A STUDY ON PERCEPTION AND PROCEDURE OF CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT IN SELECTED CITIES OF TAMILNADU

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ABSTRACT: The management of construction and demolition debris has emerged as a progressively significant global issue encompassing economic, social, and environmental dimensions. Globally, solid waste management is one of the most significant challenges that municipalities must confront. The issue at hand is primarily caused by urbanization, industrialization, inadequate urban planning, and a scarcity of suitable resources, all of which contribute to the generation of an enormous quantity of solid refuse. Developing nations such as India are currently grappling with significant environmental, social, and economic repercussions as a consequence of this issue. Rapid economic activity and population expansion in the city's environs have precipitated a severe waste management crisis. Various types of waste, including those generated at the household, industrial, and intermediate levels, contribute to environmental contamination and have emerged as enduring challenges for humanity (Ramasamy and Varghese, 2003). Much like life itself, only three things are certain: death, waste, and change." It is impossible to prevent these events from occurring in our lives. But we can be better prepared if management improves. We shall now discuss waste and waste management.

INTRODUCTION

Every individual is entitled to access pure food, water, and air. This privilege can be satisfied through the maintenance of a hygienic and unpolluted environment. To begin with the initial inquiry, what exactly is waste. Waste refers to any substance that the proprietor, manufacturer, or processor does not require. In general, waste is defined as material that has reached the conclusion of its useful existence and is deposited in landfills. As defined by the BSR (2010), waste is commonly understood to be "anything that does not create value" among businesses. From the perspective of the average person, anything undesirable or useless is refuse or waste. Scientifically speaking, however, there is no such thing as waste in the universe. Almost every constituent of solid refuse possesses some degree of potential if it is scientifically converted or treated. Therefore, solid waste can be defined as "waste materials, whether organic or inorganic, generated as a result of commercial or residential operations, which have ceased to be valuable to their original owner but could still, be of great worth to another individual."

CONSTRUCTION AND DEMOLITION WASTE

Construction and demolition waste, in a broad sense, comprises materials produced throughout the processes of construction, renovation, and demolition In addition, it may encompass materials and products that have been temporarily utilized on-site throughout the course of construction activities or are unused and damaged classify construction and demolition waste into four distinct categories according to the source materials: demolition, road planning and maintenance, excavation, and worksite waste materials. "C&D waste" is defined as "waste generated from diverse construction activities in Hong Kong, including but not limited to land excavation or creation, building and civil construction, demolition, site clearing, (C&D) waste work, and building renovation" (Shen et al., 2004; Poon et al., 2004a; Hao et al., 2007). The prevalence of the term "C&D waste" in the literature has been observed to be increasing. While it may be pragmatic for a landfill to employ this term to encompass all solid wastes requiring disposal, the term "C&D waste" does not provide an inflexible definition that specifies the origins of individual materials. Volume-wise, the two waste systems are notably dissimilar. Bossink and Brouwers (1996) estimate that the annual volumes of construction and demolition waste in Germany are thirty million tonnes and fourteen million tonnes, respectively. The majority of construction and demolition (C&D) waste, as reported by the Environmental Protection Agency (EPA) of the United States in 2002, is generated during renovations (44 percent) and demolition (48 percent). A Chinese investigation found that building professionals consider construction waste to be "negligible" and that demolition waste should be the primary focus of waste management activities (Li, 2006).In addition, investigations have been undertaken to analyze the composition of C&D refuse in order to derive meaning from it. According to the compositions of C&D refuse, the European refuse Catalogue (EWC) provides a methodical classification of the waste. It divides C&D refuse into the following eight categories: The following are examples: (1) ceramics, concrete, brickwork, and tiles; (2) glass, plastic, and wood; (3) bituminous mixtures, coal tar, and tarred products; and so forth. Construction and demolition (C&D) detritus in Hong Kong typically comprises a range of materials, including timber, steel, stucco, rubble, and soil, in addition to a variety of substances used for site clearance (Shen et al., 2004; Poon et al., 2004a; Hao et al., 2007). Although C&D waste is frequently categorized as municipal solid waste (MSW), it is heterogeneous in nature (e.g., hospital waste and computer waste) in comparison to general MSW (e.g., domestic waste) or other industrial solid wastes (ISW). As an illustration, it is customary to reuse or recycle the overwhelming majority of C&D refuse (Tam, 2008a). C&D waste, as opposed to household waste, is generated by a limited number of contractors, which may contribute to its potential ease of management. In certain developing nations, the collection of general municipal solid waste (MSW) and industrial solid waste (ISW) is reportedly carried out by the informal sector. However, for the collection of C&D waste, contractors or specialized subcontractors are the primary participants (Khalil and Khan, 2009; Yuan, 2008). While research and practice frequently "borrow" concepts and principles from general waste management (e.g., the polluter-pays principle and waste hierarchy), future analyses should address the heterogeneity of C&D waste. Furthermore, further investigation is anticipated to compare the properties of C&D waste to those of other types of waste.

