3 Building Resource Efficiency

Key Principles

1. 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.

2. Aim to minimise waste by designing elements for maximum diversity of options when re-used.

3. 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.

4. Aim to minimise waste by increasing the number of times a construction element can be re-used.

5. Minimise transportation by allowing building to be fully adaptable with the minimum use of new resources. Avoid excessive transportation of materials.

6. Prefabrication maybe cost effective, but don't forget the external pollution costs associated with transportation – aim for local prefabrication wherever possible close to the site.

3.1 Local knowledge

Reducing waste is the main aim of this guide. There is little point in advocating DfD to reduce waste, however, without full consideration of the sustainable design, wider waste reduction and ecological resource issues relating to place.

Ideally, the designer should be knowledgeable about the local region and ecology relating to the site, as well as understanding where the more remote construction materials are coming from, and what the ecological impacts of design decisions are on both a local and global scale.

Ideally the designer should be knowledgeable about the local region - each one is unique.
Source: F. Stevenson

3.2 Natural and recycled resources

All resources have an initial natural *source,* a *rate* of extraction, and a natural *sink*, where unusable waste finally rests. A key consideration is to ensure that our rate of extracting materials is not greater than the earth can naturally assimilate in any one place at any given time.

DfD should aim to reduce the rate of extraction of the construction materials by maximising the re-use of construction elements. This means "future-proofing" against waste and pollution as far as possible by considering future scenarios for building use. As DfD matures material cycles will be become more closed with waste products playing more and more of a role in the overall resourcing of construction materials.

Energy Requirements for manufacturing and / or Producing Selected Building Materials

Material	kWh/tonne	kWh/m³
1. Fletton bricks	175	300
2. Non-fletton bricks	860	1,462
3. Engineering bricks	1,120	2,016
4. Clay tiles	800	1,520
5. Concrete tiles	300	630
6. Local stone tiles	200	450
7. Local slates	200	540
8. Single layer roof membrane	45,000	47,000
9. Concrete 1:3:6	275	600
10. Concrete 1:2:4	360	800
11. Lightweight blocks	500	600
12. Autoclaved blocks	1,300	800
13. Natural sand/aggregate	30	45
14. Crushed granite aggregate	100	150
15. Lightweight aggregate	500	300
16. Cement	2,200	2,860
17. Sand/cement render	277	400
18. Plaster/plasterboard	890	900
19. Steel	13,200	103,000
20. Copper	15,000	133,000
21. Aluminium	27,000	75,600
22. Timber (imported softwood)	1,450	754
23. Timber (local airdried)	200	110
24. Timber (local greenoak)	200	220
25. Glass	9,200	23,000
26. Plastics	45,000	47,000
27. Plastic insulation		1,125
28. Mineral wool		230
29. Cellulose insulation		133
30. Woodwool (loose)		900

Source: Pat Borer, Centre for Alternative Technology

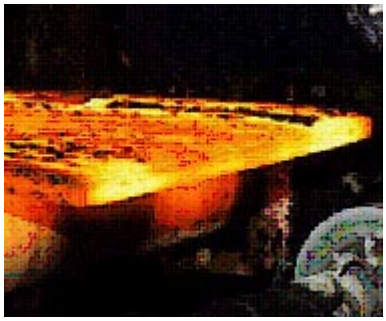
3.3 Energy

Embodied energy costs are a rough indicator of how much energy materials are using in DfD. Generally, the less energy used in the production of construction elements, the less impact there is on the environment.

It is often assumed that recycling construction products is just as energy efficient as re-using them, when this is in fact seldom the case. Recycling invariably involves re-processing, which in turn involves transport and manufacturing energy costs. A re-used element usually has virtually no embodied energy costs associated with re-processing, although transport needs careful consideration.

DfD can minimise energy costs by aiming to increase the number of times a construction element can be re-used without serious depreciation, loss of strength, rigidity and other factors associated with wear and tear. Durability has to be balanced against initial energy costs in manufacture and transport. Given that the re-use of building elements is highly unpredictable, it is still wise to always aim for low initial energy costs by using renewable materials where possible.

DfD can minimise waste by increasing the number of times an element can be re-used.
Source: N. Verow



Recycling is often not as energy efficient as re-using materials.
Source: F. Stevenson

3.4 Waste –closing the loop

An industrial ecosystem mimics a natural ecosystem through an interacting web of inputs, processes and wastes which "close the loop" by turning wastes back into resources. DfD can close the waste loop in two ways; firstly by re-using existing construction elements where practical and secondly by encouraging the designed elements to be re-used easily and locally. Ideally DfD should be contained as far as possible within a given regional area, to minimise transportation and maximise the local economy.

In Scotland, the landfill situation is now critical, with local authorities having to resort to transporting waste further and further afield or else burning it and releasing pollution into the air. There are a number of construction product reclamation sites in Scotland and the North of England[15] which should be scoured during the DfD process, if the design site is in Scotland.

