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Design for Deconstruction

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1. Introduction

A sustainable development is one that meets the needs of the present without compromising the ability of future generations to meet their own needs. The underlying principle behind this, is that to achieve a truly sustainable development there needs to be an optimal integration of economic, environmental and social considerations.

This design note addresses a very small, yet extremely important issue, which will be part of the integrated solution - the Design for Deconstruction of a steel structure to facilitate its reuse. Steel is the most recycled building material in the world by weight, however this valuable attribute of recyclability is not the only important attribute that steel offers in terms of sustainable design. If we consider the hierarchy for waste management priority which is **Reduce, Reuse, Recycle**, and finally **Dispose,** it is evident that it would be better to reduce the amount of steel or reuse existing steel in preference to recycling.

The superior strength to weight ratio of steel over many other construction materials gives it a natural advantage in terms of reducing the volume and mass of materials used in construction. This fact, plus the numerous design guides provided by OneSteel, the Australian Steel Institute and various other publishers on how to design economically has the “Reduce” priority well covered.

The issue of reuse is generally addressed in two ways – design the structure for maximum flexibility and adaptability such that the building itself can be modified and reused (i.e ease of retrofit, reducing building churn) or alternatively, design the building such that in a way that it can be easily deconstructed and the building elements reused. Steel elements’ ability to be deconstructed has long been recognised and points are now available in the Green Buildings Council of Australia’s Green Star rating tool.

This technical note provides guidance via a checklist on aspects of design and construction that should be considered to improve the ease with which a steel-framed building can be deconstructed.

2. Design for Deconstruction

The design team at the preliminary stages of design should be fully briefed on the intentions of the client to Design for Deconstruction (DfD). Thus each of the consultants can address the issues that lay within their particular discipline to ensure an integrated and optimal result.

A simple however powerful principle that usually applies is that if a structure is designed such that it is easy to construct, then it is also generally easy to deconstruct. The following items should be considered when designing a building to deliver on this principle.

a) Design the building to be built from the ground up and avoid transfer systems that ultimately support the structure from above. Provide a deconstruction plan outlining general concepts where the load path for the self-weight of structure and deconstruction loads follow conventional paths. Provide specific detailed plans where load paths are not conventional. All load transfer systems should be identified.
b) Provide clear documentation of all steel members used in the structure, including , size, grade, length, and connection details Shop drawings with any as-built changes incorporated should suffice in most cases.
c) Keep records of the steel supplied, specifically mill test certificates recording manufacturer, production date and standard.
d) All steel members should have permanent marking so that it can be uniquely identified at the time of deconstruction.
e) Minimise the number of members required. This reduces the complexity both in construction and deconstruction. Longer members are more readily usable - it is easier to trim member to the required length than extend it. Longer or larger robust

members are less likely to be damaged in the deconstruction process.

f) Structures that are constructed from relatively smaller members, should be modularised, deconstructing an entire module that can be reused is always preferable to many small members. Modules should be identified in the deconstruction plan.

g) Standardised connection details should be used to facilitate reuse without modification after deconstruction. It also makes deconstruction easier.

h) Bolted connections are preferable to welded connection. Avoid or minimise chemical bonding (eg. Glues, epoxy) as opposed the mechanical fixing of other material to steel members, as materials chemically bonded will make recovery and re-use more difficult.

i) Copies of the deconstruction documents – as built drawings and the deconstruction plan should be kept on site by the building manager and by the building owner. Copies should also be provided to the Regulatory Authorities (Local Councils), while builders, engineers and architects may make a commercial decision to store the documents with the possibility they will prove useful for securing work sometime in the future.

3. Design for Deconstructability Checklist

The checklist below provides guidance on the factors that should be considered when designing for Deconstruction. These factors should be considered by the entire design team and then reviewed by the construction team to ensure an integrated solution is produced. Remembering that if a building is relatively easy to construct it will generally be easier to deconstruct.

Design for Deconstruction Checklist		✓
1	Design Structure to utilise conventional load paths wherever possible	
2	Limit transfer systems	
3	Document and all load transfer systems	
4	Provide details for deconstruction of transfer systems	
5	Use robust members in long lengths in preference to light members in short lengths	
6	Utilise Modular construction for light short sections	
7	Identify modules in deconstruction plan	
8	Utilise standardised connections where appropriate	
9	Use Bolted connections in preference to welded connections; avoid/minimise chemical (e.g epoxy) bonded materials to the steel.	
10	Produce as built drawings of the final structure, uniquely identifying all elements, on drawings included size, length and connections.	
11	For each steel member keep copies of the mill certificate providing the manufacturer, date of production, chemistry grade, mechanical properties and production Standard.	
12	Steel members to have permanent markings corresponding to the as built drawings	
13	Identify where copies of the deconstruction plan are to be stored and the process to ensure that ownership of the deconstruction plan remains with the owners of the building	
14	Ensure a final coherent set of documents are provide which constitutes the deconstruction plan	