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S-DP4

DESIGNING FOR DECONSTRUCTION & CRADLE TO CRADLE APPROACHES

TARGET AUDIENCE & OBJECTIVES: This information sheet is on the topic of design and emerging ideas within the design community that aim to improve sustainability methods and standards. This is not a technical Information sheet and provides an introduction and signposting that will of interest to practitioners in all areas of the construction industry.

1 INTRODUCTION

The maxim 'Reduce, Reuse, Recycle' is often used to help efforts to help reduce the amount of household waste that is sent to landfill. An analogy in the construction industry is 'designing out waste'. However, the emphasis is all too often placed on the recycling element as opposed to the reduction and reuse of elements. In construction, this is demonstrated by the drive to send less to landfill via efficiencies rather than addressing the issues associated with inefficient natural resource use. The approaches outlined in this information sheet seek to 'close the loop' in resource use by encouraging alternative means and methods by which buildings and individual products are designed and produced. This can be done in such a way that at the point when their life cycle would usually be complete, the waste materials can be re-used in the same product system that they were previously in or another product without loss of product quality.

2 DESIGN FOR DECONSTRUCTION

As waste minimisation strategies, coupled with increases in landfill taxes, become integrated into the construction process, the amount of waste being sent to landfill will inevitably decrease. However, for many advocates of the design for deconstruction principle, the notion of waste minimisation does not go far enough. This is because a waste minimisation strategy based on efficiency alone will not 'close the loop' of resource use in the system to prevent unsustainable raw material use at the beginning of the process.

Similarly, recycling strategies only partially address the problem of construction waste, as considerable resources can be used up in re-processing and transportation[1]. One part of the efficiency process[2] that can make a substantial difference to construction sustainability but is often understated, is the role that can be played by designers and architects to explicitly 'design for deconstruction', or 'design for disassembly'.

The principles underlying design for deconstruction seek to address the problem of resource use at the whole building level. The result should be that buildings are more flexible and easier to maintain with increased longevity and reduced environmental impact.

An example of how this might be achieved is by ensuring that building components requiring regular maintenance or replacement are easy to remove and access within the building.

In terms of a building's lifecycle, designing for deconstruction closes the resource loop, by incorporating the reuse of traditional waste streams from deconstruction as inputs in the construction life cycle, preferably with as little re-processing as possible.

Over the last few years, various guidance materials have been produced for designing for deconstruction and links are provided to some of these in the signposting section at the end of this information sheet. The most influential report with regard to Scotland was produced in 2005 by the Scottish Ecological Design Association and is entitled "Design and Detailing for Deconstruction".

Although now 5 years old, this report still offers one of the most comprehensive overviews of the principles and application of the design for deconstruction process. The report is too large to easily summarise here as it contains substantial guidance and several case studies, however, the following set of key principles extracted from the guidelines offer a useful overview:

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3. BUILDING RESOURCE EFFICIENCY: KEY PRINCIPLES[3]

- resource efficiency is an ecological issue – the rates of use of any material must be sustainable and aim to maintain diversity in design and supply;
- aim to minimise waste by designing elements for maximum diversity of options when re-used;
- know your place – nothing can replace intimate "local knowledge" in relation to designing for a particular place. Avoid monocultural deconstruction solutions for different sites – each site is unique in terms of climate and resources;
- aim to minimise waste by increasing the number of times a construction element can be re-used;
- minimise transportation by allowing building to be fully adaptable with the minimum use of new resources. Avoid excessive transportation of materials;
- prefabrication may be cost effective, but don't forget the external pollution costs associated with transportation – aim for local prefabrication wherever possible close to the site.

4. THE DESIGN APPROACH: KEY PRINCIPLES[4]

- re-use and recycling are not interchangeable strategies; re-use is almost always environmentally preferable;
- design for maximum flexibility of spatial configuration within a structure, as this preserves the building as a whole;
- develop a comprehensive Deconstruction Plan early on - otherwise re-usable building elements may be destroyed unnecessarily;
- allow extra time from the beginning of the project to ensure that DfD is fully incorporated;
- aim to bring the whole project team and the client on board with the idea of DfD from the beginning of the project;
- audit contractors and ensure that initial briefing and training for DfD has taken place -this will pay dividends later on;
- carefully add all alterations to drawings and specifications so that there is an integrated set of "as built" drawings for maintenance and deconstruction purposes.

5. DECONSTRUCTION DETAILING PRINCIPLES: KEY PRINCIPLES[5]

- design Buildings to be adaptable to different occupancy patterns in plan, in section and in structural terms;
- ensure that buildings are conceived as layered according to their anticipated lifespans;
- ensure all components can be readily accessed and removed for repair or replacement;
- adopt a fixing regime which allows all components to be easily and safely removed, and replaced through the use of simple fixings. Design connectors to enable components to be both independent and exchangeable;
- use only durable components which can be reused. Try to use monomeric components and avoid the use of adhesives, resins and coatings which compromise the potential for reuse and recycling;
- pay particular attention to the differential weathering and wearing of surfaces and allow for those areas to be maintained or replaced separately from other areas;
- carefully plan services and service routes so that they can be easily identified, accessed and upgraded or maintained as necessary without disruption to surfaces and other parts of the building.

