International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Deconstruction and Material Reuse - Role of Architect

Meenu Latha Goyal[1], Manju. C[2], Thrivikram N B[3], Umesh R[4]

[1, 2, 3] PG Students SJB School of Architecture & Planning, Bengaluru, India

[4]Rohini Project Management Consultants Pvt Ltd, Bengaluru, India

Abstract: ***Deconstruction, the sustainable way of decommissioning, is a growing trend in the construction industry. It is a process of carefully dis-assembling a structure so that the material used during the initial construction can be given a second life. In spite of higher cost and time involved with deconstruction, the value of the long term benefits takes a better place and hence justifies adopting deconstruction over demolition. The effort by AEC (Architecture, Engineering, and Construction) practitioners to adapt to the sustainable methods to reduce the impact on environment due to construction activities is slowly shifting the focus from demolition to deconstruction.***

Keywords: Deconstruction, Demolition, Design, Management, Sustainability

1. Introduction

Every building has a definite life span, starting with the designing stage and ending with the demolition. Unlike the construction and service phases, the end phase of building is often neglected, despite its qualitative and quantitative significance. The end phase is usually marked with the decommissioning of the structure after its useful life term.

Demolition leaves behind a variety of material, out of which only a small percentage can be salvaged. The rest becomes demolition waste which constitutes 50% of the entire annual waste produced (Kibert, 2008). The above statistics makes it clear that demolition waste management is vital in addressing the sustainability and long term management of significant resources. The focus, must now, shifts from managing demolition waste to reducing and reusing it.

In recent times, the Architecture, Engineering, and Construction (AEC) industry has taken conscious effort to understand the concept of sustainable construction. "This need requires that the usage and end of life impact of construction activities on the ecosystem are to be accessible at the design stage" (Ajayi et al., 2015) leading to new perspectives of designing buildings with new materials and methods that could be utilized after decommissioning of the building."The amount, the reasons, the objectives and the contextual conditions for losses of buildings became an issue when the attention began to shift from a view of construction that was exclusively focused on the production of new buildings to a more stock-oriented one" (Hassler and Kohler, 2002Hassler). This again reinforces the need for the growing importance of the end phase over designing and construction.

2. Deconstruction- New Perspective

Deconstruction means dismantling buildings with the goal of maximising the reuse potential of its components (CIB/CSIR 2001). It is a process of carefully dis-assembling a structure so that the material used during the initial construction can be repurposed and given a second life.
Till recent times, the life cycle was seen as a waste that is '*cradle to tomb'*. With change in perspective, waste is considered as a form of resource- '*cradle-to-cradle'* perspective. One manifestation is to understand buildings as future resources and is known as 'urban mining'. (André Thomsen, Frank Schultmann & Niklaus Kohler)

2.1 Difference between Deconstruction and Demolition

By Definition: In contrast to Deconstruction, Demolition means the razing of a building in such a way that the building components are fit for nothing more than recycling and landfill.

By Process: *Deconstruction* uses manual labour and equipment to disassemble and salvage the building components mainly for reuse and the rest for recycling. *Demolition* is completely dependent on mechanical equipment which shreds the building down to D-waste.

By Duration: Deconstruction consumes almost 4 times the time taken for demolition for the same building.

By Cost: Deconstruction cost is 2 times the cost taken for demolition of the same building.

Environmental Impact:
A recent EPA study indicated that roughly 136 million tons of waste is generated annually from construction, renovation, and demolition (CRD). Depending on local conditions, CRD can comprise anywhere from 25% to 40% of the total waste in a community. Of this amount, the EPA has estimated approximately 92% is produced by building renovation and demolition, with 8% coming from new construction projects. The overall green building movement has included materials conservation and waste reduction amon its key principles.(https://www.cmdgroup.com/market-intelligence/articles/building-deconstruction/)