WASTE GENERATION CAUSED BY URBANIZATION

Enhanced living conditions and population growth contribute to an increase in the production of solid refuse in both urban and rural regions of the nation. In India, similar to other industries, a clear differentiation exists between solid refuse generated in urban and rural regions. However, as a result of continuous urbanization, the rapid implementation of the "use and throw" philosophy, and equally rapid communication between urban and rural regions, the divide between the two is narrowing. Solid waste originating from rural regions is predominantly composed of biodegradable components, whereas that from urban areas is predominantly composed of non-biodegradable elements such as packaging and plastics. Nonetheless, a reprehensible attitude toward solid refuse and its management is shared by both sectors. "Moving trash out of sight" is the universally accepted guiding principle. This section examines prior substantial investigations into the administration of C&D waste and the significant discoveries made during their research. Considerable scholarly attention and literature has been devoted to the management of C&D refuse. An observational review conducted by Shen & Yuan (2011) suggests a growing interest in this particular field. Furthermore, it was asserted that developed nations contributed substantially to research, whereas Malaysia and China, two prominent developing countries, exhibited a growing interest in the subject matter and undertook substantial research. The prevailing approach in this field was to employ surveys and evaluations as research methodologies, with case studies constituting the majority of studies. Descriptive research methodology was described as the approach taken to analyze the data obtained through the aforementioned technique (Shen & Yuan, 2011).

However, it was reported that there was a reduced utilization of simulation modeling and statistical analysis by authors, as well as cost benefit analysis by researchers. They reached the conclusion that prospective investigations in this field will be carried out in developed nations, given that their principal economic sector would be construction. Waste management is an expansive concept that conventionally denotes the process through which anthropogenesis waste materials are gathered at sites of generation and conveyed to a final destination where they can be disposed of or repurposed. The sector in which the waste material is produced—namely residential and industrial—the operation that generates the waste (e.g., municipal, construction, or industrial activities), and the method by which the waste is managed all contribute to the magnitude of waste generation. This chapter provides an overview of waste management in the construction industry, including a classification of the common materials generated during construction and demolition operations. Additionally, it elucidates the comprehensive approach to managing this type of waste and incorporates procedural elements that aid in the comprehension of the waste management strategy.

OBJECTIVES OF THIS STUDY

1. The primary objective is to establish a system for identifying different types of waste generated during construction activities and implementing effective segregation techniques. This ensures that recyclable materials are separated from non-recyclable ones, facilitating proper disposal and recycling processes.

2. To minimize waste generation throughout the construction process. This involves adopting practices such as lean construction methodologies, which aim to reduce excess materials, optimize resource use, and streamline workflows to minimize the overall waste produced.

3. To maximize the recycling and reuse of construction waste materials wherever feasible. This may involve establishing partnerships with recycling facilities, incorporating recycled materials into new construction projects, or repurposing materials on-site for secondary uses.