3.5 Regionalism

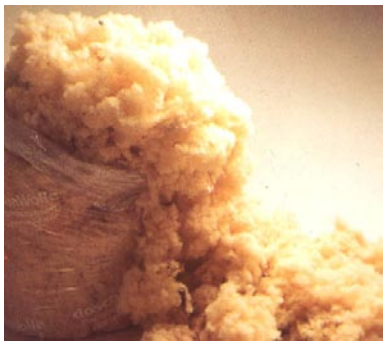
Resources, energy, waste, transport and community are all interacting aspects of a regional approach to DfD. No aspect can be considered without thinking of the consequences for the other aspects on a local level. Bioregionalism takes this one step further by insisting on the inclusion of ecological aspects as well and recognising the differences between ecological systems in different regions.

Scotland can basically be divided into four broad regions, the North West, the North East, the South West and the South East, with the Central Belt region straddling between the North and South regions. Each region has its own unique "soft palette" of renewable, re-used, recycled and by-product construction materials which can be developed by working with other industries in the region. DfD can build on this by selecting from this palette. Visible re-use of certain locally made construction elements in appropriate locations within the building fabric can also preserve a deeper historic understanding of regional building construction practice.

DfD can help support communities in Scotland economically by keeping resource use and re-use as local as possible, thus retaining economic value within the region. For this purpose SEDA have helped to produce an information guide on local construction products and materials which are produced in Scotland[16].

Minimising transportation is key part of a successful DfD, given that we spend as much energy transporting our construction materials around the country as we do making them in the first place (see diagram over page).

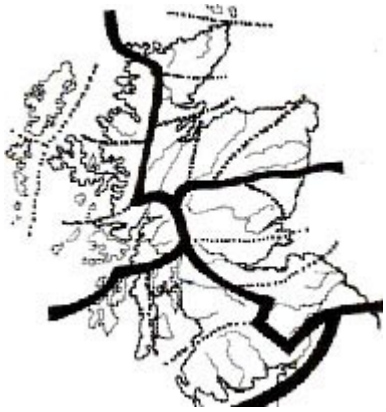
There are clear differences between reclamation and DfD practice in different parts of Scotland, which is a relatively unpopulated country. The majority of industry and population is concentrated in the Central Belt region from Glasgow through to Edinburgh. This region is well resourced for a locally derived DfD approach, with numerous salvage yards and manufacturers. It makes sense for design projects in the Central Belt to source and reclaim their construction products from



Sheeps wool is highly renewable, re-usable, and has low energy costs.
Source: F. Stevenson

This natural wool product is biodegradable, healthy and as good as mineral wool for insulation.
Source: F. Stevenson

Dundee Contemporary Arts Centre. Visible re-use of existing local building fabric preserves historic understanding and maintaining a link with the past.
Source: N. Verow

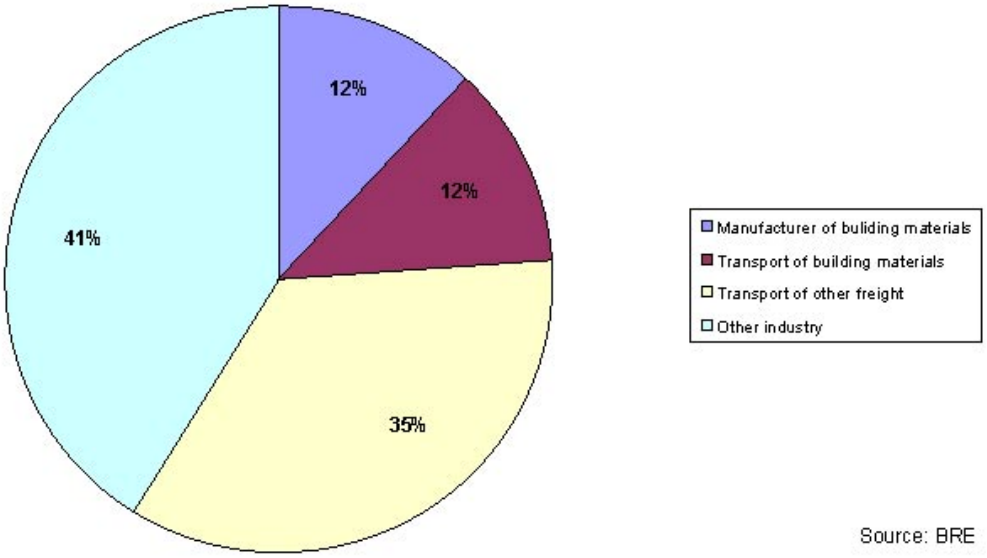


Map showing 4 regions and sub bio-regions of Scotland based on rivers.
Source: Doug Aberlay

Footnotes:
[15] See BRE's excellent site on construction waste exchange: http://www.bremap.co.uk, for GIS information on reclamation sites in Scotland and http://salvomie.co.uk for information on availability of reclaimed products and materials.

within the region. Rurally, DfD may operate on a more hybrid basis with local renewable and reclaimed construction elements forming part of the "soft palette" complimented by elements obtained more remotely that can then be re-circulated within the region. For these more remote regions, transportation impacts will have to be carefully weighed against the advantages of importing re-used construction elements to the region.

Energy consumption of building materials industry as a proportion of total UK industry energy consumption (1996).



Source: BRE

Footnotes:

[16] See www.sust.org and highlight the "Green Directory" or "Ecological Design Gateway" title to obtain an interactive database of indigenous Scottish construction materials and products.