

Green Building Handbook Volume 3

Demolish or deconstruct

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Introduction

Construction is responsible for 50 per cent of all resources consumed in the world making it one of the least sustainable global industries (Edwards 2002:1). Although it is difficult to quantify, largely due to the highly variable amount of waste generated by the construction industry, the amount of waste can be as high as 15 per cent of all construction products used in a project. Construction products are intermediate products, which are to be incorporated in construction works (notably buildings, but also roads, bridges etc.). They encompass a wide range, from simple bricks or cement to very complex glass- or polymer-based structures, reaching all the way to complete facades.

Very little of these construction products are recycled or reused in South Africa meaning that most construction and demolition (C&D) waste lands up in municipal landfill sites (best case scenario) or is dumped illegally (worst case scenario). Notwithstanding this, it must be acknowledged that a significant proportion of construction waste does get reused in informal dwellings in the poorer communities.

Under normal conditions there are three options for dealing with a building that has reached its end-of-life:

- i) Demolish and dispose in landfill sites
- ii) Reuse some or all of the construction products as is in new construction
- iii) Recycle some or all of the construction products as aggregates or similar

Demolition should be the last resort given the value represented by the resources (materials, energy, capital investment and labour) and the growing scarcity of suitable landfill sites. Reuse is preferable to recycling due to the additional energy consumed during the recycling process (i.e., grinding up concrete to reuse as aggregate).

Demolition

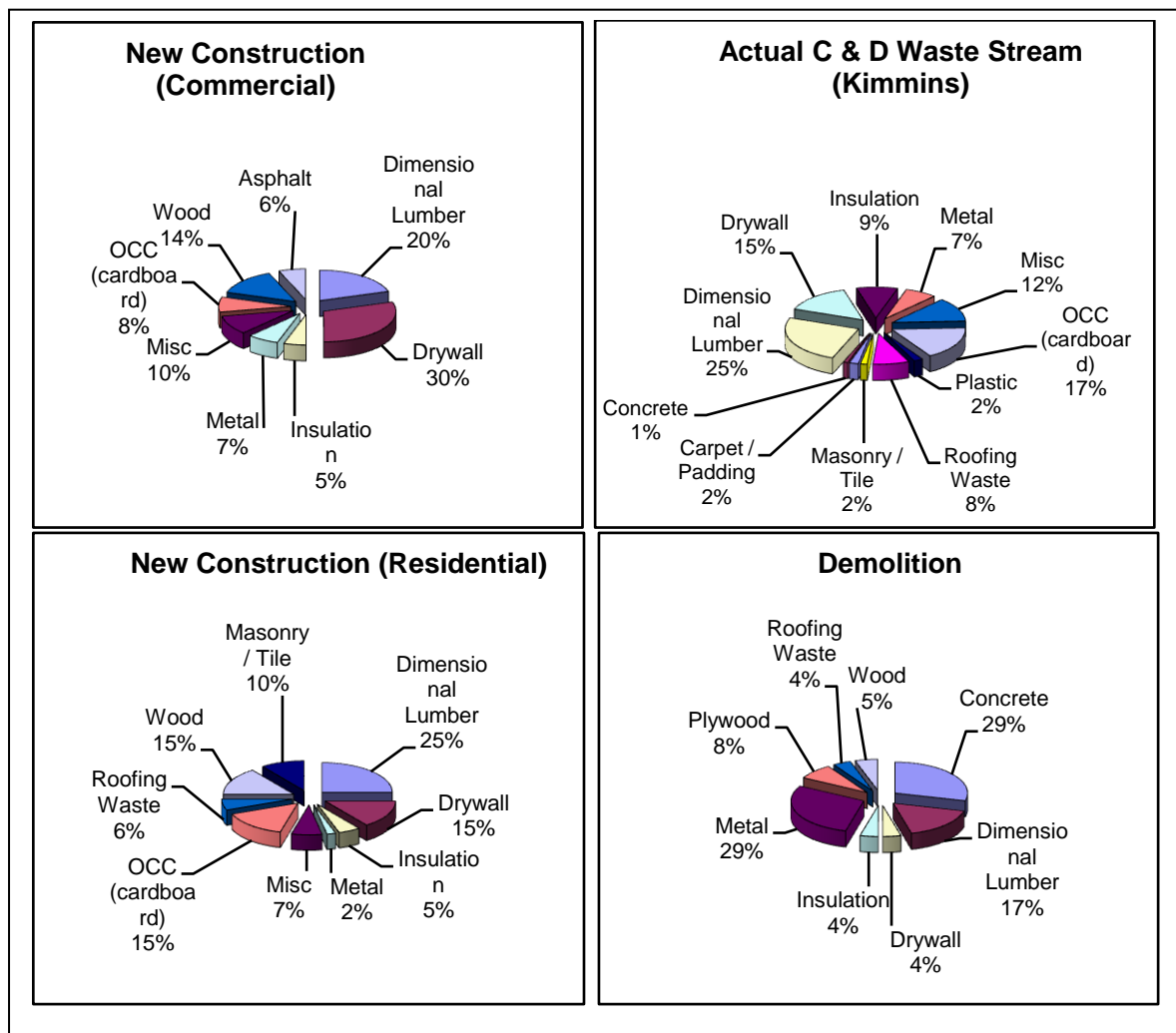
Construction waste and demolition represents a substantial proportion of the construction value, at least 15 per cent of the material component of the construction project. Since the material component of construction projects can be up to 50 per cent of the total construction value (and higher where less labour is required) C&D can represent a significant financial loss to the client. In fact, construction clients and customers can end up paying for C&D in many ways: the first cost is the cost of the material and its delivery to the construction site, the second cost is the cost of the waste; the third cost is the cost of disposal; and the fourth cost is the operation and maintenance cost of the landfill site contained in the municipal rates account levied to the project.

