

# A Review: Management of C&D Waste Materials by using 3R's Technique

Nidhi Gautam

*Civil Engineering, GL Bajaj group of Institutions, Mathura, U.P, India*

\*\*\*

**Abstract** - The paper assessing different researches based on the management of waste materials generated during the construction and after the demolition of any building. Different techniques used in previous researches for the management of C&D waste materials. This paper focused on the 3R's Technique for the management of such type of waste materials. This paper also considered the comparative study of recycled products and virgin products used in construction field. There is a review over the problem generated in world due to the generation of C&D waste.

**Key Words:** C&D: construction and demolition, Management, Recycle, Reduce, Reuse, Waste materials.

## 1. INTRODUCTION

The waste material which generates during the construction, renovation and destruction of civil engineering structure, is known as C&D material.<sup>1</sup> For example: concrete, wood, asphalt, gypsum, metals, bricks, glass and plastic etc. This paper provides a brief knowledge regarding such type of waste materials which is the field of interest of civil engineers as well as Architects too. The process of dismantling of buildings to salvage parts for recycle and reuse is known as deconstruction.<sup>1</sup> More than millions of buildings faces deconstruction due to natural disasters and wars etc. It creates a significant impact on the economy of world.<sup>4</sup> Many developing countries of the world require the construction materials on daily basis due to the fast construction of buildings and infrastructures, which create C&D waste as a byproduct. The disposal of this type of waste is a big problem in front of these countries. If this waste will recycle or reuse then it can save some amount of virgin construction materials also. However the strength of recycled materials not equal to the virgin material but it also controls if consider some parameters at the time of recycling which mentioned in previous researches. Reuse of C&D materials onsite also reduce the transportation cost as well as the consumption of virgin resources.<sup>1</sup> Therefore the 3R's Technique can play a very important role to manage the waste generated by the construction or demolition. This technique consists of Reduce, Reuse and Recycling of C&D waste after segregation.

## 2. LITERATURE REVIEW

1. In the US in 2018, 600 million tons of C&D debris generated. That is more than the amount of municipal solid waste. The process of dismantling buildings to salvage parts for recycle and reuse is known as deconstruction. The benefits of deconstruction are maximizing recovery of material, preserve resources by reuse and divert demolition debris from disposal etc. Reuse material can be doors, hardware appliances etc. And recycle material can be brick, concrete etc. Recycling of C&D material can be done and it can be replace aggregate and mix with cement to make new concrete products.
2. Concrete industry is a large consumer of natural resources. In our rapid developing world, production of concrete is approximately 6 billion tons per year. So many countries setup a tax system on the use of virgin products.
3. Approximately 180 million tons per year demolished building in Europe. Reuse of demolition waste in the manufacturing of RCA is a good option to manage the waste. Less than or equal to 30% replacement of coarse aggregate by RCA has negligible effect on compressive strength of concrete. Use of RCA, in concrete, increases the shrinkage effect. The density of concrete decreases 3-10%, because of RCA. . Thus the replacement of coarse aggregate by RCA in concrete, require proper planning and control over the concrete mix.
4. There is a requirement to solve the problem of rubble accumulation. This problem can be sort out by the recycling and reuse of waste. RCA can be use at different stage of construction. The properties of RCA checked by some experiments. The specific

gravity, water absorption, bulk density and LA % of RCA are 2.22, 6.83, 1290 kg/m<sup>3</sup> and 32.7 respectively.

5. Some areas of world have not the markets for the recycled material so the recycling not possible in those areas and create a problem of C&D material disposal. However the recycled aggregate have less strength and specific gravity as compare to fresh aggregate. An experimental research done on the concrete debris after recycling which shows less strength. It is also cheaper than standard mix.
6. Concrete rubble ratio is higher in C&D materials. RCA replace the coarse aggregate with different proportions. It found that the flexural strength was decreasing after increasing the percentage of RCA replacement.
7. In recycled material 20% fine or 30% coarse then there is no loss in strength. Recycled concrete have no adverse effect on concrete performance if replacing 20% of coarse aggregate. Natural aggregate replacement by recycled brick in concrete, decrease the 40% strength of concrete. The composition of hydrated lime in RCA is greater than normal concrete. There is a reduction in carbonation rate after using RCA. Some other results obtained by experimentations were that LA Coefficient less than or equal to 40%. To get equivalent elastic modulus of the particle
8. The reduction of strength can be avoided by increasing water cement ratio. The strength and water absorption of RCA decrease with increase in maximum size of aggregate. Both properties improve if the strength of plain cement is high which using in concrete. Strength and water absorption of recycled brick concrete is much better than recycled concrete aggregate.
9. According to the result getting after experimental analysis showed that the RCA have good workability and 86.84% to 94.74% compressive strength of plain concrete. C&D waste collected from a site and tested. The result showed the pozzolonic properties in C&D waste. The natural aggregate replaced by C&D waste and prepare a concrete mix sample. The color of RCA was pinkish brown. The specific gravity and water absorption were

2.5 and 3-4.5 respectively. After testing result showed, 30% replacement of coarse aggregate by RCA provided adequate strength to concrete mix.

