3R'S of Construction Waste: A review

Nilesh kumawat[1],Darshan parab[2], Gaurav bhanang[3],Pallavi Amale[4],Santosh kapse[5]
[1,2,3]*UG Scholar at Deogiri institute of engineering and management studies, Aurangabad (MH) India*
[4]*Lecturer in Civil Engineering Department Government polytechnic, Aurangabad*
[5]*Assistant professor Department of civil engineering at Deogiri institute of engineering and management studies, Aurangabad (MH) India*

Abstract **- The paper focuses on recycling & Reuse Building Materials as a way for environment protection and sustainable development. There are many methods used to reduce waste and increase profits through demolished, reuse, and the recycling of construction waste. Today. Recycling and reuse of such a large waste is need of an hour. There are many methods used to reduce waste and increase profits through demolished, reuse, and the recycling of construction waste. Sustainable development as a tool to continual improvement cycle and with processes innovation the need to save money in the processes via reduced resources and utility costs. This paper demonstrates that alternatives to modern building materials are available.**

Index Terms **- Construction Waste, Management Techniques, alternatives to modern building material.**

1.INTRODUCTION

"Vasansi jirnani yatha vihaya navani grihnati naro aparnai, Thata sarirani vihaya jirnanyanyani sanyati navani dehi"

The journey of the soul is continuous, just as a man gives up old worn-out garments and wears new clothes in the same way the embodied soul "Ataman" gives up old worn-out bodies verily accepts the new bodies. (Bhagwat Gita, Chapter 2, Shloka 22) This is also true with the resources and energy we use for building our environment. As our buildings worn out over time, we rebuild them with new materials. Instead, if we apply the same ideology in the process of re-building our environment and transfer the energy by reusing building materials and changing our design strategies; we would do justice not just to the natural environment but to ourselves also.

Construction and demolition waste has been defined as "wastage which are arising from construction, renovation , explosion activities ,surplus and damaged products and material arising in This report will include some background with a definition, aspects of construction waste, forms of waste, and the key solution for all discussed construction issues. Details will be highly focused on demolition and construction. In addition, it will be of interest to Civil Engineering, Architectural Engineering, and the others who would like to know more about how to have a healthy environment out of waste. Growth rate of India is reaching 9% of GDP. Rapid infrastructure development requires a large quantity of construction materials, land requirements & the site. For large construction, concrete is preferred as it has longer life, low maintenance cost & better performance. For achieving GDP rate, smaller structures are demolished & new towers are constructed. Protection of environment is a basic factor which is directly connected with the survival of the human race. Parameters like environmental conscious- ness, protection of natural resources, sustainable development, play an important role in modern requirements of construction works. Due to modernization, demolished materials are dumped on land & not used for any purpose.

Scrap waste

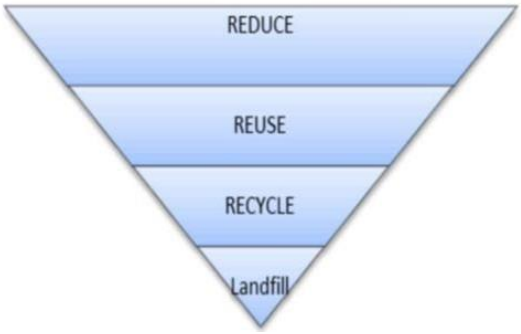
2.OBJECTIVES OF THE STUDY

the course of construction work and on-site work. The primary This study reduces the demand up on new

resources. Cuts down method is adopted in waste handling is carried through by interviewing professionals like paper managers, architects, civil engineers, contractors and government officials like city engineers, solid waste management officials. Construction and Demolition (C&D) process is considered to be a major source of waste in terms of weight, volume, and quantities. People are capable of stopping that, by acknowledging the problem and solution for it. Thus, the specific purpose of my report is to provide to the readers the danger of C&D waste and show suggested and applied solutions. the cost and effort of transport and production. Use waste which would otherwise be lost to landfill sites. Too aware about the dumping of deconstruction of building. To make people aware about the wastage of materials that may be used again. To know about the causes of wastage. To know about the various techniques through which the wastage can be reduced to know about the suitable wastage management hierarchy. To study about Landfill, Recycling, Reduce and Reuse.