In spite of higher cost and time involved with deconstruction, the value of the long term benefits takes a better place and hence justifies adopting Deconstruction over Demolition.
Net Income for demolition = (Price paid by owner) - (Pre-Demolition + Demolition + Transport +Disposal)

Net income for deconstruction = (Price paid by owner + Salvage Value) - (Pre-Deconstruction +Deconstruction + Processing + Transport + Disposal)

2.2 Benefits of Deconstruction

Deconstruction has a strong connection with environmental sustainability by reducing the amount of waste generated. It can diminish climate gas emissions and can also divert materials from landfills. It gives materials a new life cycle by reducing the need for virgin resources, thus protecting our planet from air, water and ground pollutants. The growing demand for housing, in under-developed and developing countries, calls for renovations using deconstruction methods. As explained earlier, Deconstruction is a labour intensive phenomenon as compared to demolition and thus helps in the creation of various job opportunities. It reduces the energy and emission involved in the manufacture of newer materials and makes our planet Green. Deconstruction helps in saving on transportation and travel time as energy and resources are available at local level. The project may also qualify for LEED points for keeping in compliance with local environmental and governmental regulations.

2.3 Deconstruction Methodology

Deconstruction is more complicated than demolition as the components and materials have to be used in their true form. The structure is first appraised then is followed by disassembling, separating the reusable pieces from the non-reusable ones. Proper treatment for different materials, as recommended by the professionals, is taken care of before reuse.

2.4 Structural and Non-Structural Deconstruction

Table 1: Description of Structural and Non Structural Deconstruction

Deconstruction type	Definition	Characteristics	Types of Materials Salvaged
Non-Structural	Non Structural deconstruction involves the removal for salvage / reuse of any building components or contents that are not a part of or whose removal is not dependent on the structural integrity of the building.	Usually light, can be salvaged relatively easily and with minimum safety concerns. Material can be viewed without much destructive access. Typically doesnot require support or bracing to salvage.	Finish flooring Appliances/ Mechanical Cabinetry Windows/ Doors Trim Fixtures/ hardware Fireplace mantels
Structural	Structural Deconstruction involves the removal for salvage/ reuse of building components that are an integral part of the building or contribute to the structural integrity of the building	Disassembling a structure to salvage the structural building components such as beams, joist and bric. Materials are typically large,rough products that are to be reused as building materials or remanufactured into Value added products such as chairs, tables and surface coverings	Framing Sheathing Roof system Brick/ masonry Wood timbers/ beams Wood rafters Floor joist system

(A report on the feasibility of deconstruction: an investigation of deconstruction activity in four cities-by HUD USER-pg-6)

2.5 Role of Architects in Deconstruction

The concept of Deconstruction calls for a careful understanding of the building, so as to ensure that after its successful life cycle the material can be easily retrieved and used in a new construction. This mainly focuses on aspects like *design*, with which the materials and methods of construction have to be compatible enough. This is done so that it is durable to undergo a second round of life cycle. Also, the methods and design should be such that it does not become obsolete for the next life there by exhibiting versatility. This can be achieved only with the creative efforts of an architect. Thus architectural and structural understanding is needed to successfully implement the deconstruction process and help in reducing resource utilisation and the carbon footprints.

3. Design for Deconstruction (DfD)

Like many design philosophies, design for deconstruction has been growing rapidly in recent years, especially in the developed nations. This concept is about closed loop of resource use. This is as a result of the awareness of impacts of construction on environment, its long term effects on resources and other micro parameters like socio-economic conditions of the human habitat. Increased awareness has also led to architects taking steps like DfD in trying to tackle the above mentioned problems. The increasing concern for these schools of thought has risen over recent years and has also led to the implementation of new strategies like Green Architecture. The purposes of utilising DfD are 1) Design for material recovery 2) Design for material reuse 3)Design for building flexibility

3.1 Factors guiding the success of DfD

A successful DfD is attributed to 3 major factors that decide the effectiveness of the DfD.

