

# Material Wastage Minimization & Management in Building Construction Project at the Baroda

<sup>1</sup>Habtamu Miju Teshome, <sup>2</sup>Abhishek Singh Thakur

<sup>1</sup>PG Student, Dept. Civil Engineering, Parul University, Gujarat, India

<sup>2</sup>Assistance professor, Dept., Civil Engineering, Parul University, Gujarat, India

**Abstract:** Construction industry has been developing rapidly throughout the world. The development has led to serious problem in generation of construction wastes in many developing countries and expectation of the natural resources to large extend. The construction wastes have greater impact to environment, economy and social of each world country. However, this environmental problem may be minimized by introducing a systematic planning and management of construction wastes. This construction industry is an industry, which is involved in the planning, execution, evaluation, controlling and monitoring of all types of civil works. Physical infrastructures such as buildings, communication & energy related construction works, water supply & sewerage civil works etc. are some of the major projects or program in the construction industry. This construction industry consume substantial amount of raw materials in the process and the output is obviously the product and most importantly the waste material in construction project. So this study is focuses to determine the use of waste minimization technique in creating sustainable waste management in order to identify the technique which has the most capabilities to reduce waste on-site. Effective site management is increasingly recognized as the strategic approach for achieving the required performance in construction projects. This is due to the understanding that effective site management is a key requisite for achieving key project performance indicators such as time, cost, quality, and waste and safety target, among others.

**Keywords:-** Construction material, Management, Construction Waste, Construction techniques, Environment, Causes and sources of waste, Waste managing & Waste minimization and benefits of waste minimize.

## 1. INTRODUCTION

Construction industry is an industry, which is involved in the planning, execution, evaluation, controlling and monitoring of all types of civil works. Physical infrastructures such as buildings, communication & energy related construction works, water supply & sewerage civil works etc. are some of the major projects or program in the construction industry. This construction industry consume substantial amount of raw materials in the process and the output is obviously the product and most importantly the waste material in construction project. Other than that, construction industry or project is well known as one of the most worst environmental polluters. Construction waste occurs during the actual construction activities, there is an understanding that it is caused by activities and actions at design, materials procurement and construction stages of project delivery processes. This study investigates the material waste at design, material procurement, material handling and operation measures for minimizing and managing waste generated by construction activities. To assess or evaluate the waste minimization techniques taken from the three R concepts which is reduce, reuse and recycle technique in minimizing the waste in construction site waste management. Effective site management is increasingly recognized as the strategic approach for achieving the required performance in construction projects [1]. This is due to the understanding that effective site management is a key requisite for achieving key project performance indicators such as time, cost, quality, and waste and safety target, among others.

## 2. OBJECT OF RESEARCH

To study the current situation of managing and minimizing wastage of construction material on building construction projects and gives recommendations with respect to handling of construction materials in accordance with the outcome of the thesis.

- ✚ To identify the key factors and source of construction materials wastage on building construction projects.
- ✚ To identify impacts of construction materials wastage on building construction and Environment.
- ✚ To identify the most wasteful material produced during construction operations.

### 2.1. SIGNIFICANCE OF THE RESEARCH

This research is significant in that it may help the people engaged in the construction industry how they can managing and minimize wastage of construction materials while they produce, transport and stored at construction site. In addition, this study intends to provide some frame work for the development of policies and rules in the management of construction waste.

### 2.2. SCOPE OF THE RESEARCH

This research will limited and focuses on building construction projects in Baroda which has project cost will more than 50 million Rupees with managing the flow activities of materials storage and handling and minimizing wastage of construction materials problems in which most of them are under construction. Surveys in the forms of questionnaires, site visit and personal interviews will conduct with the proponents who will undertake referenced projects

### 2.3. BENEFICIARIES OF THE RESULTS

- ✚ Construction parties like clients, consultants, project manager and contractors.
- ✚ Educational institutions, which use the information for academic purposes.
- ✚ Private/governmental organizations or construction firms that use the data for construction purposes in order to minimize and avoid the wastage of construction material in building construction project.
- ✚ Future studies in construction management and related topics.

