SUSTAINABLE MANAGEMENT OF CONSTRUCTION AND DEMOLITION WASTE MATERIALS- 4 R STRATEGY (REDUCE, REUSE, RECYCLE AND REBUY)

Abstract

Waste from construction and demolition (C&D) falls under a subcategory with a low rate of material diversion and a wide range of possible uses for waste materials. The recycled materials have enough strength to be taken into consideration for reapplication in the construction sector. The present waste management system in India has been examined, and the barriers to completing the consumption loop and creating markets for recycled materials have also been tested as part of a study project. Waste reduction would be the waste minimization approach most frequently used in the context of the 4R concept. This shows that the local construction industry has the knowledge required to design the processes involved in waste management, but the execution is still far from ideal. Profits drive the market, and they also encourage building experts to embrace innovative practices.

Keywords: Sustainable , Management , construction , demolition , waste materials, Reduce, Recycle

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I. INTRODUCTION

Construction-related waste production has a major negative influence on the ecology in the area. Due to numerous plans for the development of residences and commercial structures in India as well as the necessity for the completion of large infrastructure projects, there has been a noticeable increase in the quantity of rubbish related with construction. Industrial, commercial, and household rubbish may all be distinguished from one another. Construction companies are responsible for producing a wide variety of trash, the amount and make-up of which depends on a number of factors, including the stage of development, the type of construction work being done, and the methods used on the job site. As a result, waste reduction is a crucial subject of conversation in the Indian building and construction industry (Rawshan Ara Begum, page 13). Waste reduction is essential to construction waste management in India's building and construction sector.

With the fast growth of the world's population in recent decades, the pace of urbanization has also increased, which has increased demand for more material resources. The price of these resources has increased as a result of the rise in demand. As an illustration, a significant portion (32%) of the world's natural resources is used by the building industry. There is some residual value in more than 75% of the waste produced by the building industry, but it is not currently recycled or utilised in any other way. This amount is nevertheless significant even if it is far less than the percentage of natural resources that were used in the 1990s (which was over 40%). This is due to the lack of a well-established system for integrated waste management, claim Yeheyis, M., Hewage, K., Alam, M.S., Eskicioglu, and Sadiq (page 81). The phrase "construction and demolition wastes," frequently abbreviated as "C&D wastes," has been defined in a number of ways, but at its most basic level, it refers to anything that is produced during the process of building, remodelling, or tearing down a structure that can no longer be used in that capacity. The great majority of the time, this kind of garbage is carried to landfills to be thrown away. This definition states that construction and demolition waste is garbage produced by the construction sector. According to estimates, more than 35% of all C&D trash is disposed of in landfills annually, with the construction industry producing 30% of all waste produced globally (Rees, W.E., p.206). Thirty percent of the world's garbage production is made up of construction and demolition waste.

II. WASTE MATERIALS FROM CONSTRUCTION AND DEMOLITION: SUSTAINABLE MANAGEMENT

"Waste from construction and demolition," sometimes referred to as "C&D wastes," is any material that is produced during the building, altering, or tearing down of a structure that is no longer usable. The great majority of the time, this kind of garbage is carried to landfills to be thrown away. In accordance with this definition, the garbage produced by the building industry represents 30% of all garbage produced globally, and it is anticipated that, on average, more than 35% of all waste from construction and demolition is disposed of in landfills each year. Buildings consume a sizable quantity of natural resources, require a sizable amount of energy, and produce a sizable amount of trash, all of which have a major impact on the environment. All three of these project components fall under the purview of the construction industry. The main cause of this problem is the adoption of the linear economic framework, which is based on the concepts of production, consumption, and waste

disposal. First, the raw materials are extracted from the natural resources using technology, which uses a lot of energy. The raw ingredients are then transformed into the materials needed to construct the construction after this stage. (P. 1252, Lu, W.; Yuan, H.)

Due to the negative impact it has on the environment and the threat it presents to human health, managing waste from construction and demolition projects is a serious concern everywhere in the globe. A situation like this, which causes pollution, climate change, and resource depletion, necessitates the creation of an efficient organizational structure with the aim of reducing the aforementioned negative impacts. Construction and demolition (C&D) waste is made up of a range of materials, including concrete, wood, bricks, glass, steel, and other often wasted materials, according to Won, J., and Cheng, J.C. on page 5. Given that construction and demolition trash together produce a sizable amount of rubbish each year, it is crucial that it be managed in an environmentally sustainable manner. It has been found that conventional strategies, such as linear economics, are ineffective in reducing the environmental harm brought on by these consequences. Within this context, the idea of a circular economy, or CE, has emerged as a cutting-edge method for reducing negative environmental effects while also fostering economic growth within the building and construction sector in order to put sustainable development strategies into practice.

