Material change for a better environment

Halving Waste to Landfill

Assessing the costs and benefits of reducing waste in construction

Timber-framed Primary School

	Value	Percentage of £4.28m construction cost
Cost saving potential	**£49,100**	**1.15%**
Additional costs to achieve these savings	**£19,600**	**0.46%**
TOTAL POTENTIAL COST SAVING	**£29,500**	**0.69%**

Introduction

Reducing, reusing and recycling waste can help to reduce costs on construction projects. By asking for good practice from an early stage in the design and planning process, clients and contractors can secure these savings and demonstrate corporate responsibility. Such action lies at the heart of corporate commitments in support of the sector target for halving waste to landfill.

This case study identifies, at design stage, the costs and benefits achievable through waste reduction and recovery in the construction of a new primary school. The analysis quantifies savings starting at RIBA stages C/D i.e. once the overall design has been selected. Therefore it does not include further savings from more fundamental design changes at an earlier stage.

The project is a ~£4.3m new primary school development. The school is to be built on the site of a former primary school which has been demolished. The school is a timber frame structure over 1 storey, with an approximate gross floor area of 2,750m². N.B. This assessment includes external works, but excludes demolition, excavation, mechanical and electrical services.

Design potential

Significant savings can be made by targeting good practice wastage rates for the 10 or so components offering the biggest savings in the value of materials wasted.

	Value of wasted materials	Cost of waste disposal	Total cost of waste	Total cost of waste as % of construction value
Baseline practice	£60,115	£57,664	£117,779	2.75%
Good practice (all components)	£28,879	£28,999	£57,878	1.35%
Targeted practice (top opportunities)	£38,953	£29,709	£68,662	1.60%
Improvement over baseline	**£21,162**	**£27,955**	**£49,117**	**1.15%**

These cost savings will be shared across the supply chain. Clients and principal contractors can increase their share through the procurement process.

The savings are based upon the following changes in performance:

	Total waste arisings (t)	Waste sent to landfill (t)	Recovery rate	Embodied carbon wasted (t CO_2 eq)	Recycled content
Baseline	1,208	604	50%	77	8.57%
Good practice	620	125	80%	39	16.94%
Targeted	796	273	80%	58	14.10%
Improvement over baseline	**412 (34%)**	**331 (55%)**	**30%**	**19 (25%)**	**5.53%**

Understanding the costs and benefits

WRAP's Net Waste Tool has been used to quantify the extent of the cost savings possible, and to select the top 9 opportunities relating to the build element, and top 6 opportunities relating to the external works construction. Waste reduction and recovery actions needed to deliver these targeted savings were then identified, and their implementation costs estimated. Costs and benefits are shown below.

Achieving cost reductions (BENEFITS)	Baseline	Targeted practice	Improvement
Value of wasted materials Construction materials are a valuable resource, yet it is common to see high levels of waste through damage on site, off cuts, over ordering of materials, and the need for rework. Reducing this waste saves money. Where a trade contractor supplies materials and labour for a lump sum fee, they are likely to retain savings from waste reduction unless the client or contractor takes specific actions through the procurement process.	**£60,115**	**£38,953**	**£21,162** *(0.49% of construction value)*
Cost of waste disposal Every skip or container of waste carries a cost. Whilst segregated metals are often removed at little or even zero charge, the majority of wastes carry substantial costs – and these are set to rise with the annual increase in Landfill Tax. However, waste disposal costs aren't fixed. Substantial savings are achievable simply by reducing the quantity of waste generated. In addition, the segregation of wastes and finding destinations other than landfill can help further. In this example, the total mass of waste has been reduced by 34%, and a three skip strategy plus a mixed waste skip has been chosen instead of a single mixed waste skip strategy.	**£57,664**	**£29,709**	**£27,955** *(0.65% of construction value)* *(£22,195 saved through reduced waste arisings)* *(£5,760 saved through increased segregation)*
		Combined savings	**£49,117**

These savings will only be achieved by taking specific management actions to change behaviour during design and site practice.

Investing to save (COSTS)[1]	Costs
Develop quality SWMP – Additional time beyond minimum legal compliance (England only) to develop plan with quality forecasts (including using the Net Waste Tool) and robust management actions.	**£1,640**
Develop site logistics strategy – Planning time required to establish how materials are to be delivered, stored and moved around the site	**£1,080**
Site training – Time to provide training, and site operatives' time to receive training (5nr ½hr briefings for 10 operatives per session)	**£1,530**
Materials storage – Nominal allowance for construction of hard standing and temporary shelter for materials (or cabin hire)	**£2,200**
Management time – Additional time required to ensure SWMP is adhered to, including material handling, re-use of materials on site, efficient installation and waste segregation (2.5hrs per week for ¾ of the programme)	**£4,125**
Updating SWMP – The SWMP needs to be reviewed and updated throughout the project. This cost allows for a 4 hour review every 3 months.	**£1,467**
Site segregation – To ensure good segregation, this cost allows for a single individual to sort and move wastes and monitor the re-use of materials on site. (Included part-time for 50% of the programme as reduced demand during early packages.)	**£7,590**
Combined costs	**£19,632**

Sharing the costs and benefits

On paper there are possible savings of £49,117, but to achieve these savings an estimated £19,632 in costs must be incurred. This Section identifies how to achieve these benefits, who receives the benefits from these savings, and who pays for the improvements.