3. THE 3R'S OF CONSTRUCTION

To lower construction waste and save money, we can: Reduce the number of materials needed Reuse materials from a building paper for use at other locations and recycle whenever possible.



There is some hierarchical order for the waste management that is reduces, reuse and recycle and that is mainly related with the production and consumption today. This heretical order is such as that of making of new product. That method can be applied on the entire life cycle of the product that is start from the extraction of raw material, manufacture, construction and disposal.

Reduce- First of all wastage should be found out when starting the designing process because in that process wastage can be minimized which is generated in that stage is possible. Wastage can be reduced through reduction can be achieved by design with standard sizes for all building materials, design spaces to be flexible and adaptable to changing uses and design for deconstruction. It is process of reduction of waste generation in various stages of construction by efficient material planning. Wastage generation can be identified during the design process itself and care should be taken during execution stage to decrease the waste that may generate. Waste reduction can be achieved by design by considering adequate sizes for all required building materials. Design to be flexible and adaptable to changing uses and design for reconstruction.

Reuse-It is process of reuse of generated waste material as landfill. Reuse of generated waste material is done at same or at another site under construction. This involves identification of waste that can be segregated for reuse on the current paper or another paper and that can be donated. A comparison of the value of the materials "as it is" for salvage and to their value as materials for recycling may be considered prior to reuse in most of the cases. Some of these materials may be valuable to reuse on-site during construction work; others may be sold to be used building material in another site. This involves identification of waste that can be salvaged for reuse on the current paper or another paper or that can be donated. A comparison of the value of the materials "as it is" for salvage and to their value as materials for recycling may be considered prior to reuse in many cases. Some of these materials may be valuable to reuse on-site. others may be sold to be used building material in another site or donated to a charitable organization

Recycle-The process of converting waste material to usable construction material replacing the natural materials in some proportion is called Recycling process. After adopting all the options to prevent waste, salvage and reuse materials, the next step is to recycle as much of the remaining waste material as possible. Recycling saves money by minimizing disposal costs and replacing fresh materials at some extent. After adopting all the options to prevent waste, salvage and reuse materials, the next step is to recycle as much of the remaining debris as possible. Recycling saves money by minimizing disposal costs. We can recycle most common construction materials with

Waste Management, including Concrete, Tile ,Metals, Bricks, Plastic, Masonry, Wood

4. METHODOLOGY

"With rapid urbanization the quantum of construction & demolition waste (C&D Waste) is constantly increasing. While it is estimated that the construction industry in India generates about 14-16 million tons of Construction and Demolition (C&D) waste annually, efforts to manage and utilize this waste is very little. As per report of Central Pollution Control Board (CPCB) Delhi, in India, 58million tons solid waste is produced out of which 17.5-million-ton waste is produced from the construction waste sector. This has led to Private contractors utilizing unscientific dumping methods there-by putting severe pressure on scarce urban land as well as reducing life spans of landfills." They reported "Since there are no suchC&D waste recycling centers in India at this moment and thus no reliable cost data available. In India, the concept of recycling is not popular due to the following reasons.

- Poor Acceptability of Recycled Material
- Lack of Appropriately Located Recycling Facilities
- Absence of Appropriate Technology
- Lack of Awareness
- Lack of Government Support
- Lack of Proper Standards

