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# "COST BENEFIT ANALYSIS OF BUILDING DEMOLITION WASTE MANAGEMENT IN CONSTRUCTION PROJECTS: ACASE STUDY OF NASHIK CITY"

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***Abstract:*** This study has been undertaken to investigate the determinants of stock returns in Karachi Stock Exchange (KSE) using two assets pricing models the classical Capital Asset Pricing Model and Arbitrage Pricing Theory model. To test the CAPM market return is used and macroeconomic variables are used to test the APT. The macroeconomic variables include inflation, oil prices, interest rate and exchange rate. For the very purpose monthly time series data has been arranged from Jan 2010 to Dec 2014. The analytical framework contains. This report presents a study of building demolition waste disposal practices in the construction sector of the city of Nasik. The scope was limited to housing construction and skyscrapers. Reuse and recycling possibilities were characterized using descriptive statistics. We will investigate two buildings for cost-benefit analysis before and after the use of demolition materials. Due to the rapid growth of cities and communities, the generation of demolition waste is increasing. The construction industry has increased dramatically due to the economic growth of development and rehabilitation projects in the countryside and the subsequent progress of urbanization, but in the case of urban waste, the construction of demolition waste will have an impact on the environment. It is becoming more and more important. management. Environmental problems such as rising flood levels due to illegal dumping of construction and demolition waste into rivers, depletion of resources, lack of landfill, and illegal dumping on hillsides are evident in metropolitan areas. The research report emphasizes the importance of recycling construction waste and raises awareness of waste management issues and the availability of recycling techniques. Scientific management of construction and dismantling waste is an important challenge to mitigate environmental risks such as air pollution, land degradation and groundwater pollution. The current situation suggests that federal stakeholders remove aware and are enacting new policies, regulations, and programs. At the Nashik city level, only limited progress has been made and some obstacles remain. The rapid urbanization of India will result in an exponential increase in the amount of building demolition waste generated and a shortage of resources for construction. As we have seen, building demolition waste poses real environmental hazards, but when treated and converted to recycled materials, it also has the opportunity to reduce the extraction and use of unused aggregate, which is quickly depleted. Offers. Effective policymaking, regulatory enforcement, capacity building, and scientific waste management practices are powerful tools for achieving two goals. It should be mentioned here that there were some "outstanding islands" in India in the area of effective recycling of demolition waste and its use in its construction. Used to manufacture high quality concrete blocks and paving materials. This study analyzed the technical and financial options for developing business models based on pollutant burden principles, risk mitigation, and market-based pricing. You can choose the best business model based on the various scenarios presented. The continued role of the state and the ULB through political enablers and capacity building has been identified as an even more important success factor. Results for commercial and infrastructure projects show that the use of dismantling materials in construction can save 10.37% on housing projects and 11.98% on infrastructure projects. The cost-benefit ratios for commercial and infrastructure projects are 3.16 and 1.47, respectively.

***IndexTerms - Building Demolition Waste, Waste Management Practices, Cost Benefit Analysis, Reuse and Recycling, etc.***

## I. INTRODUCTION

India's construction industry is booming. It has grown 10% annually over the last decade, compared to the global average of 5.5%, and has already reached 10% of GDP. The building area is expected to increase almost five-fold from 21 billion square feet in 2005 to about 104 billion square feet in 2030. The United Ministry of Forestry and Environment (MoEF) acknowledges that there is no systematic database of construction and demolition waste. However, it can be inferred from the same data from the Technical Information Prediction Evaluation Council and the Center for Science and Environment. 2013 alone:

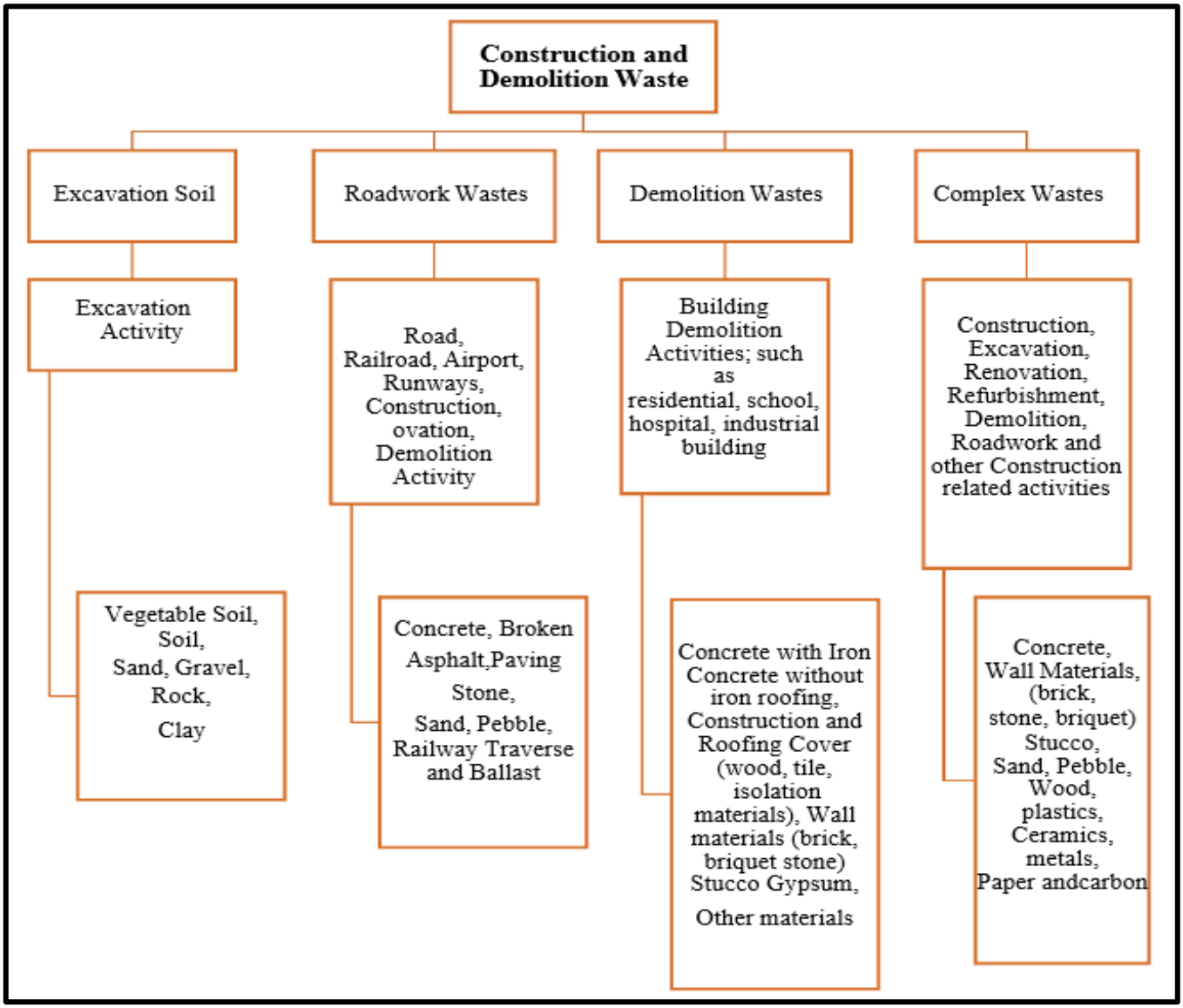
- India has built a new additional floor area of 5.75 billion m² since 2005. Of that, about 1 billion m².

- Approximately 50 kg of waste is generated per m² during construction. India must have produced 50 million tonnes of construction and demolition waste.
- Demolition produces 300-500 kg of waste per square meter. Demolition and reconstruction of 5% of existing building stock will generate approximately 288 tonnes of C & D waste annually.
- 40-50 kg per square meter. m Waste is generated by repairing the building. Repairing or refurbishing one-third of existing building stock will generate approximately 193 tonnes of construction and demolition waste.

In 2013 alone, a total of about 530 tonnes of construction and demolition waste was generated from buildings in India. This was 44 times the official estimate. This waste is illegally used to fill waters and wetlands around the city center for real estate development, and the rest is simply dumped into rivers and squares.

India produces 10-12 million tonnes of construction, demolition and excavation materials annually. The traditional Indian practice is to dump this waste in landfills or illegally in rivers and waters. According to the Central Public Health and Environmental Engineering Organization (CPHEEO), the Indian real estate industry alone faces a total shortage of 55,000 million cubic meters. In addition, a total of 750 million cubic meters is required to reach the goals of the road construction sector, which puts a great deal of pressure on natural resources.