10. The construction of cement is approximately 4.8 billion tons per year in Asia, South America and Africa alone. Therefore use of recycled concrete can help to reduce the demand of virgin cement resources.
11. In the recycling of C&D material, different types of waste generated with harmful gases. According to patent PAT.229887 the heating temperature of 650°C for 1 hour, help to decrease the waste. Waste free technology performs in four stages. This technology also improves strength by 10%.
12. Approximately 165 to 170 million tons per year debris produce in India. According to CPCB in March 2017, 12 to 14.7 million tons per year C&D material produced in India. According to a report published by World Bank in 2012, the cities which was producing 1.3 billion tons solid waste annually, estimated that in future in 2025, the generation of solid waste will be 2.2 billion tons per year. Near about 50% of C&D material reuse and recycle in India and remaining use for land filling etc. Origin of wastes is classified on the basis of different points according to Dajadian & Koch. Construction plays an important role in the development of society. It also creates a bad impact on our environment because it is a source of CO<sub>2</sub> emission. It also creates lots of dust, noise, smoke and odor. A study done by IIT Kanpur in 2017, the main source of urban pollution is road dust just because of C&D material. Different practices helping in the management of C&D waste material. Delhi and Ahmadabad set up a process of legal dumping. Kolkata dumped the C&D material in land filling. Chennai provide reconstruction permit etc.
13. In the field of construction, engineers consider different recycled materials like fly ash, blast furnace slag and red mud etc. the production of traditional construction material create a bad effect on environment. C&D waste like concrete rubble, tiles, waste bricks etc consider as industrial waste which can use as fine or coarse aggregate, recycled brick, RCA, recycled tiles etc. the reuse of

C&D waste help to manage such type of waste. Recycling of waste also help in C&D management. RCA can use in pavement construction. A good structure concrete can be obtain by mixing RCA and fly ash or condensed silica fume.

14. There is a need of continuous development of such industry for the recycling of C&D material because most of debris material dumped in open areas. For example: sub base of terminal 2, lester B, Pearson International Airport , Toronto, Canada (GTAA,2007) constructed with C&D debris.

### 3. METHODOLOGY

The disposal of C&D material is a very tough task so government agencies attract towards the reuse and recycle of such material. It is also a cost saving option. Reuse of C&D material also solves the problem of material shortage. The production of high strength concrete can be done by the C&D material.<sup>15</sup> The quality of concrete is good which made of recycled C&D material.<sup>16</sup> Recycled concrete aggregate (RCA) is a type of recycled C&D material. The different quality checked and concluded in previous researches. Recycled hollow concrete brick and tiles also made of such type of materials. The replacement ratio below than 30% was useful according to previous researches. Recycled stones are similar to RCA. Recycling of C&D material also preserves environment. Twin tower demolition generated 80000 metric tons of debris, out of which 55000 metric tons settled in basement and 25000 metric tons will be transported out over the next three months by Edifice Engineering & Jet demolition officials. To minimize the C&D waste, reduce the material for recycling. The process of deconstruction is a good option for this. In this process the parts or material dismantle safely for further use. Then the next phase is Recycling. Thus the 3R's technique is very useful in the field of C&D waste material management

A hierarchy followed in a research.<sup>18</sup> which followed for the complete life of a material.

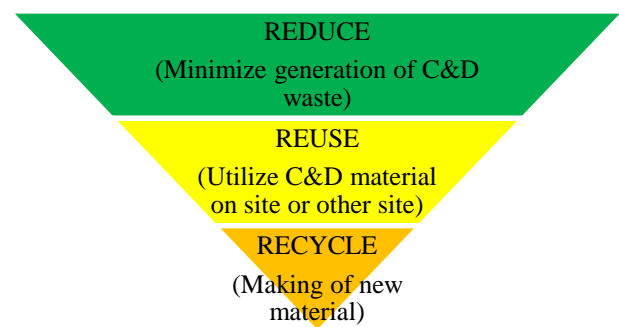


Fig. 1: 3R's Technique Hierarchy

The hierarchy shown in above picture representing the different stages of 3'R technique which used in this paper. Reduce, Reuse and Recycle are the three stages of this technique.

**Reduce:** First of all, find out the source of waste generation and minimize the cause of wastage if possible. It can be reduce by following all standards. The origin of C&D waste material can be identifying at the time of designing a building. If all the guidelines and safety factors used at that time then it can reduce the amount of C&D waste material.

**Reuse:** The waste should be segregate at the time of collection. The C&D waste material can be reuse in other place for construction if, it is in a good condition otherwise it can also reuse in land filling. Such type of C&D waste material can be sold for another site of construction or it can use onsite also. If the waste uses onsite then, it will save the transportation cost.