Most of customers are reluctant to purchase recycled raw materials due to following reasons
Higher price (46%) Lower quality (l5%)
Quality is not reliable (4%) Limited choices in market (17%) Not up to the standard (10%) Supply is not stable (10%)
As described above, price is the main factor to be considered in marketing of recycled products. In this case government support is needed to reduce prices by providing necessary capital on machineries, infrastructure and technology. But quality improvement has to be done within the scheme. In this paper examines the following things:-
Present practices of C & D waste in India with the special case of city of Pune. Possibilities and methodologies of recovery of waste materials and their application in new Construction, Institutional, regulatory and legislative framework in India in the field of construction and demolition waste management. Identifies loopholes in the framework and reasons of ineffective implementation. It studies provisions in NBC, BIS regarding recycled materials and C & D waste. Identifies issues and challenges related to C & D waste management and also elaborates the role of key stake holders. Discusses about the advantages of deconstruction over demolition
The paper emphasizes on the strategies involving technological solutions, policies, administrative and legislative framework of solving the issue and moving towards green C & D waste management.

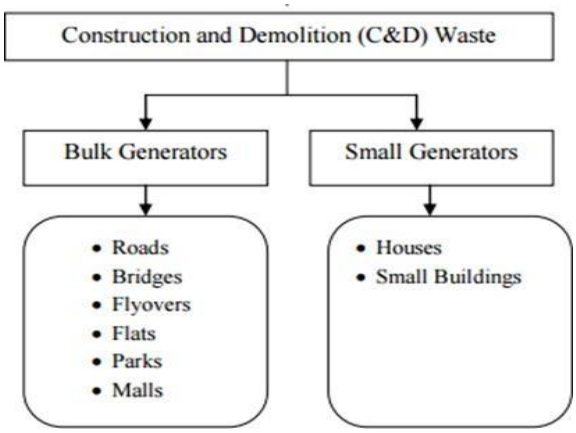
Construction waste

It has been found that there is an improvement in fire insulation characteristic of blocks containing C&D waste. Concrete blocks were prepared using recycled aggregate from 20 to 100% replacement of natural aggregate. These blocks were tested and found to have improved properties with respect to reference concrete for fire resistance, heat insulation and acoustic insulation. The reason for these improved properties was low density of blocks and more voids in these blocks thus making them suitable for nonstructural use such as blocks and prefabricated concrete panels. The use of recycled aggregate up to replacement of 20% was recommended in hot asphalt mix for paving urban roads. Similar result was obtained by Gomes and Perez et. al 014 for use of C&D waste aggregate in cold asphalt mix. As we have seen the use of RA as Subbase has a huge potential for road construction. 9 These recycled materials are not affected by weathering, abrasion, physical and chemical change hence very

much suitable for sub-base layer in pavement construction.

in this article he provide Detailed About That of Recycling Facility in Delhi, India Along with Technology Used in Other Countries Like Japan, Korea Etc. This Paper Also Elaborate On Recyclin Recycling Potential of These C&D Waste, Challenges in Processing and Using C&D Waste and Finally Guidelines for Sustainable Use of These Waste. Urbanization Is Putting Huge Pressure for The Efficient Utilization of The Existing Land Old Structures Are Being Demolished for Proving the Way to New and Modern Structures. Huge Amount and Disposal of This Construction and Demolition (C&D) Waste in Sustainable Manner Is the Biggest Challenge Today. Every Year Around 3000 Mmt(Million Metric Tons) Of Waste Is Produces in European Union, Out of Which 30% Of Total Waste I.E. Around 900 Mmt Is Generated by Construction Industry Alone in The Form Of C&D Waste ([1]Bravo Et. Al. 2015, [2] Tergal 2013). In United States Estimate Production of C&D Waste Is Reported Around 140 Mmt per Year ([2] Tergal 2013). In Developing Countries Like India and China There Is a Substantial Rise in This C&D Waste as Reported Around 14 Mmt Is Generated in Shanghai, China Alone In 2012 ([3]Ding And Xiao 2014) Out Of The Total Waste Around 80 % Consists Of Concrete, Bricks And Blocks.