Table 1: Sources of Construction & Demolition Waste Generators




### 1.1 Problem Description

The main purpose of this study is to investigate the real-time reuse and recycling of building demolition waste generated in residential projects (apartments and multi-story projects) in Nasik City. Encouraging the recycling and reuse of demolition waste in Nashik not only reduces the burden of consuming natural resources, but also reduces the embodied energy that can be significant. Therefore, the project statement looks like this**: "Cost-Benefit Analysis of Building Destruction Waste Management in Construction Projects: A Case Study of the City of Nasik".**

### 1.2 Scope of Survey

The report focuses primarily on the reuse of C & D waste generated during new construction, demolition and refurbishment in building practices focused on the Indian situation. Current construction and demolition waste management practices and the benefits of reusing this waste are shown to support the theme.

a) Reduction of construction and demolition waste: The less waste, the fewer disposal facilities and the less environmental problems. Redevelopment of existing structures, not planned demolition. Instead of demolishing a building, use demolition techniques.

b) C & D Waste Reuse: No further treatment is required to turn it into a useful product. Those that can be used directly are sorted from the rubble and can be used without further processing.

c) Recycling of construction waste and demolition waste: After the construction waste and demolition waste are separated and the reusable items are removed, the rest can be used for further processing, that is, recycling.

### 1.3 Objectives of the Study

a) To estimate different buildings of Nashik city before and after use of demolition waste materials.
b) To analyse cost benefit of building demolition waste in different construction projects.
c) To implement the use of recycling materials of building demolition in different construction projects in Nashik city.

## II. LITERATURE REVIEW

**Muluken Y. et. al. [2012]** studied an overview of construction and demolition waste management in Canada: A life cycle analysis approach to sustainability. The construction and demolition (C&D) waste generated by the Canadian construction industry accounts for 27 % of the total municipal solid waste disposed in landfills. However, it was evident that over 75 % of what the construction industry generates as waste has a residual value, and therefore could be recycled, salvaged and/or reused. This paper concluded a conceptual C&D wastemanagement framework to maximize the 3R (reduce, reuse and recycle) and minimise the disposal of construction waste by implementing sustainable and comprehensive strategy throughout the lifecycle of construction projects.

**Thomas J. et. al. [2013]** conducted study on construction waste management in India. Themanagement of construction waste is important today. This paper enlightened the importance of reduce, reuse and recycle (3R) concept for managing the construction waste in India. The exploitation of potentialresources from construction and demolition (C&D) wastes was yet another opportunity and future profession in the construction industry in India. Waste minimization and waste management programs were in its infancy in India. It was possible to minimize the volume of C&D waste generated by identifying the potential waste early in the design.

**Rawat A. et. al. [2014]** studied management of construction and demolition waste materials. Therewere tremendous increments in construction and demolition activities in last two decades due to emergence of new technologies and materials. The old structures were demolished after completion of lifespan and replaced by new construction works.

**Shishir B. et. al. [2014]** studied a sustainable approach towards the construction and demolition waste. Reduction of this demand in a small way is possible with the reusing or recycling of construction and demolition waste generated from the construction activities. Hence, the construction sector must accept the use of C& D waste wherever feasible. The Municipal bye-laws are required to be reviewed and suitably modified. Establishment of effective strategies and enactment of laws and regulations are essentialto achieve this. In addition, provisions of some incentives to users of the recycled products are necessary to promote.

**Cheng J. et. al. [2015]** studied construction and demolition waste management using BIM technology. The amount of waste generated in construction and demolition (C&D) processes is enormous. Construction wastes are mainly generated due to improper design, poor procurement and planning, inefficient material handling, residues of raw materials, and unexpected changes in building design. Building information modelling (BIM) can efficiently manage the C&D waste by avoiding design problems, changes, and rework. This paper investigated the potential of BIM technology for supporting building design and construction processes to manage C&D waste.