The construction sector is currently ranked second in terms of economic activity in the country, only after agriculture, according to the 11th Five-Year Plan. The study's findings (Srivastava & Chini, page 23) state that the building industry has a significant multiplier effect on the economy.

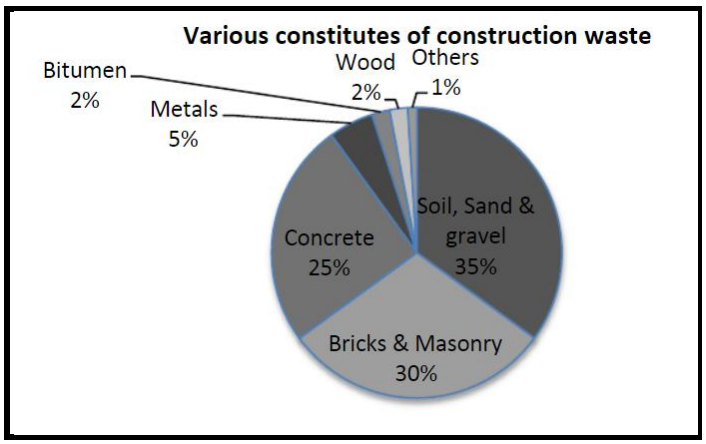

Figure 1: Construction waste comes in a variety of forms (TIFAC, 2000)

According to TIFAC's report, page 23, Figure 1 shows the percentage distribution of the main C&D waste components in India in 2000.

Harman and Benjamin (2004) contend that since it supplies the infrastructure necessary to boost output levels, the built environment is the core element of every economy. However, because of the way it uses natural resources, it is also partially to blame for the biggest changes that have taken place in the local or global environment. Sustainable architecture, according to Papargyropoulou, E., C. Preece, R. Padfield, and A.A. Abdullah (p.

13), is a method of building that seeks to restore equilibrium between the built and natural environments. This method of building is thorough and integrated.

Waste management for construction activities has been promoted as a means of achieving the goal of protecting the environment and acknowledging that such wastes contribute to the polluted environment as a result of the recognition that wastes from building and demolition works significantly contribute to the contaminated environment (Shen et al., 2002, cited in Shen et al., 2004). As a result, waste management for building projects is being promoted as a means of achieving the objective of environmental protection. In recent years, waste management has become a crucial part of managing building projects (Menegaki; Damigos, p. 9). This is mostly a result of people being more conscious of the damaging consequences that waste from buildings has on the environment.

Dealing with the trash that buildings create can be done in a variety of ways. Building waste management requires a range of approaches, one of which is simply disposing of it. It is a comprehensive strategy to use resources as efficiently as possible in the building industry with the objectives of reducing waste output and maximizing the use of the garbage that is generated. The plan was created to ensure that resources were used as efficiently as possible in the building sector. The most common practice for managing rubbish is to dump waste from construction projects in landfills. The contractor is now liable for greater costs related with garbage disposal, nevertheless, as a result of the lack of accessible landfill space. Additionally, poor material control directly contributes to the excessive rubbish generation on building sites (Chan, A., and Ma, T., p. 1059). Due to this need, initiatives have been taken to minimize, reuse, and/or recycle the waste produced by building operations. Alternative waste prevention strategies are furthermore necessary. In the subject of construction waste management, these procedures are referred to as the "three R's". Construction managers have often adopted a waste hierarchy as a guiding framework for their operations in accordance with the foundations of environmentally responsible building. To lessen the quantity of waste generated by their company, this is done. The Waste Hierarchy suggests that you...

- One of the best things that can be done for the environment is to reduce the amount of garbage produced.
- Recycling or repurposing materials can be feasible alternatives to reducing waste output in situations when further waste reduction is difficult.
- If this is not possible, the value of the trash should be preserved by composting, recycling, or energy extraction from the waste.
- If none of the other choices are realistic, only the environmentally friendly method that is practicable should be selected to dispose of garbage.