Design related factors

- According to Warszawski (1999), design related factors cover commonly observed design principles and key performance indicators for DfD. Architects can encourage and adopt the use of Modern Methods of construction such as offsite construction, modular construction, open building system, etc. The deconstruction of these structures

ensures cost and time at the same time reduces on site waste and easy recovery of building components.

Building materials related factors

- Although DfD is not a new idea in the AEC industry, its planning is largely dependent on appropriate specification of building components to facilitate easy disassembly (Addis, 2008; Akbarnezhad et al., 2014). Conscious efforts from architects' part to not use nondurable materials, materials with secondary finishes, glues, toxic materials ,and composite materials will help in reuse of all building components after the end phase of the building. In addition , architects can broaden the supply-demand chain for deconstructed products by actively making use of reused and recycled materials from prior sites. Evidence shows that reusing concrete components could reduce material cost by 56% (Charlson, 2008). The architects need to ensure the cost of DfD is justifiable compared to cost of demolition. The use of light weighted small to medium size components aids the team of workers in handling operations during disassembly, transportation, and assembly.

Human related factors

- All construction related operations requires high commitment levels and clear, regular communication between workers for a harmonious working relationship to realize the overall goals of projects. Being a labor – intensive systematic process, deconstruction also requires the same commitments from its team. These site workers must be properly trained to avoid poor craftsmanship and poor work ethics, and walked through the use of hand help tools, fasteners and materials.

('Design for Deconstruction (DfD): Critical success factors for diverting end-of-life waste from landfills')

3.2 Major Issues faced in implementing Deconstruction

- Deconstruction requires latest tools and techniques which are not always available or non- existing. Majority of labourers are not familiar with these techniques.
- As mentioned earlier, Deconstruction costs are much higher than D-waste disposal cost; this makes it difficult to educate the people in recognising the long lasting benefits of deconstruction.
- Very few countries have building and design codes that always cover the reuse of building materials.
- Finally, due to the lack of standardisation and design for deconstruction the buildings are designed only for demolition.

4. Critical Success

The success of any program depends on the effective implementation in tune with certain factors that creates an external influencing environment; called External Environmental Factors (EEF).These factors must be supportive to make a proposal workable and sustainable.
Important EEF's are

- *Stringent legislation and policy*: A strong policy supported by a good legislation is necessary for a system to work. Legislation that encourages DfD has to be framed along with an effective policy to implement, monitor and control the Deconstruction programs. Policies like Subsidies, Tax rebates must be made available to encourage implementation of deconstruction and subsequent reuse of materials for new constructions.
- *Public Sector Involvement*: Public sector is the policy maker and it includes all statutory authorities and various government led organizations. This plays a major role in promoting , implementing and monitoring deconstruction of any kind.
- *Awareness and Training programs*: Since the concept of deconstruction is in a very rudimentary stage it requires a lot of awareness to understand, accept, implement and practice. A proper understanding of the same is also required by the people of the industry and the common man as well. The current mindset has to be changed in a more rational manner to accept the practice as having a greater value in the future in terms of sustainability

5. Deconstruction – The Indian Perspective

In India the concept of deconstruction is in a very primitive stage. In spite of being a fast developing country, many Indians have very conservative thoughts about reused materials for new constructions. This thought has to be rationalised, by creating awareness to accept and implement new techniques to reduce the environmental impacts. At the same time, the consumption of dismantled material like doors frames, steel, wood etc is high among a small percentage of urban educated crowd due to the quality, originality and ethnic value of these components. It is still remaining as an independent business entity. With adequate encouragement and awareness this has prospective to be a very big industry with plenty of job opportunities.

India being a populated country, stands in the forefront of having easily available labour, that can be harnessed by proper training in deconstruction methods and techniques.

The government has an effective role to frame good policies and methods to properly implement, control and monitor these innovative eco-friendly methods. India requires a strong legislation, good encouraging policies and stringent monitoring to boost the practice of deconstruction and its success.

