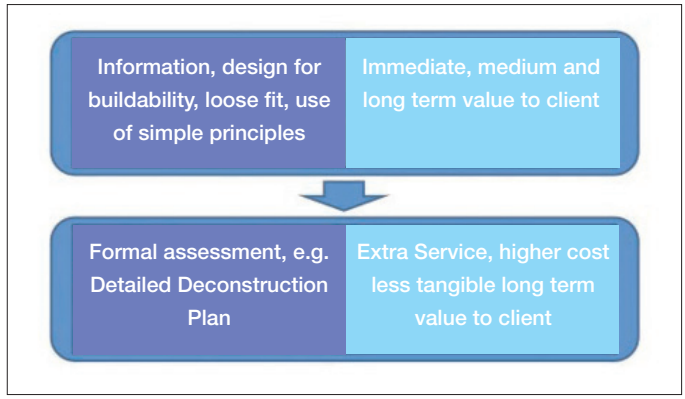
Design for deconstruction

What is design for deconstruction?

Design for deconstruction (DfD) means considering end of use scenarios during initial design. Design which incorporates re-use of deconstructed elements is a closely allied but different subject, and is not covered in this briefing. DfD means ensuring that the element has some intrinsic value, once deconstructed. End of life outcomes should be considered in a hierarchy of decreasing desirability, namely:

- re-use *in situ*
- re-use in a different setting
- recycling
- energy recovery
- disposal

This briefing will concentrate on design to facilitate re-use. To be successful the designer needs to consider the full lifecycle of the element, as well as end of life. A common misconception is that DfD is the process of designing de-mountable components. This is only a small part of the process.



1 Two approaches to design for deconstruction

What are the positive benefits of design for deconstruction?

The application of DfD principles of considering buildability, appropriate life, loose fit, easy maintenance, and improved information will generally prove a low cost, high value part of the design.

DfD will reduce waste, reduce the down-grading of materials and thus avoid resource depletion. Depending on the energy needed to extract and rework the element into a new setting, it may reduce energy use. However this is not always the case as deconstruction, transportation and reprocessing may take significant energy.

These benefits are increasingly being recognised by the UK Government. Planning constraints, taxation and Building Regulations are used to create market value. Supplier take-back regulations are already in place in some industries. So, within the life cycle of most buildings, the value of a building designed with deconstruction in mind will certainly rise.

How can structural engineers design for deconstruction?

Fig 1 shows the two approaches that are available. A thorough review and application of DfD will take time and represents an additional design service. However there are some low/no cost actions that can be taken by all.

Design for re-cyclability is an easier target to assess and demonstrate and will lead to different solutions. Current demolition techniques can, and do, generate high yields of re-cyclate. A clear hierarchy of outcomes for different elements of the building should be identified early in the design process.

The key issue in design for deconstruction is ensuring that an element has value when no longer required in its planned setting. To understand this it is important to understand the modern demolition industry and consider how it will operate in future. The modern demolition industry is highly sophisticated and skilled at extracting value, in the shortest possible time from an existing building. Health and Safety considerations are a key driving force and the move away from slow and dangerous hand techniques is continuous. Demolition is planned and the potential value which can be realised will be assessed in advance. Investment in time, plant and storage space will only be made if an element can be sold on easily. Otherwise recycling, or other disposal options, will be the most cost effective.

This shows that it is not sufficient to limit design effort to the de-mountability of elements. There are simple steps that can be taken now to improve the potential end of life outcomes.

DfD checklist

- Plan buildability & deconstruction
- Separability - Recognise life span and replacement hierarchy (loose fit)
- Specify appropriate quality
- Elements will be desirable/re-usable, available in sufficient quantity and with minimum re-processing
- Elements will be maintainable
- Information trail passed with the building (e.g. in O&M folder and the H&S file)
- Standardisation
- Fixings (minimum number - removable, aim for mechanical not chemical)
- Simplicity – clear load paths, simple connections

For structural engineers the following may prove more successful than trying to plan for full and complete deconstruction of a conventional building structure:

- Provide information about materials and construction sequence to allow future designers flexibility to provide new design solutions
- Use modular construction with mechanical connections
- Plan for re-use of compound elements, rather than single ones, to allow selective demolition techniques such as pancaking
- Plan for a combination of re-cycling and re-use

How can structural engineers demonstrate and assess DfD?

The formal assessment of the future deconstruction stage of a current new design is challenging and few precedents exist. Tools, such as a demolition audit, the ICE demolition protocol, or reference to existing building material exchange web sites could be used to form an assessment. There will be energy and cost involved in reprocessing elements and designing into a new setting, or re-cycling. This can be assessed based on current market figures and compared to the energy and impacts of the use of virgin materials. The comparison may not be favourable. This is borne out by the lack of a market for some re-used building elements. However the estimate will be conservative.

The costs and programme implications of future dis-assembly rather than demolition may be very high indeed. Reference to studies of re-used building components is recommended in order to assess an appropriate module size. These are detailed in a

companion Institution briefing note titled 'Re-use of Structural Components and Materials' (see *The Structural Engineer,* **89**/1 2011).

Summary

Structural engineers can identify low cost actions which will greatly increase the value of the building components at the end of their useful life in the building. Structural engineers can, and should, present these to the client and design team as part of sustainable design. These can form part of standard practice. For example structural engineers' standard specifications can place a requirement for identification and improved information about elements.

To provide full consideration of DfD involves additional design services and research.

Bibliography

- CIRIA guide *C607 Designing for Deconstruction: Principles of design to facilitate reuse and recycling,* 2004
- *TG39 - Deconstruction: Deconstruction and Materials Reuse - An International Overview*, CIB Publication No. 300, 2005
- Bio-regional.com free guide *Reclamation led approach to demolition*
- *Deconstruction and reuse of construction materials,* BRE Hurley, J & others http://www.reuse-steel.org/

Further Information

This briefing is prepared by the Institution of Structural Engineers' Sustainable Construction Panel. Contact: Berenice Chan (email: Berenice.chan@istructe.org)

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