

Built Environment Portfolio

Technology III



Recycling & Reuse

Why reuse and recycle?

- Construction's consumption of large amounts of resources
- Environmental impact
- Capacity and waste



Quantities of materials used in construction (UK)

Material type	Annual consumption
Minerals (crushed rock and gravel)	254 million tonnes
Metals (steel, copper, brass, aluminium and alloys)	3.35 million tonnes
Timber products	3.85 million cubic metres
Polymers (PVC, polyurethane, polystyrene, polyethylene)	c. 0.5 million tonnes
Paints	c. 0.4 million tonnes

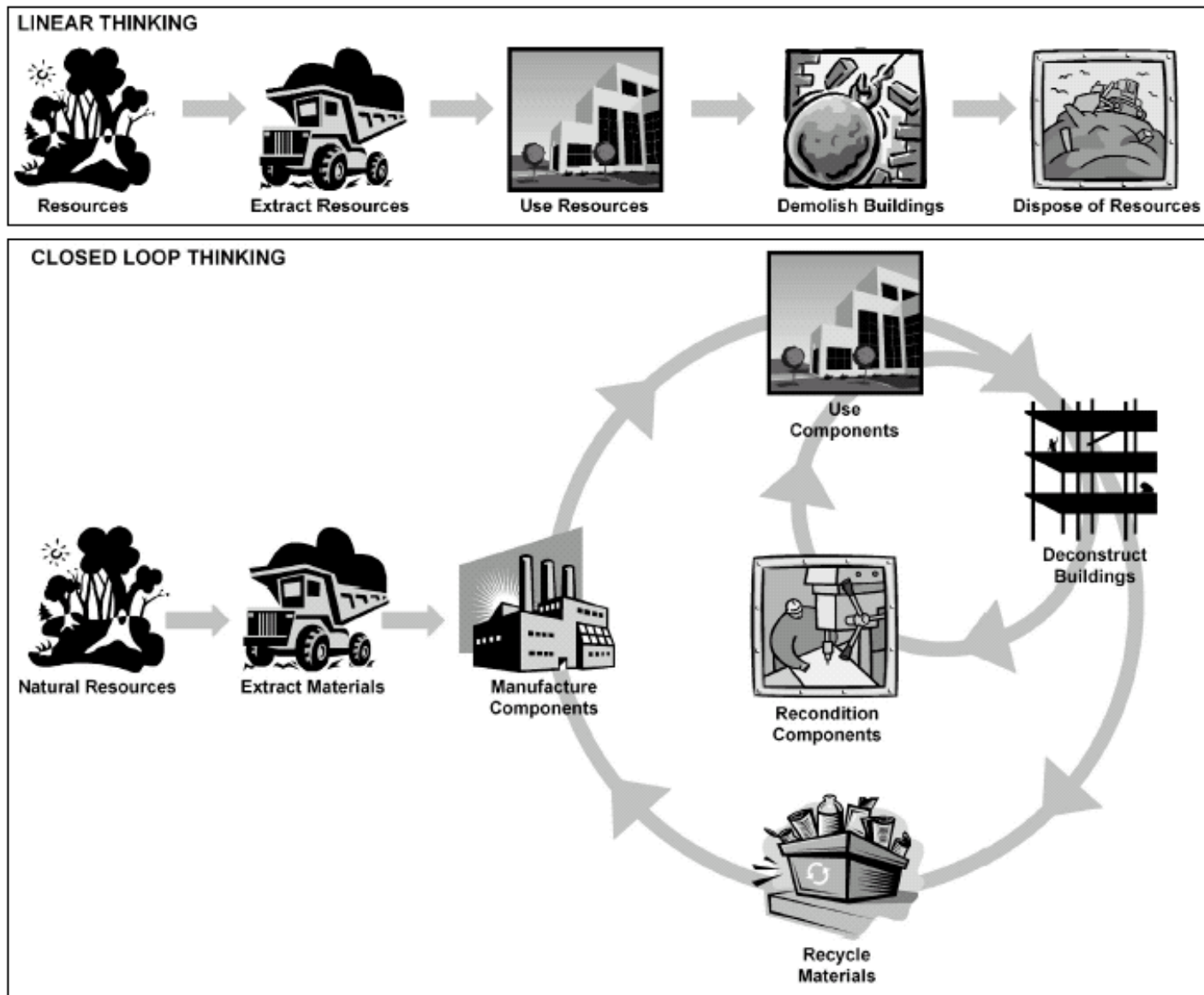
Estimate of annual quantities of materials arising from demolition in the UK

