AUSTRALIAN STEEL INSTITUTE

Design for Deconstruction discussion paper

Background and Context

The built environment is a significant contributor to greenhouse gas emissions, through both the operational energy of building stock and the embodied carbon associated with construction materials. As more renewable energy and more energy efficient buildings are introduced, the relative impact of embodied carbon increases. In the case of steel, the supply chain is undertaking a comprehensive range of measures designed to achieve net zero carbon emission manufacturing processes. These will be progressively implemented over the short, medium, and long term, as new technologies are commercialised.

Meanwhile there is increasing focus on utilising circular economy principles in construction (reduce, reuse, recycle, remanufacture) to reduce emissions attributed to the built environment, which when attributed to building materials could reduce global CO_2 emissions by 38% in 2050 according to the Ellen Macarthur Foundation. (https://www.ellenmacarthurfoundation.org/topics/built-environment/overview).

This concept / opportunity has been realised by the Australian Government and other leaders resulting in the development of regulation in this area. The Circular economy, built environment & embodied carbon industry forum that reports to the Federal Circular Economy Ministerial Advisory Group has been tasked with defining a set of recommendations for the implementation circular economy principles in the built environment through policy. Leading bodies such as the Green Building Council of Australia report a 40% reduction of embodied carbon in buildings can achieved by reusing existing buildings or by using reused components or low carbon materials are part of all new building elements, and that by 2030 Green Star buildings are expected to achieve this goal. (source: https://www.gbca.org.au/get/resources/2229/C770DF2694C32D3179AA65F674ACB9CD)

An application of circular economy principles to achieve incremental reduction of carbon emission intensity for steel in the short to medium term, is the increased utilisation of recycled scrap steel in the steel manufacturing process[1]. Production of steel using recycled scrap requires approximately one eighth to one quarter of the energy needed for production of steel from virgin raw materials. However, whilst the recycling of scrap construction materials is essential to improve sustainability and reduce embodied carbon, the actual re-use of materials in their original state provides a much more significant impact.

There are some examples of buildings that have intentionally been designed for deconstruction and reuse in another location, but these are relatively few. In the

[1] Whilst in excess of 90% of scrap steel arisings are already collected and re-used, there remain opportunities for still greater utilisation.

main, the reuse of construction materials has been limited to opportunistic reclamation of selected components from demolished structures. Reclamation tends to be labour intensive, and therefore costly, and the percentage of the demolished structure that is reclaimed is typically relatively small. Depending on the original construction method employed and the structural condition of an end-of-life building, it can also be problematic to safely reclaim specific materials.

Discussion

When buildings are intentionally designed for eventual reuse, potentially at another location, this represents the best achievable sustainability outcome, with an optimised circular economy approach. Given the significant benefit that flows from adopting a Design for Deconstruction (DfD) approach, it is reasonable to question why it hasn't been more widely adopted. There are at least two significant impediments that have been identified.

Who benefits vs. who pays? If there is a greater cost to design and construct a building so that it can be disassembled at some time in the future and re-used in its entirely, there could be a disconnect between the value placed on this by a short-term owner compared to a long-term owner. If the DfD functionality isn't utilised until 30 to 50 years after the initial construction, this represents a future benefit that is typically not recognised by the general real estate market. Following that same logic, it is probably going to be less appealing for the residential property market, but it may be more appealing for the commercial / institutional / public property market. Further, the value and functionality may be best utilised initially in government owned buildings where there is more likely to be long term continuity of ownership, as well as preservation of the building design and construction information.

The supply chain needs to be able to support the demand. Some of the key aspects of the supply chain for DfD buildings would seem to be: capability to design aspects such as connections and fixings, such that they can be safely and easily disassembled; comprehensive marking of all components such that they can be associated with building drawings and their intended location in the structure is able to be identified at the time of re-assembly; material durability specified such that the life of all components is sufficient for them to be re-used at the end of the life of the first installation. These aspects can all be done now although they would require extra effort and cost relative to conventional building.

Therefore, if the goal was to encourage wider uptake of DfD buildings, this might logically start with pilot projects associated with government owned buildings, which also have a premium placed on sustainability.

Opportunities

Olympic Games have a bad reputation for the host cities going bankrupt due to building infrastructure like stadia that are rarely used afterward, so the upcoming Brisbane 2032 Games could be a great opportunity to pilot and showcase design for deconstruction as a key strategy for sustainable infrastructure. Brisbane 2032 is reportedly the first Games to 'contractually commit' to being climate positive, which at

its simplest means more carbon savings than emissions. A Legacy 2032 Strategy has been developed. This climate positive requirement may further add to the appetite for incorporation of DfD buildings in the overall concept for the games.

The International Solar Decathlon is one example of a university based international competition themed around sustainable buildings. It is overseen by the U.S. Department of Energy, with a goal of preparing the next generation of building professionals to design and build high-performance, low-carbon buildings powered by renewables. In some years, the competition has involved designing and constructing a permanent building, which is relocated to the host site for the competition and judging. This style of competition would also be readily to suited to the DfD concept.

In Western Sydney, Bradfield City within the Western Parklands City Authority, is being deliberately planned and constructed so as to maximise circularity. This may provide an opportunity to showcase DfD.

Several possible pilot projects and use cases have been identified for potential more detailed investigation.

1. Temporary residential accommodation e.g. as part of athlete or media village associated with Brisbane Olympics.
2. Stadia and related facilities e.g. training facilities associated with the Brisbane Olympics.
3. Circular economy themed inter-university competition similar to the Solar Decathlon, with possible focus on student on-campus accommodation.
4. Build to rent residential accommodation commissioned by Commonwealth or state governments.

Potential partners
Research partner – UOW Sustainable Buildings Research Centre, ARC Steel Research Hub
Industry associations – ASI, NASH, Prefab Aus, ASBEC, MECLA
Material suppliers – BlueScope, InfraBuild, Liberty Primary Steel
Developers – Commonwealth, state and local governments, universities, corporates
Architects –
Structural engineers –

Next steps
Syndicate this discussion paper with the potential partners to determine whether there is interest in pursuing any of the opportunities.