UK GBC

The voice of our sustainable built environment

DESIGN FOR DECONSTRUCTION

PRACTICAL GUIDE

This Practical Guide covers key principles of designing for deconstruction in the built environment.

IN A SNAPSHOT

Design for deconstruction (or Design for Disassembly) is where buildings, products and components are designed in a way that can be taken apart, recovered, and re-used at the end of their lives. It is key to considering the complete lifecycle of a product or building and can be done by planning disassembly at the end of life stage using techniques like reversible connections such as screws and bolts over non-reversible ones such as glue or other chemical fixings. By considering the end of life of a building during design, a greater percentage of materials can be reclaimed and reused.

Why is it important?

In order to create a more sustainable built environment, we need to move towards a circular economy. Two core circular economy principles are 'maximising reuse' and 'minimising impact and waste'. Designing for deconstruction can play a key part in enabling this in the built environment. By designing buildings that can be deconstructed or disassembled, building structures, materials, products, and components are kept in the loop instead of wasted.

Some important benefits that come from designing for deconstruction include a reduction in demolition waste that goes to landfill, a reduction in carbon emissions that come from remanufacturing and reprocessing materials, as well as greater flexibility in the way spaces are used.

Deconstruction must be designed for in the early stages of a building project in order for disassembly to effectively occur decades in the future. Without considering deconstruction at the design stage, material recovery becomes more costly and time consuming leading to less reuse and more waste. At present, the majority of buildings are not built for deconstruction or disassembly, due to the perceived additional cost and time.

Principles of Design for Deconstruction in the built environment

Here are some of the key elements that are necessary when designing for deconstruction.

1 | Reversible connections

When considering construction methods, use connections such as screws and bolts that can be easily reversed over permanent or non-reversible ones. This allows for faster and easier disassembly at the end of life while also better maintaining the integrity of a given material.

2 | Lack of glues, chemical bonding, and other processes which cannot be reversed

Any connection that is permanent, difficult to reverse, or causes significant damage to a component or material during disassembly should be avoided. This will help to maximise recoverable material in any given project.

3 | Ease, speed and cost of disassembly

Building, components, and materials should be able to be disassembled quickly, easily, and at little extra cost. By designing for disassembly before construction, more material can be recovered faster and with little to no additional cost.

4 | Simplify and separate building systems

Separating building systems into non-structural elements of a building allows for easier repairs, upgrades, and removal of components.

5 | Storing data and deconstruction information

Data and information on deconstruction must be stored properly to be used many years in the future at the end of a buildings life. A deconstruction plan should be created and stored with other data.

6 | Consideration for worker safety

Materials, products, and components should have low risk of hazards to those who interact with a project. Use of hazardous materials should be kept to a minimum.

7 | Quality of recovered materials

In order to be reused, materials must be compliant with any regulations and standards for a given component after deconstruction. Planning for disassembly will allow for the least amount of damage to recovered elements.

8 | Aesthetic condition of recovered materials

While reuse is important, clients who fund building projects will still have requirements for aesthetic conditions of the design. Materials should be disassembled carefully to maintain a quality aesthetic condition to meet customer expectations.

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How can it be done?

A plan for deconstruction and circularity should be thought of for every stage in the design and building life. The RIBA stages are a set of steps designed to demonstrate each stage of a building project. The below shows some considerations on disassembly and circularity at each of these stages. - You can find more information on this in the UKGBC Circular Economy Report

Stage 0/1: Strategic definition, preparation and briefing

These stages are about determining the best means of achieving the client's requirements and developing the detail of the brief. To support designing for deconstruction broad objectives for circular economy and deconstruction aspirations should be set and objectives developed with specific metrics. Identify any deconstruction methods that could be implemented in the project and any further information that may be needed.

Stage 2/3: Concept design and spatial coordination

These stages are about getting the design concept right, deciding the look, feel, and spatial dynamics of the building in line with the budget. At this point agreements on opportunities, commitments and metrics/targets that measure successful design for deconstruction should be set. Consider holding workshops to investigate circular economy alternative approach and methods of disassembly.

Stage 4: Technical design

This stage is about developing the information required to manufacture and construct the building. Engage with suppliers to source products that can be deconstructed and reused at the end of life. Determine realistic lifetime of each building component and plan for disassembly for components.

Stage 5: Manufacturing and construction

This stage is when the building is manufactured and constructed. Reversible connections and processes should be used to support future disassembly. Continue to investigate alternative materials, products, and disassembly methods.

Stage 6/7: Handover and Use

By stage 6 and 7 the building will be handed over to the occupiers. During its life, many updates and repairs will be made to a building. By separating and simplifying building systems, individual components can be removed and replaced without the need for major demolition.

Stage 7: End of Life

After many years of use, the building will come to the end of its life and deconstruction will begin. This is where the building will be broken down into its various components and materials and the disassembly plans will come into use. Proper design and documentation for deconstruction allows for the building to be taken apart and materials to be recovered for reuse.

Case Study: The Forge, Bankside...

Having received funding from Innovate UK, Landsec is delivering the world's first office building designed and constructed using the 'kit of parts' solution built on a 'Design for Manufacture and Assembly' structural frame. This is reducing the amount of natural resources used and onsite waste. The use of standard parts with reversible joints means the building can be dismantled in pieces, extending the life of components for potential reuse.

Source: UKGBC

IN SUMMARY

Design for deconstruction is an important part of moving towards a circular economy. Planning for disassembly in the design stage maximises potential material reuse and recovery as well as reduces construction waste.

FURTHER RESOURCES

- UKGBC: Guidance on circular economy principles
- ArchDaily: Design for Disassembly
- UKGBC: System Enablers for a Circular Economy
- Lifecyclebuilding: Design for Deconstruction guide