With already existing demolition Industry, some conscious efforts from the AEC practitioners can easily develop deconstruction practices popular among public and thus a shift of focus from traditional practices of demolition to new sustainable solutions.

6. Conclusion

Deconstruction in its initial stages is found to be easy to adopt. With all the analysis it is seen that the Concept is highly practical and adaptable .This has to be first understood in terms of the concept, the steps involved in deconstruction of existing buildings , planning new buildings that could be deconstructed after its life span and reused in new buildings thereon.

The Deconstruction also has to focus on planning, implementation, monitoring, controlling, awareness and training for successful achievement of the process.

Strong policies to support this activity will boost its success. Deconstruction not only reduces demolition waste but also creates a sustainable cycle and creates job opportunities for the centuries to come.

References

[1] Hassler and Kohler, 2002 Hassler, U. and Kohler, N. 2002. The building stock as a research object. Building Research & Information, 30(4): 226–236. [Google Scholar]).
[2] Deconstruction, demolition and destruction André Thomsen, Frank Schultmann &Niklaus Kohler Pages 327-332 | Published online: 30 Jun 2011)
[3] (https://www.cmdgroup.com/market-intelligence/articles/building-deconstruction/)
[4] Green donation consultants - Posted on July 19, 2018, updated on July 4, 2018 by Mayur Dankhara
[5] Green donation consultants -Posted on July 12, 2018, updated on July 4, 2018 by Mayur Dankhara
[6] Original citation & hyperlink: Akinade, OO, Oyedele, LO, Ajayi, SO, Bilal, M, Alaka, HA, Owolabi, HA, Bello, SA, Jaiyeoba, BE & Kadiri, KO 2017, 'Design for Deconstruction (DfD): Critical success factors for diverting end-of-life waste from landfills' Waste Management, vol 60, pp. 3-13 https://dx.doi.org/10.1016/j.wasman.2016.08.017
[7] Construction Materials and C&D Waste in India - Sandeep Shrivastava and Abdol Chini M.E. Rinker Sr., School of Building Construction University of Florida, USA
[8] A report on the feasibility of deconstruction: an investigation of deconstruction activity in four cities, U.S. Department of Housing and Urban Development & Office of Policy Development and Research.

Author Profile

Ar. Meenu Latha Goyal, Principal Architect, Neenv Architects and Interior Designers, Bangalore. Worked as a Faculty with esteemed Institutions. Practicing Freelance Architecture and involved in designing several typologies like residential, commercial spaces. Currently pursuing M.Arch in Construction and Project Management from SJB School of Architecture and Planning, Bangalore.

Ar. Manju. C, B. Arch (1998), PG Dip (Urban Planning); 15 years Teaching experience; 20 years Architectural Practice.Currently pursuing M.Arch in Construction and Project Management from SJB School of Architecture and Planning, Bangalore.

Ar.THRIVIKRAM NB, Principal Architect, SPACES, Bangalore .Graduated in Bachelors of Architecture (1998). About 20 years of Professional experience. Practicing Freelance Architecture and Involved in designing several building typologies. Currently pursuing M.Arch in Construction and Project Management from SJB School of Architecture and Planning, Bangalore

Umesh R, B.E. (Civil) MRICS, Director, Rohini Project Management Consultants Pvt Ltd, Civil Engineering graduate with over 36 years of experience Worked earlier with AFCONS Infrastructure Limited, Navayuga Engineering Company Limited, Fischner Consulting Engineers, Chennai and SAIPEM ENI, France. Executed several underground structures involving large diameter piles (in-situ and driven), diaphragm walls, rock anchors, port construction, planning etc. Currently involved in Project Management Consultancy assignments and Cost Management Services in residential, industrial and commercial sectors with several clients, developers etc. Member of Royal Institute of Chartered Surveyors, Fellow of Institution of Engineers, Fellow of Indian Institute of Valuers, Fellow of Association of Consulting Civil Engineers, and Life Member of Indian Concrete Institute.