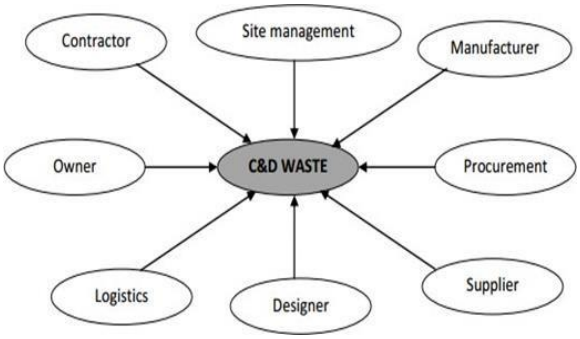
This paper studies revealed that C&D waste is a real problem in the construction industry in all over the world and it averaged to 20-30% of total waste. Various research done by various organizations to identify the causes for waste, method for waste minimization, reuse of waste, recycling of waste and finally to develop a waste management plan. Waste minimization can be done in pre-construction stage and during construction. Heavy equipment's are used by developed countries to recycle C&D waste and by-products are used to produce minor construction items. Standards and specifications have been developed by some countries as to motivate recycling of waste and use them as raw materials for other constructions. Waste management plan basically consists of waste reduce, reuse, recycle and disposal (landfill). Waste auditing: monitoring, people awareness and people training are important factors in developing a waste management plan.



5. SOURCE OF WASTE GENERATION IN CONSTRUCTION INDUSTRY

All over the world, the growth of construction industry is enormous in the past decade. The pace of generation of C&D waste is also significant. In general, there are two sources for generation of waste materials, namely, bulk generators and retail or small generators. the classification of sources is given in fig 1. the infrastructure development sector and real estate sector are the bulk generators of waste. construction and repair of roads, bridges, flyovers etc. are classified under infrastructure development sector. real estate sector consists of housing, industrial, and commercial building construction, demolition of unauthorized structures etc. small commercial enterprises and individual house building teams are considered as retail or small generators. the contributors of c&d waste in a paper are given in the paper activities are to be planned at every stage by every personnel, who are involved, to minimize the overall waste generation. construction industry is largest economic expenditure in India. according to eleventh five-year plan, it is the second largest economic activity after agriculture. the impact caused to the environment by Indian construction industry is also large. construction industry consumes high volume of raw materials and products. it generates high employment opportunity. based on an analysis of the forward and backward linkages of construction, the effect in the construction on economy is estimated to be significant the boom in the economic growth in the country is attributed to the developments in the construction industry. investment in construction accounts for nearly 11 per cent of India's gross domestic product (GDP). our

construction sector is likely to continue to record a higher growth rate in the years to come due to the government's recent initiative to allow cent per cent foreign direct investment in real estate development related papers. based on the studies done by technology, information, forecasting and assessment council –tifac (2000) the total construction works in the country for the five years during 2006-2011 has estimated to be for $847 billion. from the cost analysis of various modes of expenses in indian construction industry, it has been seen that the component of material cost comprises nearly 40 to 60 per cent of the paper cost. the material waste generation in construction industry is huge in monetary terms.



6. CLSSIFICATION OF MATERIAL

classification of wastes: -

- recyclable waste
- non- recyclable waste,

recyclable waste:-

1. plastic:-
   a. there is an overabundance of waste plastic.
   b. it is very difficult to dispose plastics.
   c. waste plastics can be shredded & used as filler in other materials such as concrete & also in construction of roads.
2. steel:-
   a. steel is most commonly used metal in the world.
   b. steel reinforcement from demolished concrete is usually separated from the rubble on site & sold scrap to recycling plants.
3. bricks:-
   a. broken & discarded brick can be used as construction infill or as aggregate for non-structural concrete.
   b. brick masonry rubble contains mortar up to 20% by volume.

non–recycled waste:-

1. concrete:-
   a. concrete is one of the most important construction materials.
   b. approximately one ton of concrete is used per capita per year throughout the world.
2. timber:-
   a. it is mostly crushed into chip & used as fuel.
   b. it can also be utilized to manufacture wood-chip concrete by injecting cement grout into voids of compacted wood chips in mold.
   c. wood-chip concrete can be used as building material.
3. sanitary ware:-
   a. Sanitary ware includes tiles also.
   b. There can be reused as it is, if they are not damaged.
   c. If sanitary ware are chipped or cracked otherwise damaged are advised to crush and use them as construction infill or as filler in concrete.