III. REDUCE, REUSE, RECYCLE, AND REBUY CONSTRUCTION AND DEMOLITION MATERIALS

1. **Reduction/Reducing the Use of Materials:** Source reduction results in a decrease in resource, energy, and waste consumption over the whole life cycle. The Environmental Protection Agency (EPA) emphasizes this part of the problem the most when it comes to creating solutions to issues with solid waste. Recycling and material reuse become essential elements of waste management that is ecologically responsible once rubbish has

been created. Source reduction is the one strategy that prevents waste from ever being created in the first place.

The preservation of existing buildings rather than building new ones, optimizing the size of new buildings, designing new buildings for adaptability to extend their useful lives, utilizing construction methods that enable disassembly and facilitate material reuse, utilizing alternative framing techniques, reducing the amount of interior finishes, and many other strategies are some examples of C&D source reduction measures.

Implementing buying agreements that forbid the delivery of extra materials and packaging to the building site is one of the C&D source reduction actions. Along with this, changes will need to be made to building systems, material composition, and design.

2. **Materials from C&D that are Reclaimed and Reused:** It is not a good use of anyone's time or money to demolish outdated buildings and dispose of the debris that results from the operation. If old construction and demolition materials that still have some value are salvaged for use in later projects, it is feasible to lower one's financial expenditure while maintaining one's utilisation of the earth's natural resources.

3. **Dismantling to Reuse:** Deconstructing entails meticulously separating a building's constituent parts with the intention of eventually reusing or recycling them. Deconstruction is a tactic that may be applied on a variety of levels to recover usable materials and drastically cut down on the quantity of waste created.

   There are many benefits to deconstruction, some of which are listed below:
   - It enables communities to develop local economic activities centred on the production or reprocessing of salvaged materials, maximizing material recovery, protecting scarce old-growth forest resources, and providing a variety of employment and training opportunities.
   - The reuse of materials helps to save resources since it avoids the disposal of waste that would have been created as a result of destruction if it weren't utilized in combination with conventional demolition procedures.

4. **Materials Can Be Reused**

   - The main benefit of recycling materials is the substantial cost savings that come from using less energy and resources to generate new materials. These financial savings could be explained by the fact that recycling materials uses less of each. Examples of materials from construction and demolition that are often recycled include the following:
   - Parts that is easily removable, such as doors, hardware, appliances, and fixtures.
   - If you utilize wood cut-offs instead of full length lumber for cripples, lintels, and blocks, you may avoid cutting full length timber. These items can be salvaged and used in other projects, donated, or used in the rebuilding process.
   - Masonry, concrete, and brick may all be recycled on-site and used as fill, sub-base, or road bedding (Gutherie, Woolveridge, & Patel, p. 34). On the job site, wood debris

can be cut up and utilized as mulch or groundcover. In moderation, crushed, de-papered gypsum can be utilized as a soil supplement.

5. **Recycling C&D Materials:** Several building materials can be recycled in areas with the necessary markets. Asphalt, concrete, and other materials may be recycled to create aggregate or new products based on asphalt and concrete, a method that is becoming more and more popular. In addition to producing engineered wood furniture, recycling of wood may provide other products including mulch and compost. Because these materials represent such valuable commodities as steel, copper, and brass, recycling them is advantageous for a variety of reasons. Additionally, even though cardboard packaging from residential construction sites is not regarded as waste from construction or demolition, it is still a part of the mixed construction and demolition stream and can be recycled in a variety of ways. It is likely that recyclable materials will occasionally be handled improperly or ineffectively. You can ensure that your materials will be handled as you desire by asking your recycler a few questions, such as whether or not they adhere to local and state regulations, whether or not they are licensed or registered with the state, and/or whether or not they have third-party certification.

Figure 2: Municipal Corporation of Delhi (MCD) recycling facility, June 2007

6. **Rebuying C&D Materials:** When employed in newly constructed structures, used construction and demolition (C&D) items and materials with recycled content can accomplish the following:

   - Because recovered materials are often purchased in the surrounding area,
   - Recycling may be beneficial to the economy of that region.
   - reducing the costs of development and restoration while maintaining the building's functionality and performance;
   - Preserving the local architectural character and historic significance (in cases of preserved or restored buildings) (Osmani, M.