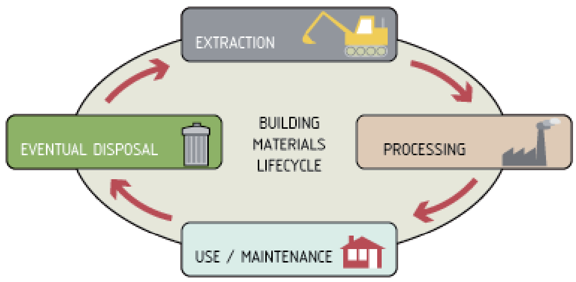
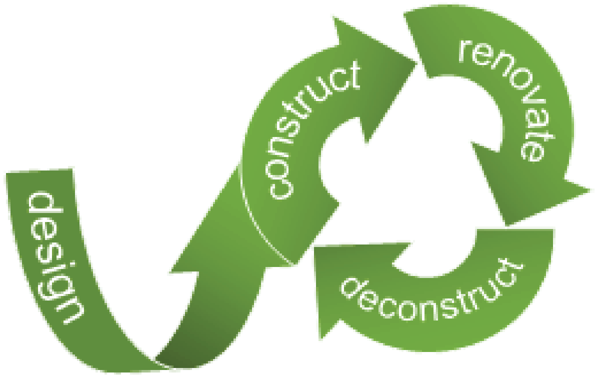


Figure 1: Typical representation of a lifecycle[6]

Figure 2: True representation of a cradle to grave lifecycle



6. 'CRADLE TO CRADLE' THINKING AND DESIGN

Many in the construction industry will now be familiar with the concept of lifecycle thinking (see information sheet S-AM3 for further details). Traditionally, the lifecycle of a product or service is considered in terms of a process spanning from 'Cradle to Grave' with design being influenced by this concept. In sustainability terms, this will often involve an analysis of the environmental impacts associated with the product or service at each stage of its lifecycle from the extraction of raw materials through processing, production, transportation, operation and disposal or demolition. Cradle to grave is often represented as a cyclical process as shown in figure 1, but in reality it is better understood as a linear model as demonstrated by figure 2.

Cradle to Cradle design, sometimes referred to as 'closed loop' or regenerative design is both a movement and a design philosophy that has been slowly emerging over the last 30 years. In a similar manner to 'designing for deconstruction', it seeks to redress the shortcomings of the traditional notion of 'cradle to grave' thinking.

Cradle to cradle thinking requires products to have disassembly designed into them from the outset. This means that t at the end of its useful life the product can return harmlessly to the soil in its constituent parts as a biological nutrient or, where possible, constituent materials can be extracted from the product and be re-manufactured into another product. This should be achieved without a loss in quality or integrity of product or material composition in a 'closed loop' of production for an indefinite number of times.

Although they did not coin the term, the notion of cradle to cradle has been popularised in recent years by William McDonough & Michael Braungart in a book entitled "Cradle to Cradle: Remaking the Way We Make Things" as well as through their associated work including their certification organisation MBDC (McDonough Braungart Design Chemistry).

The following propositions are central to the cradle to cradle philosophy:

- Materials fall into one of two categories:
    - Technical nutrients – Non-harmful and non-toxic synthetic materials that can be recycled over and over again without a loss in quality.
    - Biological nutrients – Organic materials that will decompose into the natural environment harmlessly, providing food and nutrients for bacteria, organisms etc.
- waste, pollution and crude products are the consequences of out-dated and unintelligent design. With more intelligent design, waste should be able to be eliminated from most production processes;
- eco-efficiency measures, although admirable, are not a strategy for success over the long term. They merely slow down existing processes create an 'illusion of change'. Rather, it is argued, design should seek to be eco-effective.
- most traditional recycling is, in fact, the 'downcycling' of materials. Even when one waste product is re-processed into another material, the cycle will invariably produce a lower grade material or product that will ultimately end up in landfill as a waste product. Proponents of cradle to cradle design assert that products and materials should be designed in a way that allows them to be part of a closed loop production system and 'upcycled' at the end of their usable life.

REFERENCES

1	SEDA Guidelines "Design and Detailing for Deconstruction" (2005) p4
2	http://www.wrap.org.uk/construction/tools_and_guidance/designing_out_waste/dow_introduction.html
3	From SEDA Guidelines "Design and Detailing for Deconstruction" (2005) p11
4	From SEDA Guidelines "Design and Detailing for Deconstruction" (2005) p15
5	From SEDA Guidelines "Design and Detailing for Deconstruction" (2005) p23
6	Typical lifecycle representation. From BRE environmental profiles methodology webpage, available at http://www.bre.co.uk/greenguide/page.jsp?id=2106

SIGNPOSTING

TITLE & DESCRIPTION	LINKS
Scottish Ecological Design Association (SEDA)– Home Page	http://www.seda.uk.net/
SEDA – Design and Detailing for Deconstruction guidelines	http://www.seda.uk.net/dfd/index.htm (direct link to guidelines)
Sust.org - Scotland's dedicated web site to sustainable design in architecture and the built environment.	www.sust.org
CIRIA guide 607: "Principles for Designing for Deconstruction" (2004)	Available to purchase at: http://www.ciria.org/service/bookshop/core/orders/product.aspx?prodid=98
Zero Waste Scotland – Home page	http://www.zerowastescotland.org.uk/
Zero Waste Scotland - Designing out waste information	http://www.wrap.org.uk/construction/tools_and_guidance/designing_out_waste/dow_introduction.html
Scottish Environment Protection Agency (SEPA): Construction and demolition waste reports	http://www.sepa.org.uk/waste/waste_data/waste_data_reports/construction__demolition.aspx
Wrap: Halving waste to landfill initiative	http://www.wrap.org.uk/construction/halving_waste_to_landfill/index.html
Defra (UK Government) Construction Waste information pages	http://www.defra.gov.uk/environment/waste/topics/construction/index.htm
Scottish Government Environment Statistics	http://www.scotland.gov.uk/Topics/Statistics/Browse/Environment
McDonough Braungart Design Chemistry	http://www.mbdc.com/default.aspx