4. Identify and analyze the key elements that impact waste management on building sites.

LITERATURE REVIEW

INTRODUCTION

The literature review is to examine and evaluate the previous studies related to the research area regarding the subject matter, area of study, findings and suggestions, scope for the future area to explore. It gives a road map for the researcher to fulfil the research gaps in the previous study. The methodology adopted in the previous study, ways of collecting the samples, analysing of the samples, findings in the previous study. For the review of literature recent studies are considered, since the social studies researches are changing in nature over a period of time. In this review research papers were studied detailed and the results are given below. Menegaki & damigos, (2018) reported the causes, obstacles, and perceptions that affect CDW generation and management with an analysis of modern research. Depending on the analysis, several measures for specific nations are determined to utilize the recent accessible information and an informative framework is established through a commitment to identifying the conditions influencing CDW production. Specifically, a design chart is developed 36 varying endpoints established understanding the CDW parts of the framework and the favourable or unfavourable interactions among them. This offers a comprehensive analysis of the research on CDW's present scenario and issues. For such an extent, the regulatory structure is being debated in favour of effective administration of CDW. Nevertheless, the primary emphasis is regarding CDW generation and the reasons that affect progress, and about the challenges and opportunities to create effective CDW managing activities. A conceptual chart that reflects established information about the features of the CDW framework and the favourable or unfavourable associations within themselves is therefore established on the basis of the research analysis it concludes with the key findings of the research work. Hongping Yuan, (2013) evaluated strength, weakness, opportunity, and threat (SWOT) to better clarify the reality of construction waste management focused on shenzhen city's specific scope in southern china. Evidence to endorse the evaluation were collected through various sources, like official documents, legislation relevant to waste treatment, research analysis, and focused team discussions. The study provides a gateway because significant participants may view construction waste treatment's inner and outer aspects of shenzhen. The seven crucial approaches centered on the established swots may become valuable for shenzhen to improve and encourage the upcoming building waste management strategically.Ding et al., (2018) offer a better perspective to develop and maintain practitioners' minimizing waste initiatives. Implementing precast concrete materials, decreased layout alteration in the design phase, site processing, recycling in the development step, and better administration attributes for evaluating the construction and ecological lowering management results are some CDW practices. The constrained analysis was carried out to compensate for the development phase and the building phase. Ardavan Yazdanbakhsh, (2018) presented a bi-level Life Cycle Assessment Framework for modelling waste management taking in to account its positive impact on the environment. The impact was measured in terms of measurable scales of decision and strategy making. A similar flow of managing C&DW has been defined using different functional units. An illustrative example has also been given to demonstrate the implication of the framework based on a number of simplifying assumptions which impacts the C&DWM strategies in the City of New York.Maria Menegaki, (2018) made a detailed review of the recent literature, which focuses on the factors, blockades and motivations that impact the generation and management of C&DW. Based on the analysis, two indicators were calculated for selected countries using the latest available data and an explanatory model has been developed with a view to enabling identification of the factors affecting CDW generation. Most importantly, a concept map is created involving thirty-six different nodes that represents existing knowledge with respect to the components of the CDW system, and the positive or negative relationships between them.Hongping Yuan, (2013**)** conducted a (SWOT) strength, weakness, and opportunity, and threat, analysis to understand the position of construction waste management based on the certain framework of Shenzhen city in south China. Data were derived from multiple networks including focus group meetings, governmental reports waste management related regulations and literature review, the study opens a window through which chief stakeholders involved can recognize the internal and external circumstances of construction waste management in Shenzhen. The critical strategies, presented based on the SWOTs recognized, could be useful to improve and promote its future construction waste management at the strategic level.Shaken Ding et. al (2018) in their work identified the key factors of C&D Waste minimization management at the design and construction phases by literature review and interview. Based on system Dynamics, an environmental benefit assessment model of CW reduction management at the two stages is developed to reveal how the dynamic relations among the factors and their variations influence the waste reduction management and the environmental impacts.RuoyuJin et.al. (2017) studied the recent movement and current stage of China'sconstruction and demolition (C&D) waste recycling and reuse. Specifically, the research targeted to provide the big picture of recent C&D waste management practice in China, as well as to deliver insights from Chinese field practitioners 'perceptions towards benefits, challenges, and recommendations of C & D recycling and reuse. The research was done based on a review of existing practice and a holistic approach by collecting feedback of professionals from numerous disciplines with the aid of a questionnaire-based survey. Totally 77 valid responses were obtained from 592 questionnaires sent. Both quantitative data and qualitative evidence implied that China was still at the early stage of recycling C&D wastes. Lack of client demands was recognized as one of the primary problems in C&D waste Management. The study exposed that engineers and consultants had a more positive awareness on encouraging industrial training in C &D waste recycling, while CM professionals believed more conventional opinion on it. It was also found that acquiring experience in C&D waste recycling and reuse would offer professionals more positive insight on the quality of products comprising recycled contents. It was further inferred that although governmental regulation had a high impact on China's current C & D waste management practice, the economic viability should eventually dominate the C &D waste diversion.Li Ying et. al, (2011) analysed the current management situation of construction waste, the current laws and regulations of construction waste management according to the current management situation of construction waste in Beijing. At last they put forward the problems and solutions for the current management policy of construction waste in Beijing to provide conductive effects for the revision and consummation of laws and regulations of construction waste management in Beijing.Marta Gangolellset (2014) studied the implementation of effective waste management practices in construction projects and sites, utilizing data from a survey responded by 74 Spanish construction companies based in Catalonia. Most frequently applied practices were found to be on-site cleanliness and order, correct storage of raw materials, and prioritization of the nearest approved waste managers. The least widespread practices were the use of a mobile crusher on site, the creation of individualized drawings for each construction site, and the dissemination of the contents of the waste management plan to all workers, to help them to meet its necessities. Waste handling procedures for construction and demolition and the conforming construction waste management facilities were designed before the downturn in the Spanish construction sector. This research is beneficial to better understand the current position of construction and demolition waste management in construction projects and sites. Thus, the outcomes of this research will aid policy makers and relevant stakeholders such as contractors, clients, architects, and engineers to attain the EU objective of recovering 70% of construction and demolition waste in 2020. In this context, reliable information can help governments and professional associations to set future C&D waste management guidelines, training programmes, and dissemination tools, inspections etc.,Manal, (2014) work aimed at developing a comprehensive procedure to assess construction and demolition waste management methods using Decision Matrix technique. A thorough study has been presented for the two methodologies; for each approach, a flowchart was developed to exhibit its lifecycle, as well as the cost break down structure and the different stakeholders' roles. A penetration debate of the pros and cons for each approach was established accordingly and came out with sixteen impelling attributes for both methods. The previous steps flagged the ground to construct a Decision Matrix to decide on one of the criteria from a strategic environmentally oriented perspective. The study relied on the detailed and in-depth demonstration of the two procedures to justify the assigned weight for attributes and scores for the corresponding method. From a strategic perspective, the conclusion came out in favour of the more environmentally friendly approach. Hongping (2017) investigated the most crucial challenges and promising strategies of managing C&D waste in a distinctive economically developed region of Shenzhen in south China. Data gathered through a review of the literature and government regulations and reports, semi-structured interviews and group discussions with administrative staff and industry participants. Based on analysis of C&DW generation, waste regulations, and most common waste management practices in Shenzhen, five drawbacks have been discovered. They include “undeveloped regulatory environment for managing C&D waste”, “multiple government departments are disjointedly involved in different C&D waste management procedures, but no one takes the prominent role”, “deficiency of necessary data in C&D waste”, “insufficient attention is paid to waste management in construction projects”, and “C&D waste recycling factories trudge toward growth”. Robert H. Crawford, (2017) studied the existing strategies adopted to handle materials removed as part of the demolition stage of the project. Material types and volumes were recorded both on- site and off-site waste management practices observed. Reasons for waste management decisions were documented. The study recognized a range of barriers to improving the environmental performance of construction waste management in remote communities. These include cost and time related to on-site waste management, industry culture, lack of education, challenging project priorities, and lack of financial incentive. Greater incentives to inspire the diversion of C&D waste from landfill are required, in particular. Along with other approaches for construction waste management practices in remote communities must be targeted at the context of individual communities though, due to their unique characteristics.Amal Bakshan, (2016) adopted a Bayesian Network analysis to define behavioral factors towards sustainable practices in C&DWM. In this context, a structured survey questionnaire was established and administered to field workers at construction projects. The collected statistics was used to develop a probabilistic interactive model with single and multi-factor analysis to assess conditional possibilities underlying various factors. The outcomes indicate that behaviour is highly influenced by attitude, experience, and social pressure with 21, 20, and 10% higher chance of improvement by these factors, respectively. Behaviour in C&DWM appears to be more sensitive to changes in personal factors such as attitude than corporate factors such as training. When simultaneously controlling all factors, the behaviour is enhanced with personal factors by 9% more than with corporate factors.