### 2.1 Concluding Remarks

Based on the critical review of literature, the principal aim of this study is to analyze cost benefit of building demolition waste management in Nashik city residential (housing and multi-story) projects. Promotion of recycling and reusing of building demolition waste in Nashik will not only reduce the burden on the consumption of natural resources, but it will also reduce the embodied energy, which may become significant. The research will encourage the new approach in recycling and reuse of building demolition waste management. The study surely is a step forward in the right direction to achieve safety andeconomical methods for construction projects in Nashik city. And it is also helpful to reduce pollution due to building demolition waste.

## III. Research Methodology

The methodology adopted to achieve the aims and objectives of the study, details of the methods used, and the different procedures applied to investigate various methods for reuse and recycling of building demolition waste management.

### 3.1 Methodology and Process for Systematic Assessment of C&D Waste in Nashik City

As with the rest of the country, neither the urban local bodies in Nashik nor the Nashik Municipal Corporation Pollution Control Board (NMC PCB) had readily available authentic data on the volume nor the composition of the construction waste generated in Nashik. Therefore, after deliberations with stakeholders, it was agreed that the best possible method to estimate the volume and stream of waste generation from construction waste activities was to derive the same from the three main streams of construction waste. These three streams included construction activity, demolition activity and refurbishment of hotel rooms, a large sector requiring frequent renovation and hence significant contributor to overall construction waste in Nashik. As a starting point in the data collection drive, more than 20 key stakeholders of the Nashik construction industry were identified, and meetings conducted. This included three ULBs, the planning departments (Town Planning Department Nashik), various Government development agencies such as Maharashtra Industrial Development Corporation (MIDC), Nashik Tourism Development Corp, Nashik Public Works Department, Nashik Municipal Corporation Pollution Control Board, Building material suppliers such as Cement companies,

RMC suppliers, Concrete pavers and blocks manufacturers and suppliers of vitrified and ceramic tiles, demolition contractors and debris transporters. Detailed discussions with key individuals and organizations provided an understanding of the construction market of Nashik, type of building materials used and construction practices in urban and rural areas of Nashik, the current and the potential areas for future growth, the demolition methods and disposal means for the debris.

The location of the RMC and precast companies and the waste generated at the plant and supply site was mapped to identify the volume and the geographical distribution of the waste. A detailed list of all hotel units in Nashik, with their location, from the single room facilities to the large 500 room hotels was collected and their cycle of refurbishment studied, along with the composition of the waste generated per square metre of refurbishment. Builders, architects and contractors were consulted to obtain an accurate estimate of the average waste generated in the construction phase of different building materials, from concrete and blocks to plumbing materials, electrical cables, packing materials, bathroom fittings and accessories. The discussions with the demolition contractors and the debris transporters critical inputs on the demolition process, composition of the debris, the peak season for demolition activities, transportation and disposal means adopted, including prices charged.

### 3.2 Experimental Strategy

The different phases of this project of work are shown in the following diagram. The figure simply describes the experimental strategy of this study step by step.

a) Review the existing literature and identify different construction projects,
b) Select different projects from Nashik city for conducting study on building demolition wastemanagement,
c) Estimating cost of construction projects before use of building demolition waste materials,
d) Estimating cost of construction projects after use of building demolition waste materials,
e) Cost benefit analysis of different construction projects before and after use of buildingdemolition waste materials,
f) Implementation of use of recycling materials of building demolition in different constructionprojects in Nashik city,
g) Performing questionnaire survey on construction site,
h) Interpretation of results and conclusion.

