the development team working to provide the assessments required of demolition and the new build. The result of this was improved resource efficiency through the recovery of demolition materials, as well as a target for the specification of twenty-six thousand tonnes of recovered materials in the new build - at reduced costs over primary materials.

A key outcome of the work was demonstration of the importance of establishing tender specifications that make explicit reference to the Protocol. Another key stage was the consultation with local suppliers, which identified that there was the capacity to provide high performance recycled materials (aggregates in this case).

Adoption of the Protocol

The Greater London Authority (GLA) identifies the Protocol in its Supplementary Planning Document (London Mayor’s Policy 4B.6) on Sustainable Design and Construction, as a “gold” standard for materials use in building design and construction. It has been adopted by the London Borough of Brent Council and will continue to be adopted by other local authorities across the UK. A number of companies are adopting the Protocol - regardless of planning and policy requirements.
Further information

1. The detailed Protocol documents can be downloaded from the following websites:
   - http://www.ice.org.uk
   - http://www.londonremade.co.uk
   - http://www.envirocentre.co.uk

   The documents at these sites include the Main Report (providing background information driving the research) and Implementation Document.

2. WRAP has developed the AggRegain website to provide information on applications for recycled and secondary aggregates, providing specification information and case studies giving comparative performance and cost-benefit details. AggRegain has recently been expanded to provide a much broader range of information, including a Demolition Module. WRAP’s Procurement Programme is developing a range of practical guidance on how to specify and procure construction products and materials with higher recycled content, plus case studies which demonstrate the business case. In addition, The National Green Specification is an independent organisation which has produced an Internet-based resource, with “green” products and specifications for all building designers, constructors and manufacturers involved with ‘Sustainable Construction’. The website addresses are shown below.
   - http://www.aggregain.org.uk
   - http://www.wrap.org.uk/procurement
   - http://www.greenspec.co.uk
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