The benefits

A. Reduction in value of materials wasted

Potential saving **£21,162**

The following materials provide the largest cost reduction potential. The values below show the potential saving if wastage rates are improved from a Baseline to a Good practice[2] level.

[1] These costs are based upon estimated durations, and have been reviewed with selected contractors.

[2] These wastage rates are based upon primary research carried out by Arup (on behalf of WRAP) with main contractors and sub contractors. Data were gathered on the likely level of waste at Baseline practice (the waste one would expect in normal working conditions) and at Good practice (the reduced level of waste if additional measures are put in place to prevent damage and install efficiently).

	Baseline wastage rate	Good practice wastage rate	Potential saving
Build element			
Reinforced in-situ concrete	4.00%	2.00%	£3,851
Facing brickwork	20.00%	10.00%	£3,654
Timber studwork and mineral insulation	10.00%	5.00%	£1,739
High density dry lining	22.50%	15.00%	£1,181
Rockwool flexi insulation	15.00%	5.00%	£1,131
Carpet	5.00%	2.00%	£970
Isowool Insulation	15.00%	5.00%	£881
Profiled steel structural decking; 0.8mm thick; polyester coated;			
Metal profiled roofing system	1.00%	0.00%	£733
Batted timber floating flooring	10.00%	5.00%	£600
External works			
Type 1 Unbound Mixtures	10.00%	5.00%	£1,844
Dense Macadam Base	5.00%	2.50%	£1,000
Metal fence, galvanised sheet	15.00%	5.00%	£1,107
Subsoil	10.00%	5.00%	£993
Dense Bitumen Base	5.00%	2.50%	£768
MOT Type 1	10.00%	5.00%	£604

This list includes mostly low value, high quantity items (in-situ concrete, brickwork, timber studwork, dry lining, insulation, unbound mixtures, and macadam). Some other materials contribute smaller savings including steel structural decking and metal profiled roofing. Focusing efforts on high quantity but low value items, and high value items will ensure the cost of waste is reduced as low as possible.

Who saves?
Whoever takes the risk for the supply of materials will see these costs savings. This is normally the trade contractor, or the main contractor for bulk products such as aggregates. The extent of waste is rarely reconciled with the original order, meaning that trade contractors often do not know how much waste is costing. To convert this reduction in waste into a reduction in price (for the contractor or client), the trade contractor will need to:

- include a reduced wastage rate in their tender (for more competitive pricing on a lump sum tender); or
- procure less materials, therefore save money, and share this up the supply chain (open book tender).

B. Reduction in cost of waste disposal

Potential saving **£27,955**

A reduction in waste achieves a drop in the cost of waste disposal (£22,195 saving). In addition, several of the largest waste streams can be segregated. By segregating wastes, the value of these waste streams is increased, and therefore the cost of disposal is reduced (£5,760 saving).

On this project the following waste streams have been segregated, and the breakdown of the wastes in each (by volume in m^3) is as follows:

Inert	Plasterboard	Timber	Mixed
900	4	3	50

Who saves?
The main contractor would normally pay for waste disposal on the basis of volume (and type) of waste removed, therefore these savings would normally accrue to the main contractor. The client's ability to share in these savings is determined by the procurement route. Where a form of renegotiated or open book payment structure is used, then there should be an opportunity to share in these cost savings.

Material change for a better environment

Halving Waste to Landfill

The costs

Most of the costs required to reduce waste or increase recovery are borne by the contractor. These costs are divided into two parts: planning costs and management costs.

Planning for waste is a low cost / high impact activity, highlighting the big opportunities such that effort can be focused on these. For example, by planning you might identify that you need better material storage, hence the allowance of £2,200 for this.

During construction the **management** of wastes is important to ensure that the plan is delivered. This analysis includes an additional amount of management time to oversee the waste management process (including material deliveries, material storage, installation and waste disposal), plus an allowance for a dedicated operative to manage and monitor materials storage and waste segregation (£7,590).

Conclusion

The main contractor will typically benefit from a reduction in the cost of waste disposal (£27,955), which from this analysis will exceed the costs of implementing good practice (£19,632) – providing a commercial motive for action on site. However, to ensure that maximum benefit is realised from waste reduction, it is important for the client, the contractor and the trade contractor to work together to ensure that the **value of materials wasted** is reduced by designing out waste, i.e. greater recycling is not enough in itself. Therefore:

- clients need to instruct designers to look for waste reduction opportunities, plus set threshold waste reduction and recovery targets;
- designers need to look for opportunities to design out waste (such as the simplification of the specification);
- contractors need to develop a quality SWMP and a materials logistics plan;
- trade contractors need to ensure that materials are not over ordered, and that the materials that are brought to site are used as efficiently as possible; and
- the waste management contractor must ensure that all wastes received are recycled wherever possible.

Methodology

This cost benefit analysis has been conducted using data taken from WRAP's Net Waste Tool. The Tool is freely accessible on the web at www.wrap.org.uk/nwtool, and helps project teams to forecast the waste that would be expected on different projects. The Tool works by setting up basic cost plan information to which baseline and good practice industry wastage rates are applied. The analysis identifies which components and specifications offer the greatest opportunities for waste reduction, and proposes a least cost segregation strategy. The Tool forecasts the overall quantities and costs of waste at baseline, good and user-targeted levels of performance, including the value of wasted materials and the cost of waste disposal.