Construction & Demolition Waste

Information Sheet

Construction and demolition (C&D) wastes form the largest waste fraction in most cities. In Britain, the construction industry accounts for more than a quarter of all waste arisings, around 70 million tonnes per annum (Mtpa).

A study published in 1999 by the European Commission declared that the Union's 370 million people generate around 180 Mtpa C&D waste - only one quarter of which is re-used or recycled. The Netherlands recycle 90 per cent while Ireland, Spain and Portugal recycle less than five per cent (See Table 1, page 2).

Europe produces more than 2,000 Mtpa of primary aggregates for construction, so landfilling usable secondary materials is a clear waste of finite resources. Extraction of virgin aggregates and minerals may have implications in terms of sustainable development, as quarrying, transport and disposal all cause environmental impact.

Dismantling a building and recovering materials for reuse, recycling and energy requires more planning than traditional demolition, but is becoming more common, with rising disposal costs, a growing sense of environmental awareness and an increasing demand for recovered materials.

C&D wastes contain a range of materials. Waste from clearing a new site before development will yield soil, clay and stone, together with sub-standard or damaged building materials.

One USA estimate suggests that five to seven tons of wastes arise for every new single-family house.

C&D waste comes from:

- the total or partial demolition of buildings and civil infrastructure
- the construction of buildings and civil infrastructure
- land levelling, foundation and civil works
- road construction and maintenance

C&D waste contains:

- concrete, bricks, tiles, ceramics and gypsum-based materials
- wood
- glass
- plastic
- asphalt, tar and tarred products
- metals
- soil and dredged spoil
- insulation materials

Demolition wastes often contain soil, sand, gravel, concrete, stone, bricks, wood, metals, glass, paper, board, and textiles. There may also be cables, electrical appliances and plumbing fittings. Some hazardous wastes may be present, such as asbestos. Different materials may be bonded together, which complicates recovery.

The age of a building influences the nature and volume of waste. In the 1950s and 1960s, many homes were built of reinforced concrete, with copper piping replacing lead. In the 1980s, plastics (eg PVC double glazing units) became popular.

More recently, many industrial and commercial buildings have been based on steel frames. The glass cladding in many commercial properties today will change the composition of future C&D waste, shaping the recovery and treatment regimes needed. Modern commercial building programmes can include requirements for underground parking. This significantly increases the amount of material to be excavated.

While most C&D waste is relatively inert, significant quantities of hazardous materials can be created. Construction activities generally produce cleaner materials than demolition.

Some C&D waste is hazardous by virtue of material used (eg asbestos and lead). It can become hazardous because of its environment (eg when exposed to chemical pollution). C&D waste can become hazardous through contamination (eg when lead-based paints are discarded onto bricks, concrete and rubble).

Recovered material

There are many uses for recovered and recycled materials. Presently, most is used for low-grade purposes such as road sub-base construction or landfill engineering. Landfill site operators often rely on inert C&D material such as hard-core, soil and clay for on-site engineering (site roads, landfill cell embankment walls, drainage, cover and final capping).

In Britain only four per cent of C&D waste is recycled for higher grade applications. However, the demand for used building materials is growing as the cost of new materials increases. For low

Table 1	Estimates for Construction & Demolition waste (C&DW) arisings and recovery (million tonnes per annum)		
	core* C&DW arisings	re-used or recycled (per cent)	incinerated or landfilled (per cent)
Germany	59	17	83
UK	30	45	55
France	24	15	85
Italy	20	9	91
Spain	13	<5	>95
Netherlands	11	90	10
Belgium	7	87	13
Austria	5	41	59
Portugal	3	<5	>95
Denmark	3	81	19
Greece	2	<5	>95
Sweden	2	21	79
Finland	1	45	55
Ireland	1	<5	>95
Luxembourg	0	n/a	n/a
TOTAL EU	**180**	**28**	**72**

***Core C&D waste** excludes soil, stones and road planings (mainly asphalt)

cost materials like concrete and stone the benefit over virgin materials derives from reduced transport costs and avoided extraction costs.

Many buildings contain functional components such as doors, windows and guttering that can be reconditioned. Salvage of valuable complete items such as fireplaces, sanitary ware and copper piping can take place before demolition begins. Structural components such as timbers are often of high quality, and sought after by architects and carpenters.

Efforts to reduce, re-use and recycle this waste stream are gaining momentum. In America a 'green-building' movement is emerging to close the loop, pushing industry to be more efficient and to buy recycled and re-used building materials. C&D diversion programmes are proving cost-effective in meeting waste reduction goals. Dismantling projects have also been successfully combined with the construction of nearby housing.

Demolition & renovation

Best practice will involve a high degree of selective demolition and separation, to:

- remove accessible materials of obvious value (architectural salvage, lead roofing material, copper piping)
- remove hazardous materials which will contaminate other, inert waste (asbestos)
- remove materials which will depress the value of the remainder (wood, plastics and plaster)

Landfilling

The US Environmental Protection Agency (EPA) estimates that most (up to 85 per cent) building-related waste is landfilled. In the UK more than 60 per cent of C&D wastes go to landfill sites. Half of this is used to build access roads, and landfill operators are increasingly recycling materials on-site.