### 3. LITERATURE

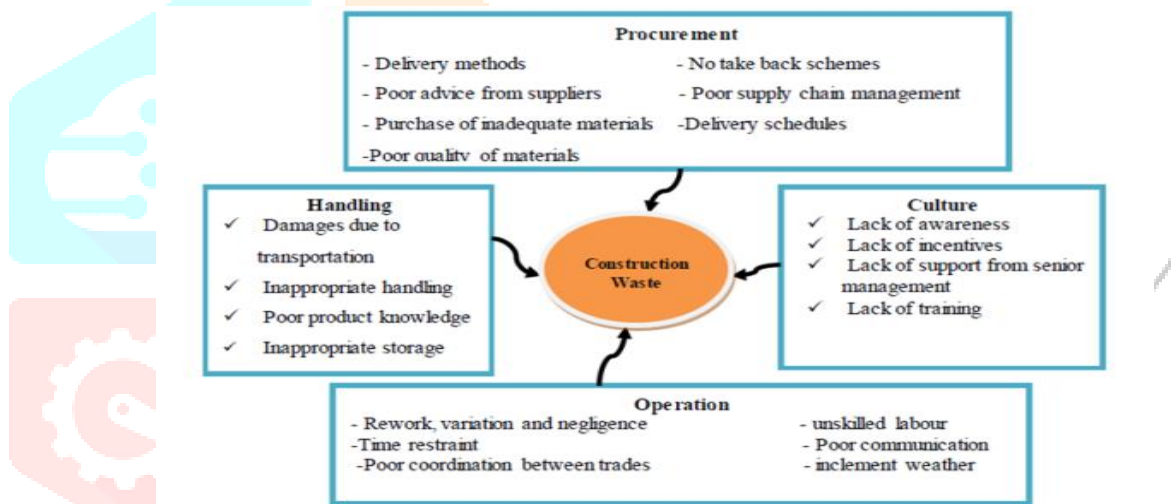
Construction industry is an industry which consume high amount of raw materials in the construction process and the output is obviously the product that we did and most importantly the waste in construction material. Other than that, construction industry is well known as one of the worst environmental polluters. This study is to determine the use of waste minimization technique in creating sustainable waste management in order to identify the technique which has the most capabilities to reduce waste on-site. The suggestion was given by the researcher that material control should begin at the design phase so that treatment and movement of equipment and components of chosen sizes during construction can be successful and convenient [2]. Furthermore, waste is usually caused by a combination of events, and not due to an isolated factor. Research deals with the identification of most wasteful materials in construction operation and also they identified the top factors that have maximum contribution to material wastage on construction site [3].

#### 3.1. DEFINITION OF BUILDING MATERIAL WASTE

Construction waste has been defined in various ways. As the different researcher defined waste is difference between materials ordered and those placed for fixing on building projects. In 1981 another definition emerged about waste stating that waste is any material apart from earth materials, which needed to be transported elsewhere from the construction site or used on the site itself. Construction wastes in any project are in the form of building debris form demolition activities, rubble, earth material, concrete wastes, steel wastes and timber etc.

#### 3.2. FACTORS OF MATERIAL WASTE IN CONSTRUCTION

Different factors contribute to the generation of material waste. These factors have been grouped by Ekanayake & Ofori [2] under four categories: (1) design; (2) procurement; (3) handling of materials; and operation (4). As I think that the process of waste minimization must be started at the early stages of the project. The most frequent measures practiced to minimize and reduce material waste are staff training, adequate storage and just- in time delivery of materials are one of the most important.



The figure 1 shows Origins of construction waste.

#### 3.3. PRESENT SITUATION OF CONSTRUCTION WASTES

Due to least priority given to appropriate construction site waste minimization and management systems in Indian construction industries leads to generation of huge or large quantities of material waste every year. Presently, awareness of resource efficient construction practices is lacking in most countries [4]. Currently, existence of national policies as well as the regional policies, laws and regulations governing reuse and recycle principles for construction waste is minimal as far as India is consent [5].

At present, private contractors remove this waste to privately owned construction site, low lying land for a price purpose, or more commonly dumping it in unauthorized locations along roads or other public land or the region [6]. Central Pollution Control Board has estimated current amount of solid waste generation in India to the tune of 48 million tons per annum of which waste from Construction Industry accounts for 25% [6]. Recent studies as in pointed out the waste generated in China are around 40% and 39.27 million tons in Spain. Today, in most European countries use recycled materials up to 80–90% of the total amount of construction wastes and most advanced demolition and recycling technologies are generally implemented [7].