**Recycling:** It is a process of making new products by using waste material or replacing virgin sources by waste material. A new product made by this process is known as recycled products like RCA and recycled hollow bricks etc. Recycling is not very popular in India because of lack of awareness, government support, proper standards and poor acceptability of recycled materials.<sup>18</sup>

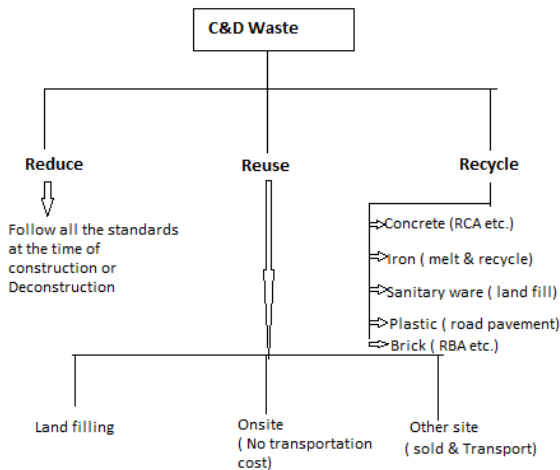


Fig. 2 : Summary of 3R's Technique

#### 4. CONCLUSIONS

This paper is an Assessment of some studies based on C&D waste material management. 3R's Technique is very useful in the field of waste management. The most important thing is people awareness about this technique and problems created by waste generation. The minimization of C&D waste should be start from the pre-construction stage. For the management of C&D waste material Reduce the wastage at pre-construction to completion of construction, Reuse of waste materials onsite or other site and recycling of damaged products. Some countries set up standards for the management of C&D waste material. So follow-up of all standards during construction, demolition and recycling can avoided the problem of C&D waste material management.

#### REFERENCES

1. Sustainable management of construction and demolition materials, EPA, United States Environmental Protection Agency.
2. S.Marinkovic, V.Radonjanin, M.Malesev, I.Ignjatovic, "Comparative environmental assessment of natural and recycled aggregate concrete", ELSEVIER, Waste Management 30(2010)2255-2262.
3. M C Limbachiya, A Koulouris, J J Robert and A N Fried, "Performance of Recycled Aggregate Concrete", RILEM International Symposium on Environment-Conscious Materials and Systems for Sustainable Development, September 6-7, 2004, pp: 127-136.
4. Hisham Qasrawi, "The Use of Recycled Building Rubble in the Reconstruction of Demolished Buildings"
5. Tomas U. Ganiron Jr, "Recycling Concrete Debris from Construction and Demolition Waste", International Journal of Advanced Science and Technology, Vol. 77 (2015), pp. 7-24.
6. M.T Gumede, S.O Frankin, "Studies on Strength and Related Properties of Concrete Incorporating Aggregates from Demolished Wastes", Open Journal of Civil Engineering, Vol.5, no.2, May 21, 2015
7. K.A Paine, R.K Dhir, "Recycled aggregate in concrete: a performance-related approach", Magazine of Concrete Research, 2010, 62, No. 7, July, 519-530
8. A.K Padmini, K. Ramamurthy, M S Mathews, "Relative moisture movement through recycled aggregate concrete", Magazine of Concrete Research, 2002, 54, No. 5, October, 377-384
9. M Monish, V srivastava, V. C Agarwal, P. K Mehta, R Kumar, "Demolished waste as coarse aggregate in concrete", Youth Education and Research Trust, j. Acad. Res., Vol. 1 (19) February 2013, 540-542
10. S. Lotfi, M. Eggimann, E. Wagner, R. Mróz, J. Deja, Performance of recycled aggregate concrete based on a new concrete recycling technology, Constr. Build. Mater. 95 (2015) 243–256, conbuildmat.2015.07.021
11. K.K Wichrowska, E Pawluczuk, M Boltryk, "Waste-free technology for recycling concrete rubble", ELSEVIER, Construction and Building Materials, 234 (2020) 117407
12. S Gupta, Malik RK, "The Impact of C&D Waste on Indian Environment: A Critical Review", Civil Engineering Research Journal, Review Article, Vol. 5, Issue 2- May 2018, 57-63
13. Md. Safiuddin, Md. Z Jumaat, M A Salam, M S Islam and R. hashim, "Utilization of Solid wastes in construction materials", International Journal of the Physical Sciences, Vol. 5(13) pp. 1952-1963, 18 October, 2010
14. Rao A, Jha KN, Mishra S, "Use of aggregate from Recycled Construction and Demolition Waste in Concrete" Resources, conservation and Recycling. 2007, 50: 71-78
15. Nelson, Shing Chai NGO, 2004 "High-Strength Structural Concrete with Recycled Aggregates, Dissertation, "University of Southern Queensland, 112 pp.
16. Qasrawi, H, and Marie, I., 2013 "Towards Better Understanding of Concrete Containing Recycled Concrete Aggregate", Advances in Materials Science and Engineering, Article ID 636034, 8 pages.
17. Qasrawi, H, and Marie, I., Tantawi, H. 2012, "The Use of Concrete Rubble as Coarse Aggregate in Concrete", International Jordanian Civil Engineering Conference, JAE, Jordan, January, pp 281-287.
18. N Kumawat, D Parab, G Bhanang, P Amale, S Kapse, "3R's of Construction Waste: A Review", International Journal of Innovative Research in Technology, February 2022, Vol. 8, Issue 9, 571-577