7. ROLE & RESPONSIBILITY OF PERSON INVOLVED IN DEMOLITION AND 3R'S PROCESS

After deconstruction of building various department role are play role for reusing, reducing, recycling, of building deconstruction material waste management plan for successfully recycling of the deconstruction waste

Roles and responsibility

Government Role

Some important roles of government rules for waste management:

1. Municipal Corporations, Municipalities should frame Rules & Regulations for C&D Waste
2. Civic Bodies should provide a facility for collection and disposal of C&D waste and charge a reasonable amount for the same
3. Civic Bodies can also charge builders/contractors who are willing to buy C&D waste for construction purposes
4. A collection center should be established and managed by the municipality for construction and demolition waste in each town/ village
5. A separate department in the municipal bodies.

6. Awareness among the builders and contractors should be increased
7. Private entities setting up C & D recycling units should be given tax breaks
8. Demolition permit itself can have a clause for waste recycling.

Architects Role:-

Architects have a key role to play in the initial decision to use demolished materials and in helping clients make this decision. Initial reaction of owners, and future building users, is often negative; the image of "building with garbage" often comes to mind.

The decision as to what level of use of demolished material should be determined based on the following criteria:-

- The size of the proposed building. Because of the nature of the supply of demolished materials and the different acquisition process involved demolished materials are most easily, and cost effectively, obtained in relatively small volumes. Greater and more efficient use can therefore be achieved in smaller buildings.
- Previous experience of the design team and contractor, with the use of demolished materials. Knowing how and where to located and acquire demolished materials can improve the efficiency and cost effectiveness of the process.
- Time available during both design and / or construction phases, to locate and acquire demolished materials.
- Type of construction of the building. Wood and wood products represent the largest category of demolished materials; buildings permitted by code to be of combustible, or heavy timber construction, offer the best opportunities for demolished materials use.
- The level of implementation of other environmental strategies. On small to medium sized papers using combustible construction, up to 25% use of demolished materials can be easily achieved. Achieving higher percentages will require more effort and time, although goals of 50 or 75% are realistic.

Demolition contractor:

They work on the ideology of demolition, although they may also carry out some deconstruction, and sell the more valuable materials such as heavy timbers, to demolished contractors, or specialty sub-contractors.

Demolished contractor/ demolished building material Supplier:

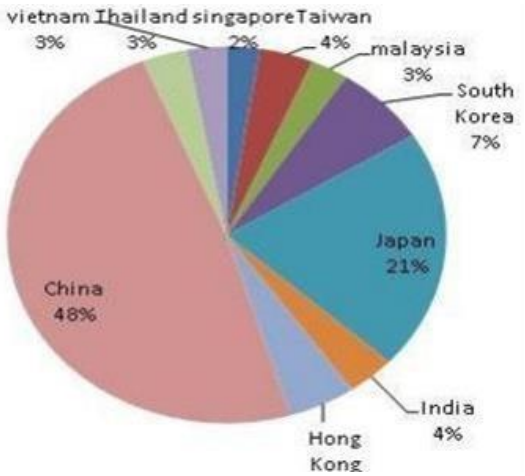
The terms demolished contractor and demolished building materials supplier refer to the two aspects of acquiring and selling materials. In some cases, they may contract to selectively deconstruct portions of the building, and remove particular materials themselves, but usually the demolition contractor removes the material from the building and sells them to the demolished contractors.

Specialty suppliers / Brokers:

They purchase specific demolished materials, particularly those with high value, such as heavy timbers. In many cases demolition contractors, and even demolished contractors who have their own yards, will sell directly to these companies.