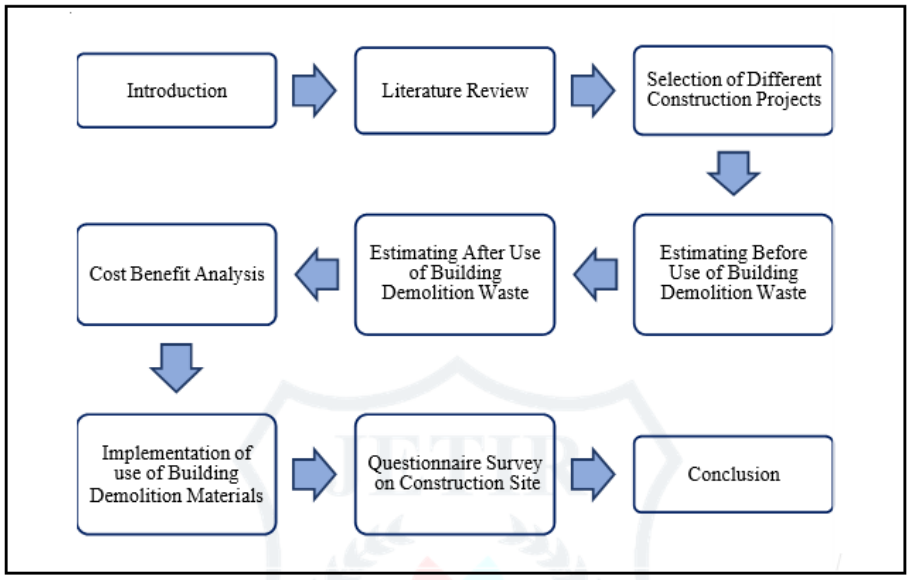



Figure 1: Layout of the system

### 3.3 Secondary Data Collection

Nashik is estimated to generate about 50-100 tonnes per day (TPD) of construction and demolitionwaste. To address the Construction & Demolition waste, NMC has

a) NMC has prepared a DPR to understand quantity, quality and sources of C&D waste,
b) Consultation with various stakeholders and understanding their concerns,
c) Developed separate tenders for collection and transportation as also for processing anddisposal of C&D waste District administration has already allocated land at Nashik East, Nashik West, NashikRoad, Satpur, Cidco and Panchavati for C&D waste processing.

The Nashik Municipal Corporation's (NMC) bid to appoint a private agency for collection and transportation of construction and demolition waste in the city has received poor response. Not a single agency has come forward for the bidding, forcing the municipal corporation to extend the date of submission by a period of 15 days. The date has now been revised from December 20 to January 5. The NMC had recently floated a bid for collection, transportation, procession and management of construction and demolition waste in the city on design, build, operate, transfer (DBOR) basis along with the on-site recycling facility. The NMC will provide land for recycling the waste.

"The last date for submission of the bid was set at December 20; however, the NMC did not receivea positive response. Hence, the date for submission of bids has now been extended by another 15 days," an NMC official said. Disposing the debris from demolition and construction has become a major issue in the city. The civic body has received a number of complaints against debris being disposed on roads. Taking serious cognizance of the situation, the municipal corporation has come up with a solution of appointing a private agency for collection and transportation of the construction and demolition waste on the on-site recycling facility. "The civic administration has noproper management or disposal system for construction and demolition waste. There have been

regulations of the central ministry in this regard. As per the government guidelines, we are planningto manage and recycle construction and demolition waste through private agency," the official added.

Table 2: Different Constituents of C&D Waste Generation in Nashik

| Constituent | % of C&D Waste Distribution |
|---|---|
| Building | 45-50 |
| Roads | 15-20 |
| Bridges | 8-10 |
| Power | 5-8 |
| Railway | 8-10 |

The construction waste which is not usable or cannot be recycled is to be placed at the dumping ground as identified by the municipal corporation. The list of dumping grounds in all six divisions will be given to the contractor beforehand. There are six divisions of the municipal corporation Nashik East, Nashik West, Nashik Road, Satpur, Cidco and Panchavati. The Public Works Department (PWD) of the NMC has selected a few locations across all six divisions for dumping the debris.

## IV. RESEARCH ANALYSIS

**Project 1:** Ganadhish Park, Indira Nagar, Nashik: Residential Project

a) Name of Building: Ganadhish Park
b) Name of Contractor: Shree Hari Krushna Developers
c) Location: Ganadhish Park, Near Ashoka Medicover Hospital, Indira Nagar, Nashik – 6
d) Type of Structure: G+1 Structure
e) Construction Year: 2022

**Project 2:** Trimbak Naka to Ashok Stambh Road, Nashik: Infrastructure Project

a) Name of Project: Trimbak Naka to Ashok Stambh Road
b) Name of Contractor: B. G. Shirke Constructions
c) Location: Trimbak Naka to Ashok Stambh Road, Nashik – 2
d) Type of Structure: Infrastructure Project
e) Construction Year: 2020

### 4.1 Cost-Benefit Analysis

The cost-benefit analysis compares the costs and benefits of a project and then makes a decision on whether or not to proceed with the project. The project's costs and benefits are measured in monetary terms after adjusting for the time value of money, thus providing a true picture of the costs and benefits. Net Present Value and Benefit-Cost Ratio are the two most common methods of doing a cost-benefit analysis. The NPV model chooses the project with the highest NPV. The benefit-cost ratio model chooses the project with the highest benefit-cost ratio.