The materials used in construction products also have a significant environmental impact throughout the value chain, beginning at extraction and progressing through processing, transport, use, and finally disposal. This environmental impact occurs at many geographical levels ranging from the global to the regional to the local and from climate to biodiversity to

health. Waste disposed of to landfill sites give rise to off-gassing of global warming gasses over time, contributing to increased climate change impacts in the longer term.

Construction waste and demolition varies according to the type of project: Figure 1 below provides an indication of the differences in waste between residential construction works and commercial construction works as supplied by the United States Environmental Protection Agency (EPA 2007). While the materials used in construction in the United States differs quite substantially from that used in South Africa, it is useful to note the variety of construction products that typically land up in landfill sites.

Figure 1: Waste percentages by construction type (U.S. EPA 2007)



The draft South African National Waste Management Strategy notes that while C&D waste does not represent a primary source of hazardous waste illegal dumping, diverting this waste stream from landfill sites, and properly managing hazardous waste components are the primary concern with regard to the management of construction and demolition waste (DEA 2010:89). The draft strategy argues that C&D waste requires separation into component parts for reuse and recycling. The strategy suggests a multi-pronged approach including promoting reuse and encouraging sector stakeholders to develop an Industry Waste Management Strategy (IWMS) on a voluntary basis with specific emphasis on reuse and recycling mechanisms and instruments.

Deconstruction

Deconstruction involves the selective dismantling of buildings and building components, specifically for reuse and recycling. Emerging legislative drivers globally will require the construction industry to look in detail at every aspect of the process from design to demolition, looking at the 'recyclability of the construction works, their components and materials after demolition.'

While the increased adoption of offsite construction solutions globally is leading to significant reductions in the levels of waste generated during the construction process, the next stage is to look at the opportunities to design buildings that can be adapted throughout their life cycle, including the end of life implications.

Analysing typical C&D waste is the first step to eliminating waste: knowing what typically gets wasted enables the designer to design and specify the construction products in a manner that facilitates reuse and recycling. For example, applying a coating to aluminium or steel makes it more difficult to recycle in future. Laying ceramic tiles in complicated patterns makes it more difficult to reuse in new construction projects.

The Netherlands has developed a system called *Eco-Quantum* which assesses the life-cycle of whole units of construction such as glazing systems (including inter alia glass, frames and mastic used), structural walls (including inter alia bricks, mortar, foundations), and interior partitions (including inter alia plasterboard, framing and paint). This system-based approach serves as a useful guide when designing the building and making decisions about construction products and systems that will be more easily reused and/or recycled at end-of-life.

Reuse and Recycling

Many of the resources that go into making construction products can be "retrieved and converted back into a useful product at the end of a building's life" (Edwards 2002:60). This applies to most of the basic construction products used in the South African construction industry, including concrete, masonry walling, windows and doors (including glass and door leafs), steel products, sanitary ware, ceiling boards, timber, electrical fittings, floor finishes, wall finishes, and insulation materials.

Reuse refers to those construction products that are reused without substantial re-manufacture, for example, reusing a steel or timber beam. Recycling refers to construction products that have to be re-manufactured and/or re-processed into a new construction product of the same product type, for example aggregates in concrete. Many construction products can be reused and/or recycled: for example, steel beams and columns can be reused as is, or re-processed into new steel sections.