Weisheng Lua, (2015) developed a set of reliable key performance indicators (KPI)/ waste generation rates (WGR) using an existing big dataset on CWM in Hong Kong. By mining the 2,212,026 waste disposal records created from 5764 projects in the years of 2011-12, the WGRs/KPIs are re-examined and refined. Demolition is found the most wasteful works. Construction of new building and maintenance and renovation works individually produce the least waste amount, but by accumulating all maintenance and renovation works, their contribution to the total amount of construction waste could be remarkable. Based on the more dependable WGRs from the big data, C&DWM performance benchmarks for different categories of projects are set up.

Paola VilloriaSaeza et al. (2013) carried out a study to support construction participants in concluding effective C&DWM. This paper brings out a survey conducted among the construction managers to evaluate the success of 20 best practices concerning C&DWM, identifying the most appropriate types of building constructions to apply these practices and also the benefits and shortcomings of their performance in a building construction project. Results of this study show that among the highly effective methods are: the use of industrialized systems and the contract of suppliers managing the waste. Also, distributing small containers in the work areas is also another high valued practice, although only 36% of respondents usually implement this measure in their works.

Niluka Domingo and Hao Luo, (2017) investigated the Canterbury earthquake C&DWM process, limitations and offers suggestions to improve retrieval from imminent catastrophes. Detailed semi-structured discussions and a questionnaire survey were carried out with government and non-government bodies involved with C&DWM, including the Canterbury Earthquake Recovery Authority (CERA) and recognized demolition contractors. Results revealed that the “pick and go” strategy introduced by CERA proved to be instrumental, as it directs debris into the market. This study recognized some limitations in the current C&DWM method, such as deficiency of waste-processing facilities, imperfect strategies and acts, organizational restrictions, and ineffective interaction and management between the concerned parties.

Ruichang Mao et al. (2016) thoroughly review the current use and further progress of the glass curtain wall system in Shenzhen city. It also analyzes the configurations and features of the production of waste glass curtain wall. The results show that the total gross surface area of buildings that use glass curtain wall system has approximately reached 3 million m2 in the region (Nanshan district in Shenzhen). It also indicates that there is around 2 kg of waste which could be produced from the construction of glass curtain wall per m^2 and will generate more than 6000 tons of glass curtain wall waste, including the whole life cycle from manufactory and building. Also, several recommendations to sound management of the waste glass curtain wall are proposed based on the further review of the management strategies and process methods employed in developed counties. Overall, the findings in this study could be helpful to contribute valuable knowledge and techniques to environmental management and waste recycling in China.

Uzzal Hossain, (2018) carried out an investigation to compare and contrastthe environmental performance of building C&DWM systems in Hong Kong. Life cycle assessment (LCA) approach was applied to evaluate the performance of CWM systems holistically based on primary data collected from two real building construction sites and secondary data obtained from the literature. Different waste recovery rates were applied based on compositions and material flow to assess the influence on the environmental performance of CWM systems. The system boundary includes all stages of the life cycle of building construction waste (including transportation, sorting, public fill or landfill disposal, recovery and reuse, and transformation and valorisation into secondary products).

Uzzal Hossain, (2018) studied the management of wood waste generated from construction activities. Wood waste is an inherently renewable resource that can be recycled and utilized for the production of green products and renewable energy. To minimize the environmental impacts and to provide a scientific basis for the decision-making process on the wood waste management systems, a life cycle assessment (LCA) approach was employed in this study to evaluate the potential. Management systems from an environmental point of view. Three alternative scenarios, including the recycling and reusing of wood waste to produce organic polymer-based particleboard, cement-bonded particleboard and energy were compared with the current disposal strategy (landfill disposal), with the functional unit of 1 tonne of wood waste within a cradle-to- grave system boundary. The analysis conducted in this study can serve as guidelines to design a sustainable and resource-efficient wood waste management system.

Weisheng Lua et. al. (2017) study aimed to demystify BIM's computational application to CWM. Based on a critical literature review, a prototypical framework of a computational BIM for CWM has been delineated, within which the two essential prerequisites of 'information readiness' and 'computational algorithms' was highlighted. The work also details the required information and how it can be organized in a standalone database or encapsulated in existing BIM for CWM. They also further explored the computational BIM algorithms that can manipulate the information to facilitate decision-making for CWM. Finally, the operation of computational BIM was elaborated by relating it to various prevailing procurement models within which BIM applications was contextualized.