Table 3: Saving in Cost of Project 1: Ganadhish Park

| Sr. No. | Item | Cost in Rupees |
|---|---|---|
| 1 | Estimating Cost before Use of BuildingDemolition Waste Materials | 1,792,460.00 |
| 2 | Estimating Cost after Use of BuildingDemolition Waste Materials | 1,606,493.0 |
| 3 | Saving in Cost | 185,967.00 |
| 4 | **% Saving in Cost** | **10.37 %** |

Table 4: Saving in Cost of Project 2: Trimbak Naka to Ashok Stambh Road

| Sr. No. | Item | Cost in Rupees |
|---|---|---|
| 1 | Estimating Cost before Use of BuildingDemolition Waste Materials | 124,847,739.80 |
| 2 | Estimating Cost after Use of BuildingDemolition Waste Materials | 109,880,432.40 |
| 3 | Saving in Cost | 14967307.41 |
| 4 | **% Saving in Cost** | **11.98 %** |

### 4.2 Calculation of Cost-Benefit Analysis

Table 5: Benefit Analysis of Project 1: Ganadhish Park

| Sr. No. | Item | Cost in Rupees |
|---|---|---|
| 1 | Estimating Cost before use of BuildingDemolition Waste Materials | 1,792,460.00 |
| 2 | Estimating Cost after use of BuildingDemolition Waste Materials | 1,606,493.00 |
| 3 | Per sq. ft. Cost | 3000.00/- per sq. ft |
| 4 | Total Sellable Area (7.69 x 10.24 m) | 847.30 sq. ft |
| 5 | Total Sellable Cost / Total Benefit | 5,083,800.00 |
| 6 | Saving in Cost | 185,967.00 |
| 7 | **Benefit- Cost Ratio** | **3.16** |

Table 6: Benefit Analysis of Project 2: Trimbak Naka to Ashok Stambh Road

| Sr. No. | Item | Cost in Rupees |
|---|---|---|
| 1 | Estimating Cost before use of BuildingDemolition Waste Materials | 124,847,739.80 |
| 2 | Estimating Cost after use of BuildingDemolition Waste Materials | 109,880,432.40 |
| 3 | Total Benefit | 161,504,998.00 |
| 4 | **Benefit- Cost Ratio** | **1.47** |

### 4.3 Result and Questionnaire Survey

For this research, the target population is from employees at Nashik. There are 100 questionnaires were distributed to all level of employees, but only 75 questionnaires were received. Data was collected using the questionnaire. The questionnaire consists of 7 item questionnaires. Responses noted from different peoples from different construction sites.

Table 7: Response of Questionnaire Survey

| Question No. | Yes | No |
|---|---|---|
| 1. Have you used demolition waste on construction site? | 9 | 41 |
| 2. Have you used recycled aggregates in construction? | 2 | 48 |
| 3. Have you used recycled timber in construction? | 3 | 47 |
| 4. Have you used recycled steel in construction? | 4 | 46 |
| 5. Have you used recycled pipes and wires in construction? | 2 | 48 |
| 6. Have you used concrete debris in construction? | 20 | 30 |
| 7. Do you know about Construction and Demolition Waste Management Rules,2016? | 5 | 45 |

## V. CONCLUSION

a) At the Nashik city level, there has been limited progress and several barriers still exist. India‟s rapid urbanization will lead to an exponential increase in the volumes of the building demolition waste generated and resource shortage for construction.

**b)** Building demolition waste poses a real danger to the environment as we have seen earlier, but when treated and converted to recycled materials it also provides an opportunity to reduce the extraction and use of virgin aggregates that are depleting rapidly.

**c)** The result of commercial project and infrastructure project shows that if we use building materials in construction then we can save 10.37 % cost in residential projects and 11.98 % cost in infrastructure projects. Also benefit-cost ratio for commercial project and infrastructure projects are 3.16 and 1.47 respectively.

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