Significant opportunity exists to recycle and reuse construction and demolition waste as aggregates in road construction for sub-base layers in concrete. Several countries are recycling up to 85 percent in this way.

Case Study

In the refurbishment of its office accommodation in 2003, the then newly established Construction Industry Development Board (cidb) was challenged to address its own role as a best practice client in the context of industry development in South Africa.

The refurbishment project presented the cidb with an opportunity to promote best practice from the identification of objectives through to implementation, monitoring and evaluation (Gyimah, van Wyk & Hodgson 2003). The case study served to describe the challenges, achievements and lessons learned in promoting industry development and triple bottom line sustainability objectives such as:

- National empowerment initiatives;

- Procurement methods that underpin value, transparency and partnership;
- Health and safety, including HIV/Aids awareness; and
- Environmental objectives, including design for flexibility and comfort, materials recycling and energy conservation.

The recovery of the face bricks used as division walls internally was identified as an early objective of the contract. However, the contractor recovered the run-of-the-kiln (rok.'s) bricks used internally as well. The technique for this was quite simple: the vertical and horizontal joints between the infill wall panel and the concrete frame were cut open with a radial saw, and the wall pushed over onto the floor of the adjacent room. The coursing of the bricks would simply break open along the horizontal mortar joints. The mortar would then be chiselled off.

This objective was successfully met with over 30,000 rok's bricks being recovered and set aside for reuse. The recovery rate achieved for rok's was 80%, and 15% for face bricks. The replacement value of the rok's is R15 000.00. However, the contractor – who is a specialist in this field – recovered materials in addition to the bricks as called for in the tender. Although the value looks relatively low, it represents almost 10% of the total value of the materials used for the project.

A list of the materials covered for reuse is included below.

Table: Materials Recovery and Value (2003)

Material	Quantity	Used Value (R)	New Value (R)
Aluminium		4 200.00	4 200.00
Bricks, rok	30,000	15 000.00	15 000.00
Carpets		1 500.00	1 500.00
Ceilings, acoustic	250 sq.m.	12 496.00	27 496.00
Ceiling, tees	250 sq.m.	2 528.00	2 528.00
Doors	30	1 800.00	3 600.00
Ducting		1 800.00	1 800.00
Insulation		3 800.00	3 800.00
Partitioning boards	200	8 000.00	19 200.00
Partitions, studs	240	1 920.00	4 320.00
Power skirting	110 lengths	7 696.00	20 456.00
Sanitary ware	9 sets	3 144.00	8 000.00

Tiles, wall	120 sq.m.	2 400.00	8 400.00
Timber, pine		2 000.00	4 000.00
Timber, meranti		696.00	2 800.00
TOTAL		68 968.00	127 080.00

From an environmental perspective of course, the recycled material represents a major benefit: the energy consumed is saved from the manufacturing and transport components; the concomitant emission of CO₂ gases is reduced; the consumption of raw material is reduced; and the dumping of materials to landfill sites is reduced. Given that this was refurbishment project of a building not designed for reuse and/or recycling, the potential volume and value that can be reused and recycled if the building is designed for deconstruction becomes highly significant.

Strategies for Reuse and Recycling

The following design strategies will assist the designer to conceptualise the design having regard for the reuse and/or recycling of the construction products at its end-of-life (van Wyk 2004).

1. Evaluate which construction products would meet the performance requirements of the brief.
2. Evaluate the optimal usage of those construction products that would result in the least amount of construction waste.
3. Investigate which construction product offers the greatest potential for reuse and/or recycling at the building's end-of-life.
4. Investigate which construction products offer the most durability for the life-cycle of the facility.
5. Implement a design approach that maximises the flexibility of construction products for reuse and recycling, i.e., planning on standardised modules, installing with a view to easier removal, restricting additionally applied finishes onto construction products.

Conclusion

Construction products have the potential to be reused and/or recycled to a significant extent, providing however that measures are put into place early in the project's life cycle, commencing with the design phase.

This requires the designer to be aware of the reuse and/or recycling potential of various construction products and to specify those construction products offering the greatest potential. To facilitate the easier reuse and/or recycling of construction products requires that a standardised module be used, that the fixing and installation of construction products be done in a manner that facilitates easier removal without resultant damage, and restricting the applications of finishes to those that can be easily removed for reuse and/or recycling purposes.

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