Material type	Annual quantity (MT)
Concrete	12.0
Masonry	7.2
Paper, plastic, cardboard and other	5.1
Asphalt	4.5
Wood-based	1.0
Other	0.2
Total	30.0

Average end-of-life scenario data for steel in EU

Product %	Recycled %	Reused %	Landfill %
Girder	88	11	1
Lintel	88	10	2
Doorframe	90	9	1
M&E services	87	11	2
Purlins & rails	87	11	2
Composite cladding sandwich panels	53	37	10
Profiled cladding / roofing sections	81	15	4
Heavy structural sections	87	11	2
Composite floor decking	81	15	4

Aspiring to a zero-waste economy



Influencing construction design



- Detail design
- Specifications
- Specialist contractors
- Contracts
- EI
- Management
- Effectiveness
- H&S
- Feasibility studies
- Education and training

Key design principles achieved via...

- Mind set
- Life-cycle
- Drivers
- Education



Design for Deconstruction



The same idea is sometimes conveyed as “design for disassembly”, and both are widely abbreviated as DfD.

The phrase widely used in the construction and other industries to refer to the process of designing structures to facilitate their deconstruction or disassembly.



Deconstruction

A process of carefully taking apart components of a structure, possibly with some damage, with the intention of either reusing some of the components after refurbishment or reconditioning, or recycling the materials.



It may be undertaken during refurbishment, when adapting a structure for new use, or at the end of its life.

The challenges...

Consider

- Whole life
- The potential of components for reuse
- The process of deconstruction in the design
- The ownership of structures and their components



Reduction

Waste reduction has two components:

- reducing the amount of waste produced
- reducing the hazard of the waste produced.

Reuse

Putting objects back into use so that they do not enter the waste stream.

Recovery

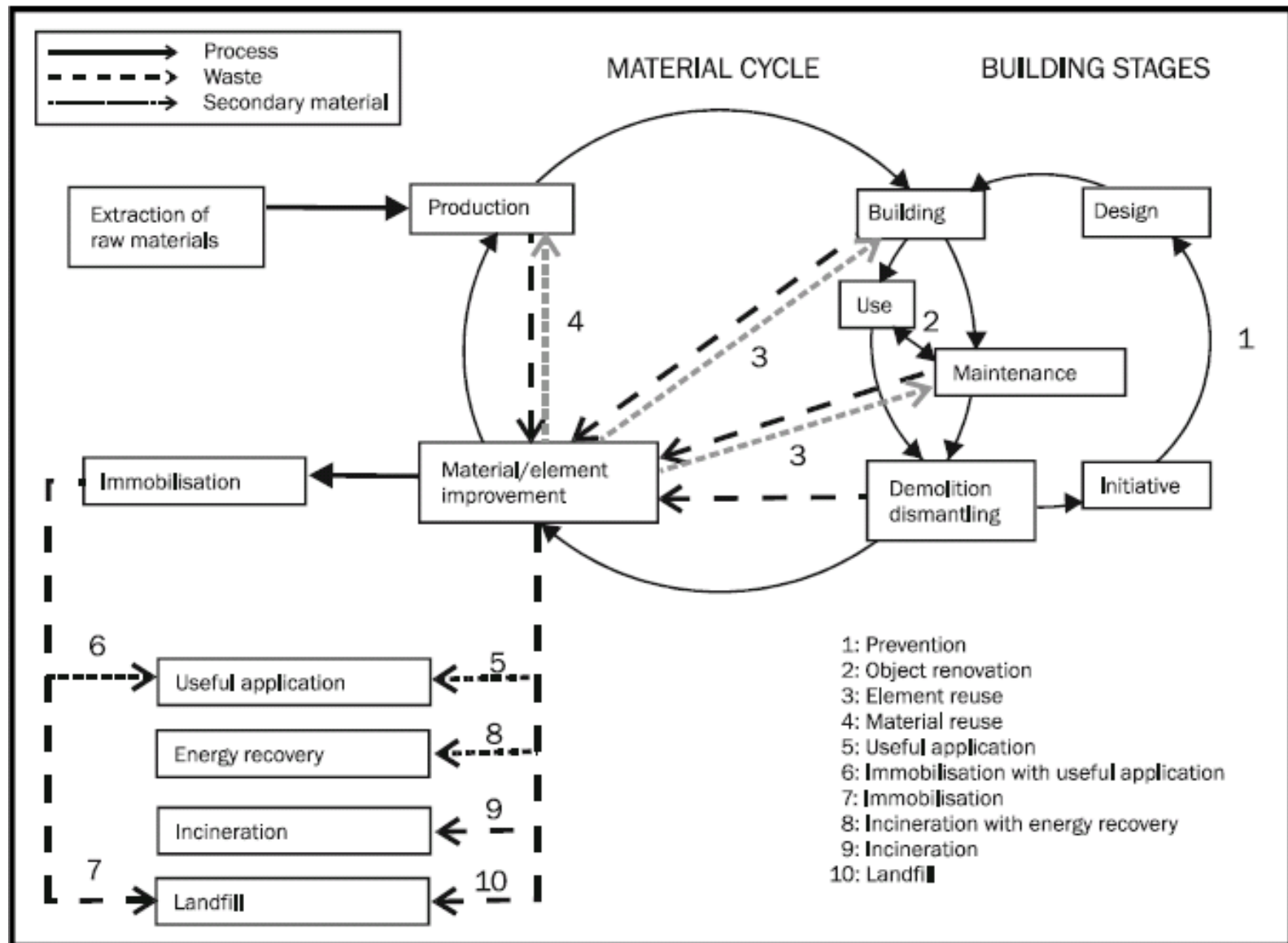
Waste recovery has three components:

- recycling – collecting and separating materials from waste and reprocessing them to produce marketable products
- composting – processing biologically degradable organic waste aerobically to produce a reasonably stable, granular material
- energy – incinerating waste to generate energy.

Disposal

Disposal of waste to a landfill site or land raised site.

The Delft Ladder

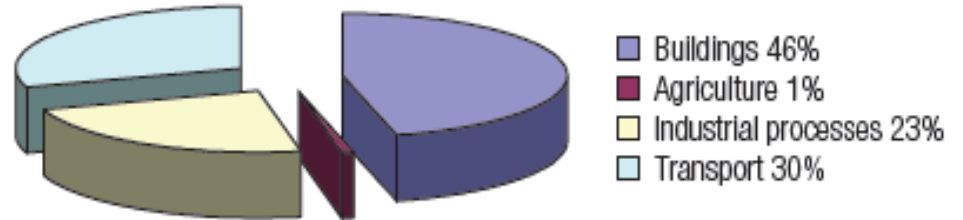
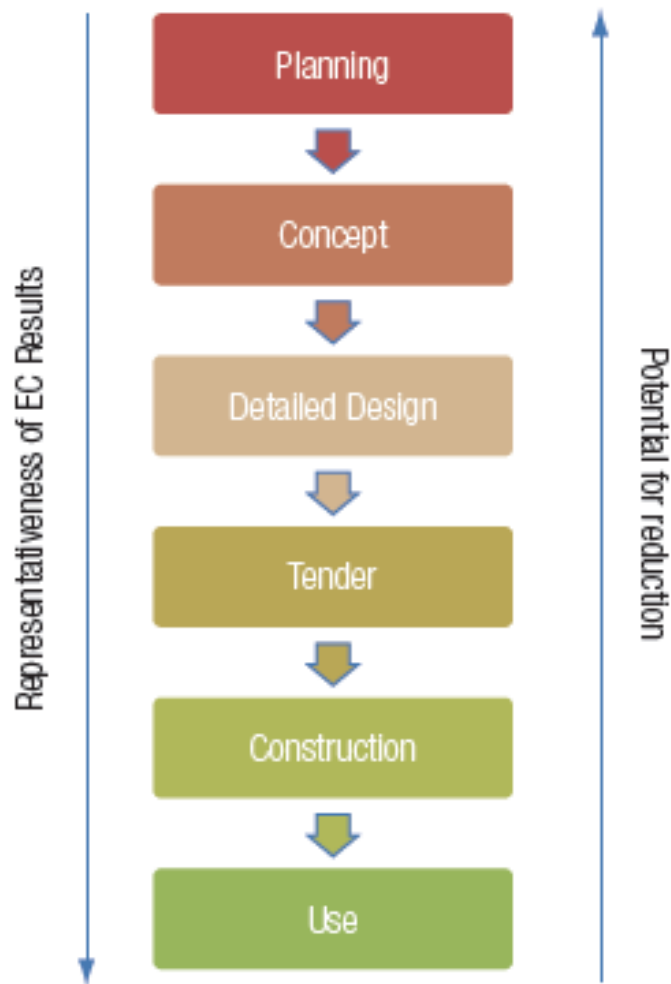