Simon Lockrey et al. (2017) carried out a work which addresses the absence of knowledge, by plotting the current recycling system and estimating recycling performance of a key module in C&DW in Vietnam, concrete. Principal data were collected directly from six Vietnamese construction enterprises involved in the life cycle of C&DWM. The outcomes indicated that potential net environmental benefits exist for all impact categories examined if a mechanized plant were considered. The results confirm benefits to technological progressions in concrete recycling in the construction demolition waste sector. Nurturing investment and interest in such policies could be achieved by imposing clear and reliable C&DW categorizations, establishing clear lines of accountability, and organizing activities amongst key stakeholders and thereby promoting the benefits of concrete recycling. These findings stress the need for research in Vietnam and other developing nations, where more detailed life cycle inventory development and stakeholder engagement could help. Then better environmental outcomes through the concrete recycling management may be delivered Jiayuan Wang et.al (2018) proposed a method to optimize the construction waste management fee by considering life-cycle environmental impacts of construction waste and society's willingness to improving the management of construction waste. The proposed method and suggestion could be helpful for waste policy makers as well as researchers for developing construction waste management fee schemes. It worth to mention that these proposed waste management fee would vary over time and regions, as any change of factors in the calculation models would result in a change of the final result. As the application of waste management fee would affect the attitudes and behaviours of stakeholders including the government departments, owners of landfills, collection and transportation parties, waste recycling parties, landfills parties and so on. The determination of waste management fee is a very complex issue and need to be solved via systematic approaches from different perspectives.

José-Luis Gálvez-Martosa et al. (2018) studied the fundamental principles andrelated best practices for the C&DWM across the complete construction value chain in Europe. It was inferred that efficient implementation of these best practices could dramatically improve resource efficiency and reduce environmental impact by reducing waste generation, minimizing transport impacts, maximizing re-use and recycling by improving the quality of secondary materials and optimizing the environmental performance of C&DWM methods.

AluísioBraz De Meloa et al, (2011) carried out a study on C&DW generation and management in the Lisbon Metropolitan Area (LMA). CDW generation was calculated for the period 2006 and 2007 based on construction activity and waste load movements. The results exposed that in the municipality of Lisbon, remodelling construction activity resulted in the CDW generation of 954 t/day and 0.60 t/year.

Sapuay (2016) studied about the issues of solid waste management in construction sites that he worked on, and he suggested some methods to reuse the solid wastes. Also, the author presents certain issues that lead to negligent application and enforcement of appropriate WM in the sites. Several adaptable techniques can be recommended to improve the compliance of the construction industry to environmental solid waste management Anna Sobotkaa and Joanna Saganb (2016) analyzed three WM. Scenarios for ascertain construction project. “Current” “eco-centric” and “Anthropocentric,” methodologies were studied regarding waste collection costs. Two extreme methods were formulated as an alternative to the usual waste management strategy practiced on construction site. The “anthropocentric” method is a reflection of ill-conceived WM- supposing no segregation, which leads to high costs of waste processing. The “eco-centric” approach, carried out by reverse logistics and sale of sorted waste at lower prices, thereby providing cost savings. The results illustrate that the strategy of waste disposal inspires and even forces stakeholders to implement reverse logistics despite the additional duties and requirements. General conclusions of research confirm that currently, operating systems of WM on site are ecological, to make more efficient the “Eco-centric” approach can be followed, which could also be called “Economic.”

Ruane Fernandes de Magalhães, (2018) presented the best practices to reduce waste in the previous projects, highlighting the role of decision-making in the design stage and the effective management of construction practices in the public sector. The best practices were recognized from literature review, document analysis in 14 projects of urban infrastructure, and both quantitative and qualitative survey with 18 professionals (architects and engineers) playing different roles on those projects. The influences of these research are: (i) the identification of the building techniques related to the urban project typologies analyzed; (ii) the identification of cause-effect relationships between the design ranges and the CW generation analysis; (iii) the proposal of a worksheet to enhance the decision-making process, that can be used as a control and evaluation tool when developing urban infrastructure designs, focused on the construction waste minimization (CWM).

SUMMARY FROM LITERATURE

Waste management on construction sites is a critical aspect of sustainable development and environmental stewardship. Literature studies underscore the significance of efficient waste management practices to minimize environmental impact, reduce costs, and enhance project efficiency. Key strategies highlighted in the literature include waste prevention, source reduction, recycling, and proper disposal techniques. Waste prevention involves careful planning and design to minimize material usage and optimize resource efficiency from the outset. Source reduction focuses on reducing waste generation through improved construction practices and material selection.

Recycling initiatives aim to divert reusable materials such as concrete, wood, and metal from landfills, promoting circular economy principles and reducing the demand for virgin resources. Proper disposal techniques encompass safe handling, storage, and disposal of hazardous materials, ensuring compliance with regulatory standards and mitigating potential health and environmental risks. Effective waste management requires collaboration among stakeholders, including contractors, developers, government agencies, and waste management service providers, to implement comprehensive waste management plans and foster a culture of sustainability throughout the construction lifecycle. Overall, the literature emphasizes the importance of proactive waste management strategies in achieving environmental sustainability goals and advancing the construction industry towards a more resource-efficient and resilient future.

CONSTRUCTION WASTE MANAGEMENT (CWM)

CWM is the process of repurposing materials that would otherwise be discarded as waste, recycling waste material when feasible, and removing waste material when no other option remains. The principal objective of construction waste management is to implement these solutions to ensure sustainable management of construction materials and resources, including labor and time, whenever possible. The significance of CWM lies in the fact that waste materials are disposed of in landfills in adherence to relevant legislation and regulations in the majority of countries, including regions where the disposal of construction and demolition debris is prohibited. Illegal disposal practices not only violate environmental regulations but also result in adverse effects on human health and economic interests, particularly when improperly constructed landfills are involved (Napier, 2012).