7. **Composition and C&D Waste Characterization:** The bulk of garbage from construction and demolition is created whenever buildings and other types of infrastructure are demolished, refurbished, extended, or otherwise updated in any other way. These activities can also produce waste in any other way.

- Bituminous mixes, tar macadam, and other tar products; wood, glass, and plastic; soil (including that which is dug from contaminated locations);
- stones and dredged soil; insulation materials and building materials containing asbestos; gypsum-based materials; gypsum-based materials;
- As well as a combination of construction and demolition debris. C&DW often comprises at least trace amounts of organic wastes, such as food scraps and wrappers that employees at the construction or demolition site have simply put into C&DW receptacles.
- These wastes may be found in a lot of construction and demolition waste (C&DW). C&DW's bins are often positioned in accessible and handy areas.

8. **Masonry Waste:** There are two basic contributors of the trash that is generated by masonry. To begin, demolition work accounts for over sixty percent of the total quantity of waste masonry that is produced. Brick, calcium-siliceous brick combined with concrete, and cement mortars are some of the conceivable components of this form of waste, along with a wide range of other possible components. The characteristics of this form of garbage, which vary substantially depending on the waste type, are significantly impacted by the origin of the rubbish. The characteristics of this type of garbage vary dramatically depending on the waste type. When it comes to demolition trash, the characteristics of the debris rely not only on the kind of structure from which it was generated but also on the primary construction materials, such as concrete, calcium-siliceous bricks, or bricks. For example, the features of the debris might differ depending on the sort of structure the debris was created from. Begum, R.A., and Siwar, C., p. 86).

9. **Concrete Waste:** Concrete debris is the waste product that results when crushed concrete is utilized in the production of fresh concrete using a mixer. Concrete that has been rolled, crushed, or produced from crystallized dreg, or a mix of the two, and is manufactured using Portland clinker cement and natural aggregates are referred to as concrete debris. Concrete debris can also refer to concrete that has been broken up into smaller pieces and combined with natural aggregates. The majority of this waste is created as a result of the demolition of roads, buildings, and other types of civil works. The magnitude of this debris might be different depending on the kind of demolition work that was carried out. In most cases, it is made up of impure components such as metals, glass, bitumen, organic debris, and sulphates, amongst other things.

10. **Properties of Concrete Waste Derivates:** Recycling these wastes has a few benefits, one of which is the ability to produce aggregates that adhere to accepted criteria. If properly processed at the recycling plant, these aggregates might be very beneficial as they lessen the requirement for new, unprocessed material and the amount of garbage that needs to be dumped in landfills. Figuratively 3.

    Logic dictates that the characteristics of recycled aggregate are influenced by the nature of the concrete waste, which constitutes 75% of all concrete waste, as well as by other cement hydration components such silicates, hydrated calcium aluminates, or calcium hydroxide. The qualities of the concrete debris from which recycled aggregate was formed are likewise reflected in that material. Additionally, the hydration of cement is aided by components that are related to these aggregates (approximately 30% in

aggregates between 16 and 32 mm and around 60% in those between 4 and 8 mm) (TIFAC, page 23).

Despite recycled aggregates having more erratic shapes, greater porosity, and coarser textures, crushing limestone yields a form coefficient that is equivalent to that of recycled aggregates. This material's density is between five and ten percent less than that of natural aggregate. This specific variant is important.

Recycled coarse aggregates are normally only used in situations that attempt to maintain an optimum level of hydration since they tend to absorb significantly more water than virgin aggregates. This is due to the fact that recycled coarse aggregates often have a lower density than new aggregates. Sprinkler systems are typically installed in areas that will be utilized to store aggregates that were purchased from C&DW. This lessens the quantity of fugitive dust discharged into the atmosphere while also ensuring that the aggregates are properly hydrated.

Figure 3: Sorting trash at the recycling facility for the Municipal Corporation of Delhi (MCD). (June 2007).

11. **Challenges for construction and demolition (C&D) waste:** Because to the expansion of the building industry, notably in India's megacities, there has been a rise in the amount of garbage generated by construction and demolition (C&D) projects. This trend is especially noticeable in the country's urban areas. The rubbish that is produced during the construction, remodelling, or demolition of structures like roads, bridges, or buildings falls under the umbrella of the category known as "construction and demolition" (C&D) waste. According to the BMTPC, page 13, some examples of materials that are regularly utilized in the production of C&D water include concrete, wood, metals, asphalt, gypsum, plastics, and salvaged building materials. Surveys of consumer demand indicate that the construction sector in India will enjoy tremendous expansion over the course of the following 10 years. In terms of the contribution it makes to the entire economic activity of India, the construction industry is only surpassed in importance by the agricultural sector. On the other hand, the C&D waste that is generated by the construction industry is poorly handled and confronts a number of obstacles. Inefficiency in the management of construction and demolition waste has a number of negative consequences on the environment, including pollution of the air, water, and land. This is in addition to the

financial loss that results from the poor management of a potential resource, which is caused when that resource is not managed properly.