Reuse and recycling – challenges...



- Material mass
- Material volume
- Embodied energy
- Market value
- Toxicity
- Biodegradability

Life cycle inventory of structures



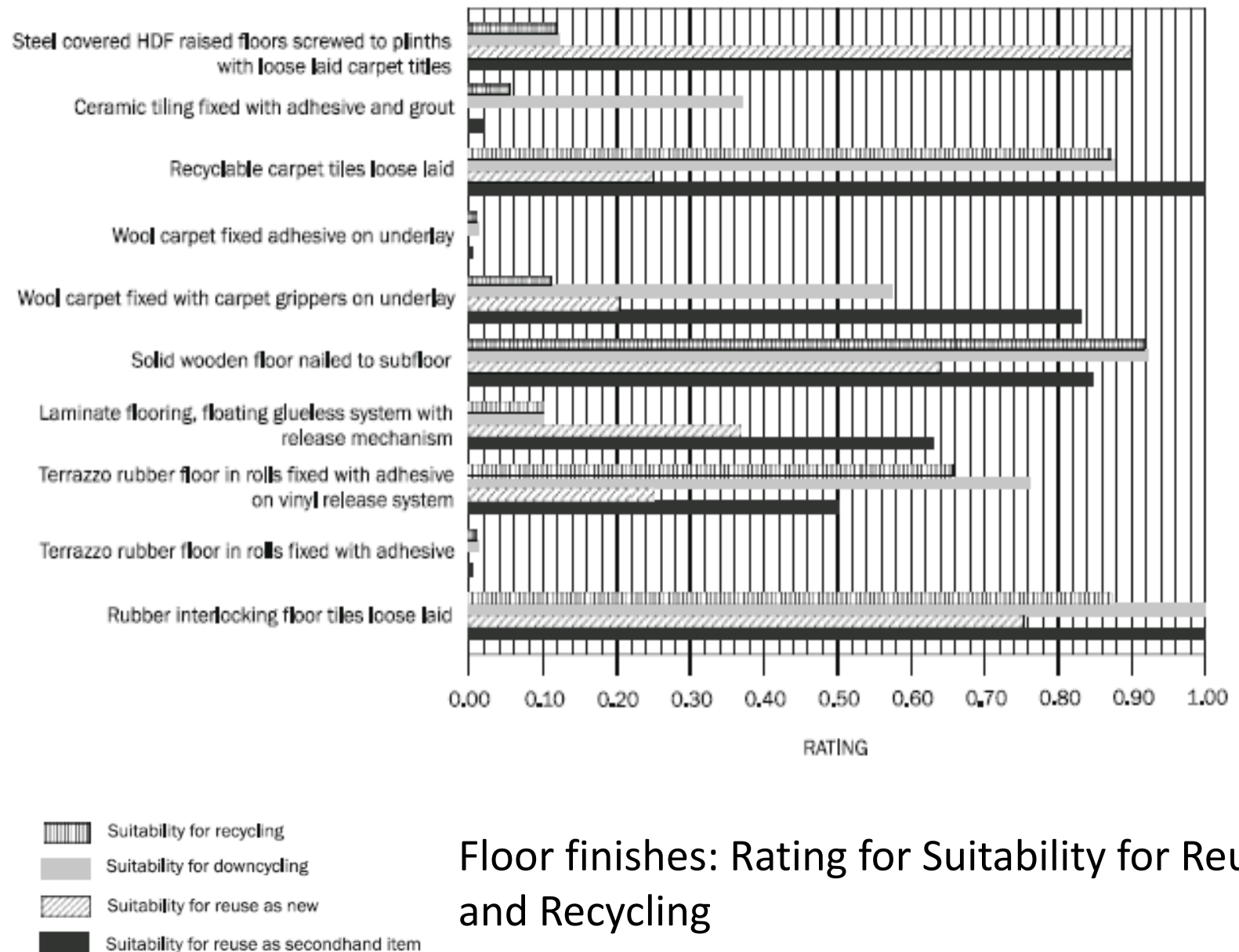
Carbon dioxide emissions by sector

A building's carbon footprint describes its impact in terms of CO₂ emissions...

Embodied carbon

Operational carbon

Embodied carbon consideration



Floor finishes: Rating for Suitability for Reuse and Recycling

Design for Deconstruction

- Some questions...
 - Why design for reuse or recycling?
 - Is design for component reuse, or for material recycling?
 - What type of reuse or recycling is being designed?
 - Does the design for reuse / recycling apply to every component / element?
 - What information needs to be provided?



Ownership

Private / public?

Type of development

Levels of maintenance



Changes of use

Attitude

Producer responsibility

Case studies



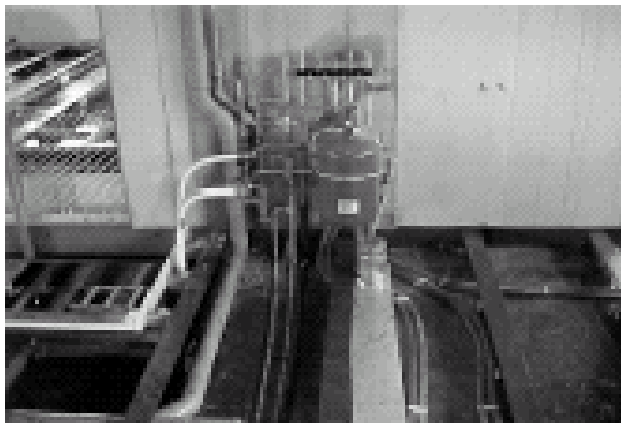
Services located on the outside of the building enables easy replacement.