Recycling

Recycling is fairly well established for some C&D materials, especially asphalt, concrete and metals. The US EPA estimates that 50 million tons pa of American pavements are recycled into roads. The Steel Recycling Institute in Pittsburgh, USA claims an 85 per cent recovery rate for steel from buildings, roads and bridges. Recycling asphalt roof shingles is becoming more popular, with some road specifications permitting asphalt waste.

The UK Building Research Establishment (BRE) published guidance in 1998 to the construction industry on specifications for recycled aggregate. Full European standards are expected by 2008.

The Japanese government is promoting C&D waste recycling, and plans to make demolition contractors responsible for classifying recovered material streams

and delivering materials to reclamation plants. This is because there are generally many years between a building's construction and demolition, so it is impractical to assign responsibility to builders and developers.

In Britain crushed concrete is available as a capping and sub-base material. Traditionally, foundation materials used in road construction are derived from primary resources, but in some parts of the country these materials must be transported over long distances, with obvious economic and environmental effects.

With appropriate selection and processing, crushed concrete can have a performance to match or even exceed primary materials. Comparisons with primary aggregates suggest that savings of 20-30 per cent are possible.

In Austria, anyone disposing of concrete (in quantities greater than 20 tonnes), must consider recycling before disposal. The base layer of concrete in all Austrian roads contains 65 per cent recycled aggregate, contributing towards a C&D waste recycling rate of 50 per cent in 1998.

In Copenhagen, Denmark, more than 90 per cent of C&D waste has been recycled since 1995, with the combustible fraction (around ten per cent of the total) separated for energy recovery. Some 400,000 tonnes pa of concrete and brick waste is recycled, and 45,000 tonnes pa of waste is used for electricity generation and district heating. Total treatment costs have increased by 10-15 per cent, although sorting at source means transport costs are significantly lower.

The American city of Portland, Oregon recycles 40 per cent of its C&D waste and in Minnesota, USA most demolition contractors now recycle on site. However, there is still insufficient incentive to recycle construction material.

Current low tipping fees at landfills mean landfilling is often cheaper than recycling.

A lack of markets for recyclable materials compounds the problem.

A project in San Francisco, USA has clearly shown that manual deconstruction (of wooden buildings) can be performed at rates competitive with mechanised demolition when recovering valuable material.

Options for C&D Waste

Re-use:

Materials recovered from a structure are used for their original purpose. Timber, frames, doors, windows and other hardware are prime candidates for re-use.

Recycling:

Materials are crushed or shredded, sorted, and then re-used in another process (eg concrete used in aggregate).

Energy recovery:

Combustible materials are separated, processed and burned for electricity production and/or district heating.

Disposal:

Some materials that cannot be economically segregated will still need to be landfilled.

Source for data in Tables 1 & 2 - European Commission, 1999

Table 2	Arisings & fate of Core C&DW for Denmark				
	Arisings (Mtpa)	**Re-use (per cent)**	**Recycling (per cent)**	**Energy recovery (per cent)**	**Landfill (per cent)**
concrete bricks etc	1.80	1	97	0	2
wood	0.20	30	30	15	25
glass	0.05	15	40	0	45
plastics	0.01	0	20	30	50
metals	0.16	38	60	0	2
insulation	0.05	40	30	0	30
misc	0.37	0	0	10	90
Total	**2.64**	**6**	**75**	**3**	**16**

Some rare woods are valuable and mechanised demolition causes damage, lowering the selling price.

In Britain, BRE has used the construction of its new headquarters as a demonstration project. Around 96 per cent of the waste generated from the original building was re-used or recycled, with only four per cent going to landfill.

Materials reclaimed for sale from the building, included slate cladding, cast iron and roofing timbers. Masonry and concrete were crushed to provide hard-core for the site. Recycled aggregate was used in the concrete for the new building and reclaimed bricks were used for external cladding.

Extra costs were incurred, for example the price of recycled aggregate was the same as that of primary material but transport costs were much higher. However, reclaimed wood block flooring was up to 30 per cent cheaper.

One of the factors limiting the re-use and recycling of C&D wastes is the need for predictable, consistent performance from materials. Designers, architects and builders cannot compromise safety with performance specifications which favour re-used or recycled materials.

Waste avoidance policies can be effective if they are built into a project at the early stages. Care given to specifying accurate quantities needed can significantly reduce waste, and careful salvage before demolition contractors begin their work can increase re-use and help avoid unnecessary waste.

Around the world, there are a number of C&D waste information systems, some using the Internet, to provide information about sources, quantities, material types and time of supply and demand.

Conclusion

C&D waste which is not recovered is a particular waste of resources - across the entire life cycle of construction and demolition. A great deal of this material is inert and potentially useful.

Growing environmental pressures mean that the days of landfilling virtually all this stream are surely numbered. Selective demolition is becoming a more standard practice in many countries.

Restrictions or outright bans on landfilling this material are effective incentives to more sustainable practices. The use of additional planning controls, taxes, subsidies and grants, voluntary agreements, support for research programmes and the establishment of useful pilot projects can all help.

Perhaps most importantly, there is a need for better information. Education, training, advisory services, waste exchanges (particularly Internet-based) will allow all those involved to make better, more timely decisions.

As with all resource recovery systems, it is important that markets exist for the secondary materials. There are encouraging signs that standards are now being drafted which do not accidentally discriminate against recycled materials.

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