Both the application and management of construction and demolition waste have flaws and inconsistencies that need to be fixed in order to function properly. The method and its implementation is flawed due to the fact that the numerous players involved, such as the architects and construction managers, do not demonstrate sufficient understanding and do not actively participate in the process. Even though there is published research that focuses on some areas of the C&D garbage sector in India, there is a pressing need for an all-encompassing strategy that takes into consideration the many various components of C&D trash management for cities in India. This need exists despite the fact that there is already published research.

IV. OBJECTIVES OF THE STUDY

- To study on the Management of Building Materials Salvage and Reuse
- To study on issues with construction and demolition (C&D) waste

V. AIM

1. **Management of Building Material Salvage and Reuse:** When it comes to managing trash from buildings, it is important to take into consideration the relative value of the different kinds of materials. On a building site, for instance, there may be materials whose value "as is" for the purpose of salvaging is higher than the cost that would be incurred to recycle them. They could be in better form than us, which could be the reason for this phenomenon. While some of these items would be appropriate for on-site reuse, others might be of greater interest to a company that trades in recycled building supplies. It's possible that the initial expenditures for deconstruction services might be compensated by profits made from the sale of recovered materials or decreased purchasing prices. Instead, there is the possibility of lowering the costs. There are occasions when recycled materials can give desirable or useful features that are not available in new materials. These attributes are not present in recycled materials. It's possible that certain functions won't always be available to use. For example, acquiring wood of a precise grade and a range of species might be difficult, but old wood typically possesses both of these characteristics. There are two different approaches that may be used in order to salvage and reuse previously used materials: Before the structure may be razed to the ground, it must first be disassembled, then one of many recovery procedures must be performed. The term "deconstruction" refers to the act of dismantling a complete structure by hand in the opposite direction from that in which it was created. This is done in order to salvage the materials.

2. **Benefits from C&D Waste Recycle:** Recycling, reusing salvaged construction materials, and lowering the amount of materials used are all ways to save expenses that help minimize the amount of waste that needs to be disposed of as well as the cost of supplies**.**

    - **A Potential Marketing Opportunity -** An ever-increasing number of potential customers are expressing an interest in the utilization of environmentally friendly

construction technology. It is possible to acquire these customers by utilizing recycling and trash reduction as a strategy in your marketing efforts.

- The fact that the client is eligible for a tax break in the event that they give the reusable building materials to a charitable organization (also known as an NGO) is yet another advantage of this arrangement.
- Stay away from construction altogether to avoid producing garbage Recycling is not nearly as effective as reducing the amount of rubbish produced in the first place. By identifying possible sources of garbage at the early stages of the planning process, the amount of waste that is produced as a result of construction may be cut down significantly.
- Use standard sizing for all of the construction materials that are incorporated into your design. When materials with standard dimensions are chopped to lengths that are not typical, there is no need to dispose of the material as waste.
- Get everything ready in case you have to take it apart. The disentanglement of systems is one of the guiding principles, along with the use of bolted-together rather than connected components, the provision of a construction and deconstruction design, the inclusion of connection sockets and tie-offs for personnel and machinery, the exclusion of potentially hazardous materials, and the preference for highly recyclable materials. Other guiding principles include: the exclusion of potentially hazardous materials; the preference for highly recyclable materials; the use of bolted-together rather than connected components; the use of bolted