Diversion is the process by which construction and demolition debris can be separated from the main waste stream; the resultant materials are known as diverted materials. According to Napier (2012), the quantity of the materials mentioned above is influenced by several factors, with macroeconomic conditions impacting construction, societal consumption rates, and natural and anthropogenic hazards being the most significant. Significant quantities of construction detritus are generated at the level of small-scale projects, which in the majority of nations are under the jurisdiction of the local government and municipality. Napier (2012) posits that the management of waste materials is influenced by various factors, which comprise the subsequent: Whether an appropriate location is accessible for the disposal of materials.

1) The comprehensive status of the economic environment within a given nation or state

2) Societal objectives

3) The presence or absence of a feasible market for the recycling and reutilization of materials

4) Options for transportation

5) Commodities

Three critical phases comprise the waste management implementation process. Which of the following comprises the majority of refuse products: at the project level, the corporate level, and the disposal level? The material is deemed critical at every stage, as its utilization and reutilization contribute to the development of C&DW plans. It is essential, prior to developing a management plan, to ensure that all surplus materials generated throughout the construction and demolition phases are handled in an efficient manner. Before commencing the undertaking, it is imperative to categorize the materials that will be incorporated into the waste management strategy (Napier, 2012).

Certain residential construction materials are frequently discarded, not only during the building phase but also after the undertaking are concluded. Plastic, gypsum board, lighting fixtures, plant materials, masonry, debris, glass, and woody materials (various sizes) including doors, cardboard, asphalt roofing, wood, plumbing fixtures, concrete, carpets, and windows are among the aforementioned materials. The implementation process for every waste management plan is intricately linked to the particular project's specifications and criteria. Conversely, in the context of smaller-scale residential construction, a range of general specifications and requirements may be delineated, encompassing a diverse array of construction materials (Napier, 2012).

The initial stage in managing construction waste entails the classification and prioritization of materials by form, volume, and site location. By implementing this measure, the manager will be able to efficiently prevent the disposal of materials in landfills and instead guide them towards a solution that is more sustainable in terms of the environment (Cambridge, 2008). Construction refuse materials are regulated by waste management laws in the majority of developing nations. When composing contracts and subcontracts for different construction sections, it is critical to bear in mind the codes and regulations of the state or country in which one is working (Laquatra & Pierce, 2002).

Preferred on construction sites due to their reduced spatial requirements and ease of management. Container capacities should be maximized in order to reduce expenses and distances traveled (Laquatra & Pierce, 2002). The containers are then transported to diversion facilities via vehicle. For this purpose, light-duty and occasionally medium-duty vehicles are employed. The identification of waste materials within facilities is of the utmost importance, as it substantially impacts the management procedure. In general, the facilities conduct the process of identifying and delineating the suitable categories of materials. In the event that any unsuitable materials are transported to these facilities, they are disposed of in a landfill (Napier, 2012). Following collection and sorting is the subsequent phase of refuse management. Loader devices transfer materials from containers to the floor for picking.

The process of material sorting generally involves the utilization of an inclined belt that is traversed by a sorting section manned by several individuals. These individuals are responsible for categorizing different types of materials, removing them from the flow, and depositing them into a designated container for each material. Sorting achieves the same level of success as the choosing stage that precedes it. Failing to select large materials in the picking stage would render them unmanageable and consequently diminish the efficiency of the current process (Cambridge, 2008). Specialized machinery is employed to compact segregated materials in industrial containers that are designed for their specific properties, thereby optimizing the utilization of space.

The compressed substances are subsequently conveyed via intermodal containers designed specifically for maritime travel. Material transportation across the nation or region is presently facilitated by heavy-duty vehicles. Trains and ships are among the supplementary modes of transportation utilized to convey commodities at a domestic or global level (Cambridge, 2008). Ultimately, materials that are recyclable are subjected to recycling processes, while those that are unsuitable for reuse or contaminated with waste materials are disposed of in landfills (Laquatra & Pierce, 2002).

Several considerations must be taken into account when constructing a landfill. To commence, the Ministry of the Environment of British Columbia asserts that "the operation and design of landfills ought to mirror the three R's of waste management are reduction, reuse, and recycling. This aligns with a philosophy that prioritizes the prevention or reduction, to the greatest extent possible, of leachate and landfill gas emissions (British Columbia Ministry of Environment, 2014). Furthermore, with regards to water quality, it is imperative that the management of landfills does not compromise the Authorized and Working Criteria to the extent that the condition of ground or surface water in present or future water source aquifers or surface waters declines below the acceptable threshold (British Columbia Ministry of Environment, 2014). Lastly, with regard to public health, a landfill should not be operated in a manner that generates a public nuisance or poses a significant risk to public safety or health, such as through unauthorized access, highways, traffic, noise, dust, garbage, vectors, or wildlife attraction (British Columbia Ministry of Environment, 2014).

VALUE OF MATERIALS

The relative abundance of each construction material in the aggregate waste stream is significantly influenced by the prevailing economic conditions of the state or country, as well as local inclinations. For instance, in a setting where timber is readily available and inexpensive, it is probable that a significant proportion of construction and demolition debris will consist of wood or wood-based materials. Conversely, in a locality characterized by older structures constructed entirely of masonry components, substantial amounts of masonry refuse are probable to be incorporated into the overall demolition waste (Cambridge, 2008).