#### 3.4. CONSTRUCTION MATERIALS WASTAGE MANAGEMENT ON CONSTRUCTION PROJECTS

Construction materials minimization and management in construction projects one of the key functions that important contribute to the success of a project. The management of construction materials in construction projects is made challenging by materials shortages, delays in supply, price fluctuations, damage, just in time delivery and wastage, and lack of storage space. Construction materials management is one of the key functions for improving productivity in construction projects. The management of construction materials must consider at all the phases of the construction process and throughout the construction and production periods. This is because poor construction materials management and control can often affect the overall construction time, quality and budget. The important for planning, organizing, supervision and controlling of construction materials to ensure that the right quality and quantity of materials and installed equipment are appropriately specified in a timely manner, obtained at a reasonable cost, and are available when needed.

### 3.5. MATERIAL WASTE MINIMIZATION MEASURES

Waste mitigation, minimization and prevention management are sometimes used, interchangeably. Jacobsen and Kristofferson [8] in their report on waste minimization and reduction practices in Europe gave a clear distinction between the three R concepts and defined waste minimization in three options prioritized according to the waste hierarchy. The first major priority is waste prevention, the second is waste re-use and the third priority is waste recycle. Reducing the waste generated at source is considered as the first option out of 3R concept to be implemented for better protection of the environment and economic saving.

### 3.6. TECHNIQUES OF CONSTRUCTION MATERIAL MANAGEMENT

Construction materials management is categorized to 5 processes these processes are majorly followed on construction site they are namely 1.Planning, 2. Procurement, 3. Logistics, 4. Handling and 5 Waste control processes. Construction materials planning include quantifying, ordering and scheduling. Construction materials handling encompasses virtually all aspects of various movements of raw construction materials, work in process, or finished goods within a construction site [9]. For effective material management the most important construction materials management functions are Primary Functions: the primary functions of the construction materials management are defined as construction materials requirements planning (MRP), purchasing, inventory planning and control, ascertaining and maintaining the flow and supply of construction materials, quality control of construction materials, departmental efficiency. Research has shown that construction materials and equipment may constitute more than 65% of the total cost for a typical construction project [9]. There should be awareness about material planning & scheduling at every stage of material management.

### 3.7. ENVIRONMENTAL IMPACT OF CONSTRUCTION ACTIVITIES

Globally, the construction sector is arguably one of the most resource intensive industries. Concern is growing about the impact of building activities on human and environmental health. The construction industry and the environment are intrinsically linked and it has found itself at the center of concerns about environmental impact. Indeed, the construction industry has a significant irreversible impact on the environment across a broad spectrum of its activities during the off-site, on-site and operational activities, which alter ecological integrity. Construction activities affect the environment throughout the life cycle of a construction project. This life-cycle concept refers to all activities from extraction of resources through product manufacture and use final disposal or recycle, i.e. from —cradle to grave. Even though the construction period is comparatively short in relation to the other stages of a building's life, it has various significant effects on the environment. Therefore the analysis of the impact of the construction industry on the environment may need to look at a cradle to grave viewpoint.

## 4. METHODOLOGY

The general methodology of this study relies or depends largely on the survey questionnaire which will be collected from the local building contractors, project manager and client of different sizes by personnel meeting. A thorough literature survey was initially conducted to identify the waste management factor that affect the performance of construction industry as a whole. Also this chapter includes the methodology used in this thesis work and provides information about the research strategy and research design, research location, case study, questionnaire design, questionnaire content, and tests of reliability and validity of questionnaire and the last thing is the process of data analysis

### 4.1. RESEARCH STRATEGY

Research strategy is the overall plan for gating answers to the questions that will be studied and for handling some of the difficulties encountered or faced during the research process. Research design is an action plan for getting from here to there where here may be defines as the initial set of questions to be answers, and there is some set of conclusion (answers) about these questions. Between here and there are a number of major steps, including the collection and analysis of relevant data [10]. The structured questionnaire is probably the most widely uses data collection technique for conducting surveys to find out facts, opinions and views.

### 4.2. SOURCE OF DATA

Data for the research will be collects using both primary and secondary sources. The primary data are obtains through questionnaire direct to contractors, project manager,consaltant and client that are involve in Baroda district building construction projects. The secondary data are obtains from the internet, thesis, journals, books and different articles in published documents. The secondary data are uses to get an insight of the problem and are uses as criteria for developing and analyzing the primary data. . The research is both qualitative and quantitative in nature.