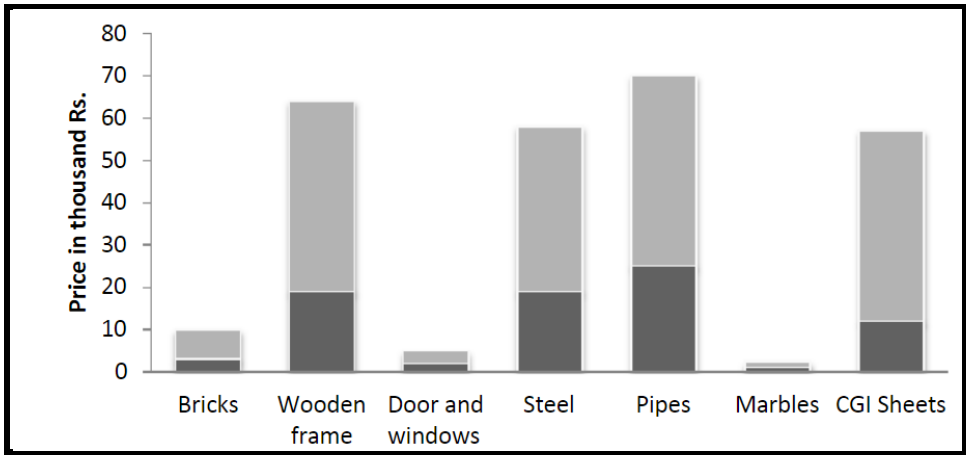

Figure 4: Price Comparison between old and new material

Fig. 4 demonstrates how recycling building debris may cut the price of modest homes by about 30% to 35%.

3. **C&D Waste Disposal Strategy in Delhi:** Because the three current landfill sites in Delhi have long ago reached their limit, the Municipal Corporation of Delhi (MCD) has given its approval for the building of a sanitary landfill facility in Narela-Bawana, which is located in the northwest part of Delhi. Narela-Bawana is located in the northwest part of Delhi. The integrated solid waste management facility, which will be developed at a cost of Rs 700 million ($15.5 million), will be constructed to fulfil Delhi's requirements for the disposal of rubbish for the next 20 years. In all, the property has an area that is 150

acres in size. It is planned to dedicate fifty acres of land to the cleanup and disposal of debris from demolished buildings and other construction projects. In addition to the Municipal Corporation of Delhi's approval of a feasibility study on the use of construction and demolition waste in the construction of roads and embankments, the landfill site will be responsible for managing construction and demolition waste from the Rohini and Civil Lines zones. (J. Brennan, G. Ding, C.-R. Wonschik, and K. Vessalas, p. 12)

4. **C&D Waste Disposal Strategy in Maharashtra:** While some states choose to handle the problem on their own, others choose to do so in conjunction with the Municipal Solid Waste (Management and Handling) Rules, 2000, which were already in place. The Indian state of Maharashtra has assumed a leading position in the global community by including in its Action Plan the implementation of a one-of-a-kind collection and disposal strategy for large amounts of garbage and debris. In line with this plan, it will be the responsibility of each and every local government to obtain the equipment that is necessary for the collection and disposal of C&D trash that is generated in large quantities by manufacturers. The Construction, Demolition, and Waste (Management and Disposal) Rules have been granted the green light for implementation by the Municipal Corporation of Greater Mumbai, which gave its approval of the rules. It is recommended that at least 4% of the total land area be reserved for the purpose of storing rubbish and carrying out the initial stage of waste treatment. Demolition contractors work to maximize the amount of usable materials that can be gathered once a structure has been systematically disassembled in order to save as much of it as possible. It's possible that recovery rates might range anywhere from 25% in older buildings up to 75% in more modern ones. Bricks of a particularly high grade were used in the construction of the vast majority of the older structures. Nearly all of the materials required to bring down an old structure may be obtained for prices that are within a reasonable range.

VI. CONCLUSION

The establishment of a framework draws attention to the significance of institutional, technological, legal, financial, and implementation-related problems, all of which have had a detrimental impact on the management of construction and demolition waste in urban environments. When putting different strategies into reality, it is essential to emphasize how important it is to use a systematic approach during the vital stages of planning and design, in-situ building, commissioning, operation and maintenance, and retrofitting in the buildings. These stages include in-situ building. The local building sector was also damaged by the economic crisis, and as a result, contractors are seeking for any type of affordable waste management plan to employ in order to use in order to use in order to use in order to save money. When contrasted with the other three methods, recycling waste shines out as an approach that is distinctively distinct from the others. The researcher could arrive to the following conclusion as a result of this finding: As they always have, local construction industry experts will always choose the tactic that provides them with the most opportunity for benefit and profit. It is possible to classify waste reduction as a conceptual activity due to the significant amount of planning that is required at each stage of the project.

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