Global snapshot of construction & demodulation waste management

Asian institute of technology of Thailand had conducted a survey in various Asian countries; Bhutan, Japan, Hong-Kong, China, Thailand and India prepared a report regarding the construction and explosion waste management in May 2008. The following chart shows the status of construction and demolition waste in Asian countries. Fig- 3: Estimates of C&D Wastes in Some Asian countries (Asian Institute of Technology, „Report on reduce, reuse and recycle (3R) practices in construction and demolition waste management in Asia", Thailand, May 2008) From the report of Ministry of Environment and Forest in 2008 estimated that 0.53 million tone's/day of wasteis generated in the country. On that basis the 210 million tons of MSW are produced annually, table 1 shows the estimate prepared by central government ofIndia. But as per the world bank report says Asian countries produces around about 1000kg per capita peryear, it means the figure which stated by the MoEF isvery less than the world bank report figure.



Use of construction waste in different countries

This show in India is underestimating the construction and demolition waste handling. The figure 2 with graphical representation shows construction and demolition waste production per day in Indian cities.

Table-1: Estimate Prepared by Central Govt.

year	Authority	Estimate in Million Tonnes
2000	Ministry of Urban Development(2000)	10—12
2001	TIFAC (2000)	12—15
2010	Ministry of Environment and Forest	10—12
2014	Ministry of Urban Development(2014)	no estimate exist

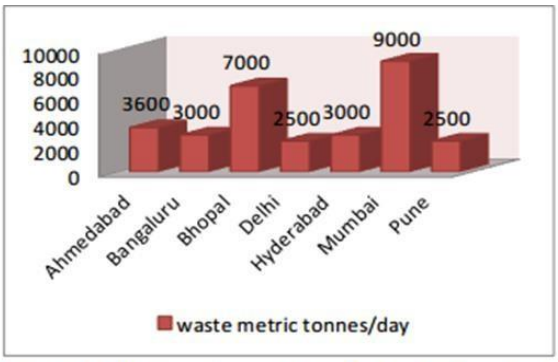


Chart -1: Waste Generated in Indian Cities Source (nexusnovus.com)

8.CONCLUSION

After completing paper, the, in a broader sense we can come to some conclusions:-

1. Regional factors are responsible for most non-recyclable materials, and many non-recyclable materials will become recyclable and can be reused if building's location changed.
2. There are always multiple obstacles for a single item.
3. Some obstacles are leading ones. If we can break these leading obstacles, non-recyclable materials will become recyclable even though other obstacles still exist; many responsibilities of recycling and reusing on site have been put onto contractors, while the designers' role in reusing has always been omitted. As primary participants in the first stage of a paper, designers' action can change the outcome of recycling tremendously. If designers can deliver a recyclable design, it will be very easy for contractors to do their job and fulfill the goal of reusing. Using more recyclable materials and making building more deconstruct able can make designs more reusable and recyclable.
4. Contamination is another major obstacle which prevents many materials from being recycled.
5. Increasing people's willingness for recycling can help to conquer most obstacles. In current construction practice.

9.ACKNOWLEDGMENT

We are very thankful to Dr Ulhas Shiurkar (Director DIEMS,Aurangabad) and Dr. Gajendra Gandhe (HOD DIEMS,Aurangabad) for providing platform for the project also each one who supported us during the journey of paper.

REFERENCE

[1] G. O. Young, "Synthetic structure of industrial plastics (Book style with paper title and editor)," in Plastics, 2nd ed. vol. 3, J. Peters, Ed. New York: McGraw-Hill, 1964, pp. 15–64.

[2] W.-K. Chen, Linear Networks and Systems (Book style). Belmont, CA: Wadsworth, 1993, pp. 123–135.

[3] H. Poor, An Introduction to Signal Detection and Estimation. New York: Springer-Verlag, 1985, Ch. 4.

[4] B. Smith, "An approach to graphs of linear forms (Unpublished work style)," unpublished.

[5] E. H. Miller, "A note on reflector arrays (Periodical style— Accepted for publication)," IEEE Trans. Antennas Propagate., to bepublished.

[6] J. Wang, "Fundamentals of erbium-doped fiber amplifiers arrays (Periodical style—Submitted for publication)," IEEE J. Quantum Electron., submitted for publication.