### 4.3. QUALITATIVE DATA COLLECTION

In this study, interviews are uses as it allows exploration of inter subjective opinion among the construction participant in order to arrive at common understanding of the participants. Carrying out data collection in a qualitative research, in-depth interview with construction participant. The advantage of the qualitative approach is that the information is richer and has a deeper insight into the phenomenon under study.

### 4.4. QUANTITATIVE DATA COLLECTION

The structured questionnaire is one of the most widely using data collection techniques for conducting surveys to find out facts, opinions and views. A quantitative data collection technique depends on random sampling and structured data collection instruments or techniques that fit diverse experiences into predetermined response categories.

## 5. ANALYSIS

The results that I have been obtained from survey questionnaires using Excel and statistical analysis. The results are prepared to present the information about the sample size, response rate and contracting companies' characteristics in Baroda. It also includes the ranking of factors affecting the waste on construction projects based on their Relative Importance Index ranks, in addition to the causes of waste in some important materials, magnitude of waste, waste minimization strategies and the relative significant of construction waste sources.

### 5.1. RESPONSE RATE

Totally 69 questionnaires distributed among different contracting companies like contractors, client and project manager 32, 16 and 21 questioners was distributed respectively among contracting company. Out of the 69 questionnaires distributed on the contracting companies, 61 responses were received with 88.41 % return rate in this study. The other 9 questionnaires as follows: 6 (8.69%) have not been received from contractor side, 1(1.45%) are not received form project manager and 1(1.45%) are illogical or incorrect responses, see Table.1.

Table 1 Response rates among the groups of contracting companies

| Construction participant | Responded No. | Response Rate (%) | Declined | Dropped  |
|--------------------------|---------------|-------------------|----------|----------|
| Contractor               | 26            | 42.62             | 6        | 0        |
| Project Manager          | 19            | 31.15             | 1        | 0        |
| Client/Ownr              | 16            | 26.23             | 0        | 1        |
| <b>Total</b>             | <b>61</b>     | <b>100</b>        | <b>7</b> | <b>1</b> |

Table.1above represents the response rates among the groups of contracting companies, these rates are 42.62% for contractor, 31.15% for project manager and 26.23% for Client or owner have been received from contracting company.

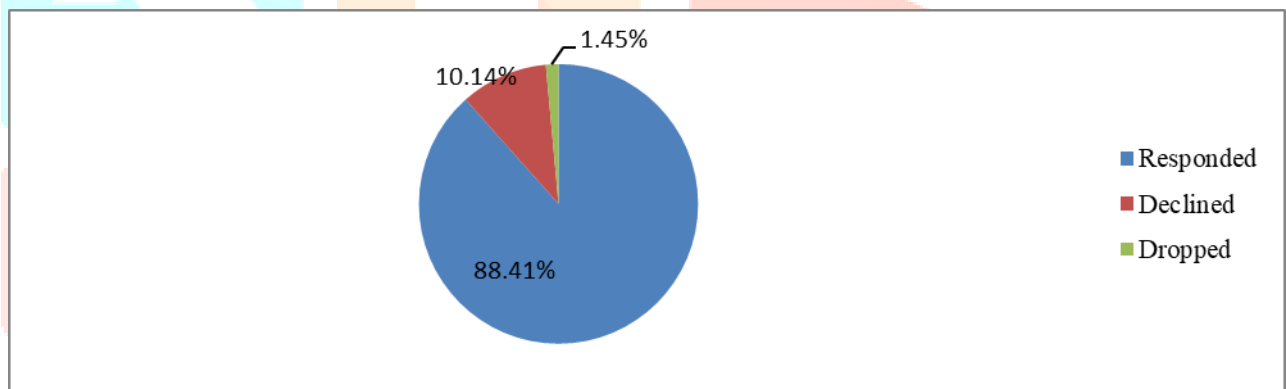


Figure 2 Questionnaire general response rate

### 5.2.

#### POPULATIONS YEARS OF EXPERIENCE

Table 2 shows the years of experience for the surveyed contracting companies in Baroda. About 88.33% of contracting companies have more than 20 years of experience and 19.67% of them have more than 30 years of experience. This gives a higher confidence in the quality of answers.