Ferrous and non-ferrous metals

Metal is the most rapidly diverted building and demolition waste material relative to other materials, owing to its relatively high value. In order to separate larger ferrous metal components from concrete, specialized excavation apparatus is required. Conversely, sorting smaller particles over the sort line involves manual labor or the application of magnets (Laquatra & Pierce, 2002). Aluminum constitutes the majority of non-ferrous metals, which are processed utilizing a manual collection method or a reverse magnet apparatus analogous to that employed for ferrous metals.

Paper and cardboard

Despite being recyclable, this particular material is not as practical as papers or cardboards, which are the norm for curbside collection. This is due to the fact that paper and cardboard that are isolated from construction and demolition debris are frequently contaminated with debris from the construction site, including dust, water, and other substances (Cambridge, 2008).

Plastic Material

Plastic, unlike other waste materials, does not possess the same recyclability characteristics. Generally speaking, plastic cannot be converted back into identical materials in terms of consistency and form. Plastic is, in fact, repurposed. Plastic film is among the most detrimental materials discarded in plastic waste. The rationale behind the appeal of plastic film lies in the substantial reduction in selecting process efficiency that its presence induces. Typically, the comparatively low cost of recycled products acts as an impediment to plastic recycling. Exporting waste plastic or utilizing it to generate electricity in combustion energy generation facilities are viable solutions to the issue. Recyclable waste plastic includes polystyrene, polyethylene, polypropylene, polyvinyl chloride, and polyethylene terephthalate (Laquatra & Pierce, 2002).

Wood

Wood holds significant importance as a recyclable material, particularly in regions where it is easily accessible and affordably priced. Wood construction is highly dependent on the weather conditions of a given district, state, or country. The time and money required to process wood to make it suitable for residential use is prohibitive. However, in regions with consistent humidity throughout the year, wood does not necessitate processing, rendering it an ideal material for residential construction. Alternatively, the waste can be fed directly into a combined heat and power facility or converted to biomass (Laquatra & Pierce, 2002).

Concrete

Concrete is a popular waste material for recycling in a number of countries. Completely recyclable concrete is achievable with relatively basic technology. After the concrete has been selected, it is crushed and subsequently divided into two distinct varieties. Metal in the initial category was formerly incorporated into concrete prior to its relocation to a metal processing facility. Following this, the residual concrete and gravel are tracked and crushed to the precise dimensions in order to be utilized as aggregates in a multitude of applications (Napier, 2012).

Aggregates and fines

Aggregates and particles constitute a considerable proportion, approximately one-fifth, of refuse materials. This classification contains bricks, stone fragments, and small pieces of concrete. On construction locations, they are easily removable and reusable in aggregated form for an array of applications (Cambridge, 2008).

Window glass

The proportion of window glass in construction and demolition debris is minimal. Due to its high weight per volume and extreme difficulty of handling, transporting this material would result in additional expenses for the projects or waste management company. Consequently, window glass is typically deposited in landfills, unless it is discovered within an extremely short distance of the structure or location undergoing demolition (Laquatra & Pierce, 2002).

Carpeting

The significance of carpet material reuse lies in the fact that the production of new carpeting materials generates greenhouse gas emissions. Carpet waste is a particularly sorted materials pose a challenge due to the limited number of modifications that permit the retrieval of valuable substances. Carpet fabrics are conventionally acquired from inventories and subsequently sold to manufacturers, who have the option to utilize the fibers in the fabrication of novel materials (Cambridge, 2008).

3.2.9 Asphalt roofing

Waste asphalt can be categorized according to its size and utilized in the construction of new roadways, foundations, or roofing materials beneath the primary road layer. Asphalt shingles are composed of felt that has undergone an asphalt coating and reinforcement process involving rock granules and mineral stabilizers. Approximately 20% to 35% of the product's weight is asphalt. It is imperative to remove any contaminants present, such as metallic objects and wood debris (Laquatra & Pierce, 2002). A number of additional items typically have a lesser volume than other forms of waste. Illustrative instances of such materials include furniture, irrigation fixtures, electronics, tires, and non-ferrous materials such as stainless steel or copper. If a secondary market exists, these materials will be valuable. In addition, certain items of this category require unique management and handling procedures. For tires, for instance, shredding is required to prevent their disposal in landfills. Particular appliances necessitate cautious management due to the potential presence of hazardous materials.

3.2.10 Facility Design

A number of additional products contain less refuse than others. Non-ferrous metals (e.g., copper or stainless steel), furniture, refuse from land clearing, electronics, tires, and plumbing fixtures are among these items. When a secondary market is present, these items will possess value. Furthermore, certain of these objects necessitate distinct protocols for handling and administration. For instance, tires necessitate shredding prior to their disposal in a landfill. Certain appliances may contain hazardous substances and therefore must be handled with care.