Case studies

Prefabricated flooring system



Reusing construction materials



Temporary roads

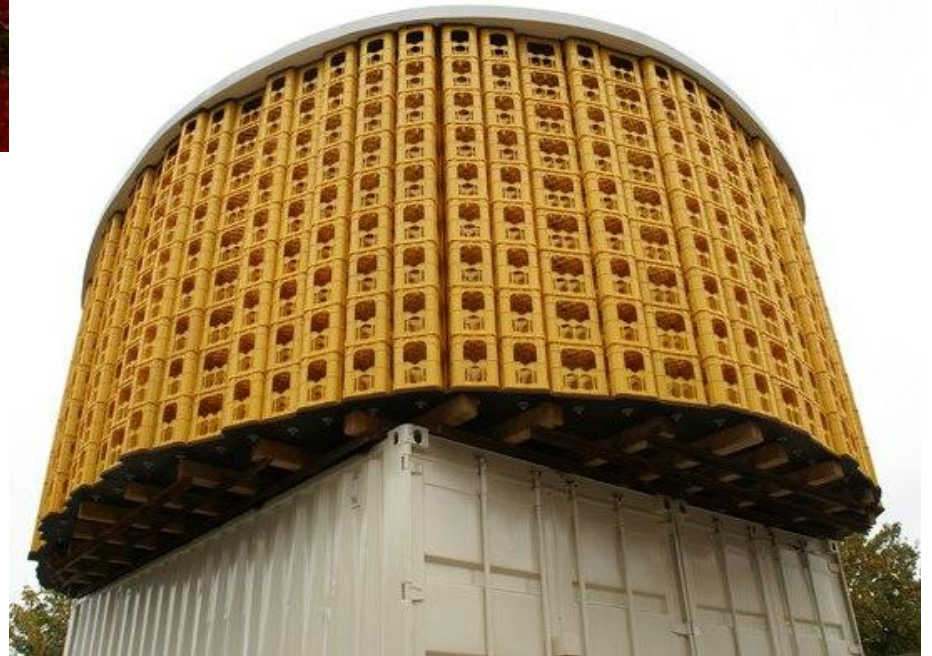


Prefabricated structures

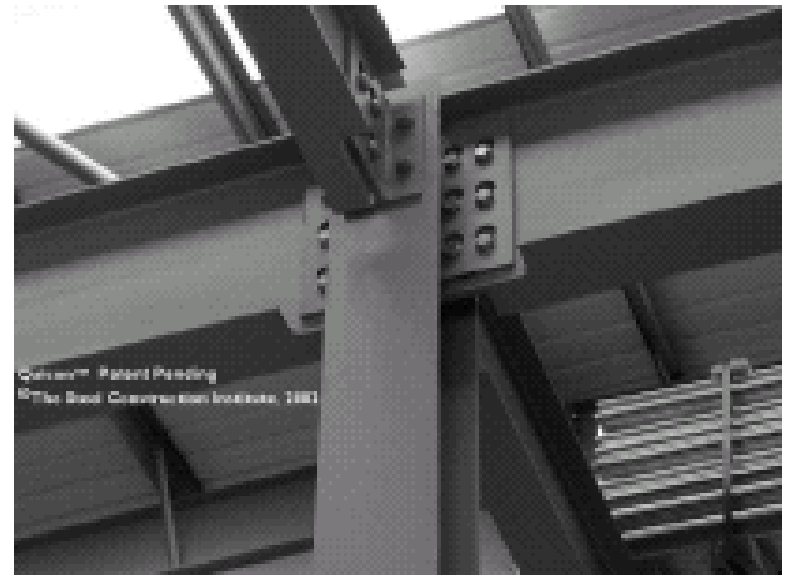
Material reuse



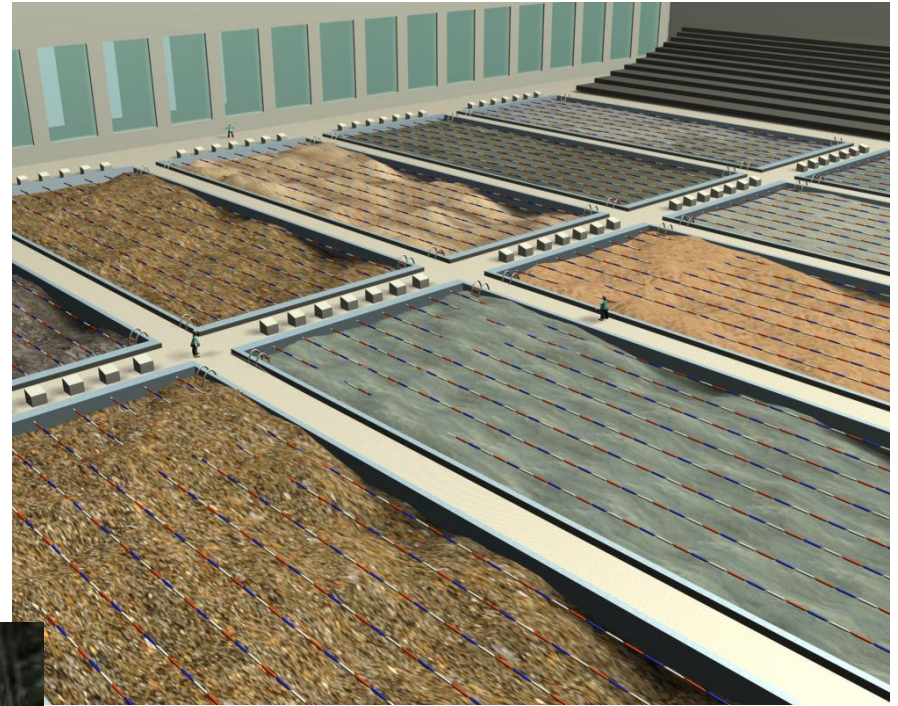
Crate housing



Case studies

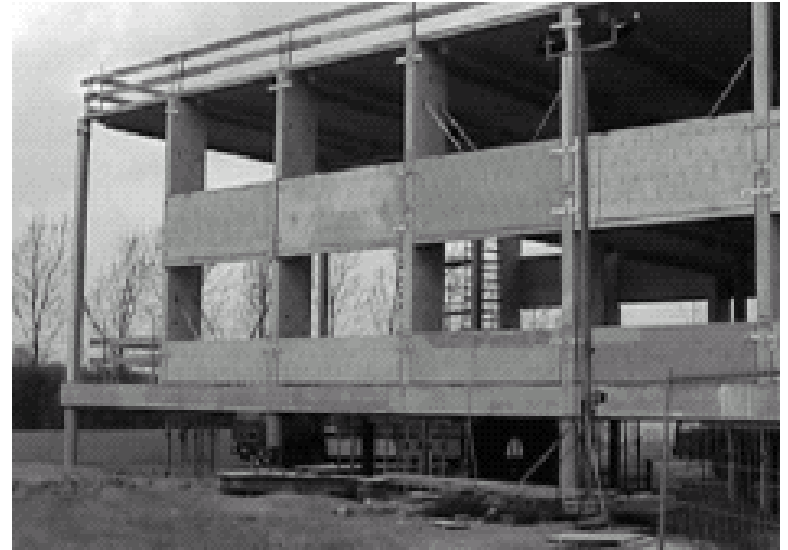


Recycled aggregates



Rock reuse for slope stabilisation

Case studies



Coastal defence



Key drivers to encourage deconstruction for reuse and recycling



- Environmental
- Socio-economic
- Commercial
- Political

Perceived challenges to designing for deconstruction, reuse and recycling