Table 2 Years of experience

| Years of experience | No. of Companies | Percent (%) | Cumulative Percent (%) |
|---------------------|------------------|-------------|------------------------|
| 1-10                | 21               | 34.42       | 34.42                  |
| 10-20               | 18               | 29.51       | 63.93                  |
| 20-30               | 10               | 16.40       | 80.33                  |
| >30                 | 12               | 19.67       | 100                    |
| <b>Total</b>        | <b>61</b>        | <b>100</b>  | <b>100</b>             |



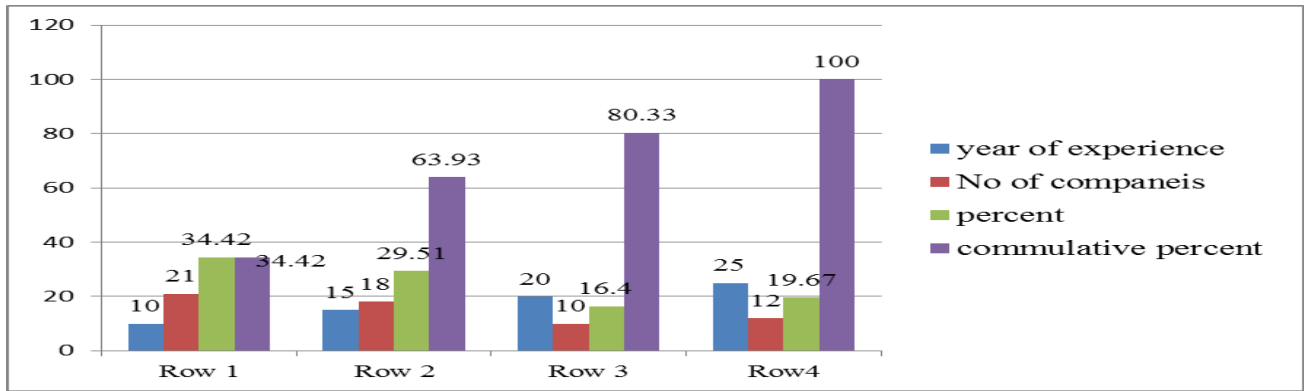


Figure 3 Years of experience, number of companies and percent

**5.3. VALUE EXECUTED PROJECTS DURING THE LAST FIVE YEARS**

The value of the executed projects during the last five years is illustrated in Table 3 (77.05 %) of the executed projects up to 200 million rupee, while 22.955% of them with more than 200 million rupee.

Table 3 Value distribution of the executed projects in term of rupee

| Value of projects | No. of companies | Percent (%) | Cumulative Percent (%) |
|-------------------|------------------|-------------|------------------------|
| 50-100 million    | 18               | 29.51       | 29.51                  |
| 100-150 million   | 14               | 22.95       | 52.46                  |
| 150-200 million   | 15               | 24.59       | 77.05                  |
| Above 200 million | 14               | 22.95       | 100                    |
| <b>Total</b>      | <b>61</b>        | <b>100</b>  | <b>100</b>             |

The results from analysis ranked from the first to fifth position by contractors, project manager and owners that the most significant factors causing construction waste on building construction projects are:- Design and documentation, Site management and practices factors, Materials handling and storage factors, and Operations factors are the following:-

**5.4. DESIGN AND DOCUMENTATION FACTORS**

The findings showing that in the first weighted average ranks value in Design and documentation factors as causes of materials wastage on building construction site by contractors, project manager and owners are due to “Selecting the lowest bidder contractors and subcontractor; Design changes and revisions; Lack of attention paid to standard sizes available on the market; Poor communication leading to mistakes and errors & Lack of knowledge about construction techniques during design activities are the first five major causes of materials waste had the highest weighted average rank 0.52, 0.51, 0.47, 0.46 and 0.45 in descending order respectively. The other causes or factor of waste includes “Lack of knowledge about construction techniques during design activities; Poor/wrong specifications; Selection of low quality products; Ambiguities, mistakes, and inconsistencies in drawings and Poor site layout and” had the lowest rank with weighted average rank value 0.40, 0.36, 0.35, 0.33 and 0.28 in descending order respectively.