Table 3.1 Typical composition of Indian C & D waste

Sl.No	Material	Composition
1	Soil, Sand & Gravel	36%
2	Brick & Masonry	31%
3	Concrete	23%
4	Metals	5%
5	Bitumen	2%
6	Wood	2%
7	Others	1%

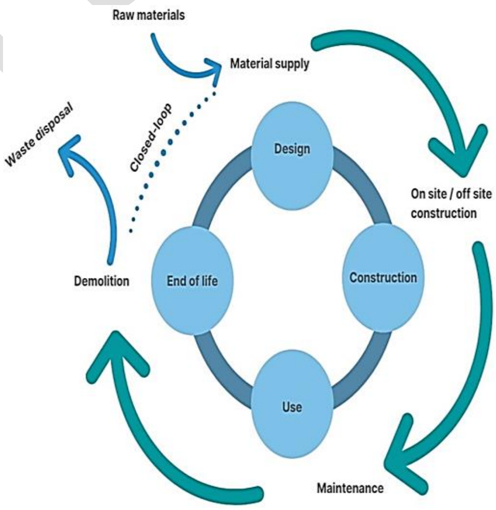

Figure 3.1 C&D waste circular economy

CHALLENGES AND CONCERNS REGARDING C&D WASTE MANAGEMENT IN INDIA

India requires the development of a streamlined C&D waste management system. Before proceeding, it is critical to gain a comprehensive understanding of the issues and obstacles that the Indian construction industry must confront in its endeavor to enhance C&D waste management. Consequently, an exhaustive examination was undertaken in order to determine the issues and obstacles. In this section, a summary of the issues and obstacles has been provided, which is detailed in Table 3.1. The identified issues have offered valuable insights into the present condition of waste management for C&D in India. Rapid infrastructure development in India is contributing to an increase in waste production, particularly as the urban population and demand for housing and infrastructure initiatives continue to expand. Waste generation has increased as a result of urbanization, which has increased the pressure on relevant organizations to assure waste minimization in the in the interest of ecological preservation. Furthermore, the construction sector would negatively impact the environment if not managed appropriately. For instance, construction materials can substantially pollute the atmosphere by emitting carbon dioxide and other greenhouse gases. Figure 3.1 depicts the C&D waste circular economy.

The prevalence of illicit disposal in India has been demonstrated in the works of Mahayuddin et al. (2008) and Nagapan and Asmi (2012). Illicit waste disposal has proliferated due to construction actors' irresponsible decision-making, which has been facilitated by the dearth of landfills and the escalating volume of waste. Lastly, for the implementation of C&D waste management in India to be successful, skill development for enhanced management is required. A multitude of entities are engaged in the construction process; on certain occasions, ambiguity has arisen regarding the allocation of refuse management responsibilities due to inadequate organizational abilities.

SUMMARY

The management of construction and demolition (C&D) waste is of utmost importance for the long-term viability of India. This research contributes to the advancement of a systems-based and circular economy approach to C&D waste management. CE is a non-hazardous method of development that may be taken into account when managing C&D waste. CE is committed to ensuring the efficient management of construction industry refuse. As of now, India lacks a comprehensive framework, paradigm, or guideline that specifically addresses the management of C&D waste. Therefore, India must investigate the sustainable construction practices of other Asian nations, including Japan and Hong Kong. It is imperative that India undertakes comprehensive and stringent measures to guarantee the efficient management of construction and demolition (C&D) waste. One potential approach is to incorporate the concept of CE, which may lead to the adoption of more environmentally sustainable construction practices.

RESEARCH METHODOLOGY

GENERAL

Research is a structured method for problem-solving that involves a series of stages to be carried out. Social research is mostly focused on descriptive studies. The study concentrated on the societal advantages of recycling building and demolition trash. The main sources of the study are building enterprises located in places such as Coimbatore, Chennai, and Madurai. The researcher observed waste handling practices carried out by construction businesses as part of the study. An oral presentation was given to the workers and owners of the companies about recycling, reusing, and reducing trash output. The Architecture Engineers were clearly informed about the significance of appropriate design to support the waste handling process. The current study "A Study on Perception and Practices of Construction and Demolition Waste Management in Selected Cities of Tamilnadu" is based on both primary and secondary data.

PILOT STUDY

The original data was gathered using questionnaires and survey methodology. A pilot study was carried out with 50 samples consisting of Managers and Administrators from construction organizations that underwent a pretest for questionnaire refinement. The questionnaire's reliability was assessed throughout the pilot research. The study utilized a Simple Random Sampling technique.

POPULATION OF THE STUDY

The construction companies from Coimbatore, Chennai & Madurai area of Tamilnadu were considered as the population of the study. Total population was around 20 construction companies were chosen from the selected cities of South India.

SECONDARY DATA

The secondary data was gathered from a variety of sources including books, journals, and research papers, annual reports of firms, and governmental publications on waste management. Industrial reports from the Central Pollution Control Board of India and the internet. Statistical tools were used to make logical and scientific findings and inferences to attain the intended aims and verify the necessary underlying hypotheses. The research utilized both primary and secondary data. The acquired data was analyzed using descriptive and applied statistics through SPSS software.

SAMPLE SIZE CALCULATION

The samples collection from the cities were given equal importance as all the cities the quantity of waste generation is almost same. So a sample size of 50 from each city was justifies by the researcher. So totally 150 questionnaires were circulated among the respondents to collect their opinion. The response rate is almost equal from all the three cities.

CONCLUSIONS AND WORK SCHEDULE FOR PHASE 2

❖ Effective waste management on construction sites is paramount for environmental sustainability and operational efficiency.

❖ It involves proper planning, segregation, recycling, and disposal of waste materials generated during construction activities.

❖ Implementing strategies such as onsite sorting, reusing materials, and partnering with recycling facilities helps minimize landfill waste and reduces the environmental impact of construction projects.

❖ By prioritizing waste management, construction sites can contribute to a cleaner environment while optimizing resources and costs.

❖ A questionnaire study will be carried out among several construction companies situated in and around the Coimbatore, Chennai, and Madurai region. After collecting the data, statistical analysis must be conducted using the SPSS software tool.

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