- Design side
 - Lack of legislation
 - Human barriers
 - Additional design costs
 - Procurement / contractual



Perceived challenges to designing for deconstruction, reuse and recycling



- Constraints to reuse and recycling
 - Lack of legislation
 - Insurance
 - Legal issues
 - Construction programme
 - Environmental
 - Codes of practice

Perceived challenges to designing for deconstruction, reuse and recycling

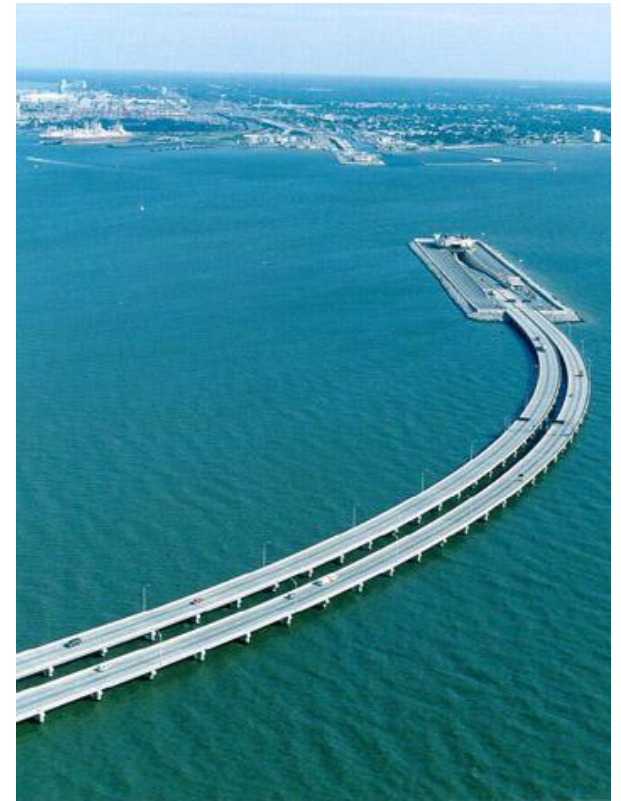


Perceived challenges to designing for deconstruction, reuse and recycling

- Technical side
 - Recycling
 - Performance
 - Guarantees
 - Robustness
 - Composite construction



Workshop



Evaluate the different structural materials available for construction and civil engineering projects emphasising their ability for reuse and or recycling

Comment on the key factors that are likely to affect the quality and value of data used to produce a life cycle inventory for structures.

Transparency

Differentiation

Currency

Variability

Energy sources

Transport and site work

Allowance for recycling

Allowance for the use of waste materials and by-products

Allowance for materials wasted on site

Treatment of sequestered carbon

Carbonation