**5.5. SITE MANAGEMENT AND PRACTICES FACTORS**

The findings showing that in the second ranks Site management and practices factors as causes of materials wastage on building construction site by contractors, project manager and owners due to “Lack of strategy to waste minimization; Lack of proper waste management plan and control; Poor coordination and communication between parties involved in the project and Ineffective planning and scheduling of the project by the contractor” had the highest four factors with average rank 0.51, 0.46, 0.45 and 0.44 descending order respectively. While “Shortage of technical professionals in the contractors organization; Poor provision of information to project participants’ technical staff assigned to the project and Poor site layout” had the lowest three factors with average ranks of 0.37, 0.36, and 0.29 descending order respectively.

**5.6. SITE SUPERVISION FACTORS**

The findings showing that in the third ranks the site supervision factor as causes of materials wastage on building construction site by contractors, project manager and owners due to “Change orders by owner; Poor coordination and communication between the consultant engineer, contractor and client; Slow response from the consultant engineer to contractor inquiries” had the highest three factors with average rank value 0.48, 0.42, and 0.40 in descending order respectively. While “Poor qualification of consultant engineers staff assigned to the project; Lack of supervision and delay of Inspections;” had the lowest two factors with average rank value of 0.37 and 0.33 in descending order respectively.

### 5.7. MATERIALS STORAGE AND HANDLING FACTORS

The findings showing that in the four ranks Materials storage and handling factors as causes of materials wastage on building construction site by contractors, project manager and owners due to “Poorly schedule to procurement the materials; Conversion waste from cutting uneconomical shapes and Over ordering or under ordering due to mistake in quantity surveys; Overproduction/Production of a quantity greater than required; Lack of onsite materials control; Using excessive quantities of materials more than the required and Poor storage of materials” with average ranks 0.48, 0.47, 0.42, 0.41 and 0.40 in descending order respectively. It has been noticed that the “Inadequate stacking and insufficient storage on site and Wrong storage of materials; Inappropriate storage leading to damage or deterioration and Lack of onsite materials control; Insufficient instructions about handling; Insufficient instructions about storage and stacking; Lack storage of materials near of construction site and Damage during transportation” are the lowest five factors that causing material waste with weighted average ranks value 0.38, 0.37, 0.36, 0.35, 0.33 and 0.31 in descending order respectively.

### 5.8. OPERATIONAL FACTORS

The findings showing that in the fifth ranks Operational factors causes of materials wastage on building construction site by contractors, project manager and owners due to It indicate that the highest five factors are “Rework due to workers’ mistakes and Shortage of manpower (skilled, semiskilled, unskilled labor); Lack of workers or tradesmen or subcontractors” skill; Poor workmanship; Using untrained labors and damage to work done caused by subsequent trades; damage to work done caused by subsequent trades” with ranks 0.46, 0.43, 0.42, 0.41 and 0.39 respectively. It has been noticed that the “Choice of wrong construction method; Use of incorrect material, thus requiring replacement; Equipment frequently breakdown; Poor technology of equipment” are the lowest five factors that causing materials waste with mean ranks 0.35, 0.34, 0.33, 0.27 and 0.26.

### 5.9. PROPOSED FURTHER STUDIES

- ✚ It is necessary to repeat this research every five years to observe the new trends of contractors.
- ✚ Researches about the technology of recycling waste and administrative mechanism for applying this technology to construction companies in Baroda are needed.
- ✚ Running new tests for all reused or recycled materials are needed to determine to what extent they fit with international standards.
- ✚ It's needed to develop a study concerning cost minimization alternatives base on minimizing construction waste and improving an efficient management practice in Baroda.

### 5.10. CONCLUSION

Construction waste management is required for a country to develop in a sustainable manner. It helps to address issues related to environment, social and economy. Once the causes of waste generation are identified, it can either be avoided or minimized to benefit the globe for better future. This study has identified significant factors contributing to waste in construction projects. By identifying the significant factors in construction process, construction players are able to notice the best ways to apply new practice for reducing material waste and cost in any project. From the study the factors that contribute to materials that are minimum wasted are identified. Also there is a need to concentrate even on materials that are least wasted as any small improvement in reduction of waste generated adds to the advantage in improving the overall efficiency of the project and enhance the construction industries performance with cost saving benefits.. It is very important to focus on the waste management plan. Changes in specifications also contribute to material wastage. It is important for the site manager to focus on material minimization strategies. This improvement in waste management plan not only minimizes the material waste but also improves the profitability and decreases the cost overrun.

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