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Construction Waste Management

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Abstract: - *This study contains the general application of a construction waste management plan is to minimize the number of materials going to landfills during construction by diverting the construction waste and demolition and land clearing debris from landfill disposal. The construction and demolition waste has been correspondingly increased enormously which results in nasty and fatal impacts on urban sustainability and survival in the term of economic values and environmental safety. In literature, various methods have been employed to quantify the C&D waste generation at both regional and project levels. However, an integrated review that systemically describes and analyses all the existing methods has yet to be conducted. To bridge this research gap, an analytical review is conducted. Papers are retrieved based on a set of rigorous procedures. The characteristics of the selected papers are classified according to the following criteria - waste generation activity, estimation level and quantification methodology.*

Keyword: - Construction Waste Management, Landfills, Debris, Sustainability, Environmental Safety, etc.

I. INTRODUCTION

The construction industry is a major contributor to excessive natural resource consumption, depletion and degradation; waste generation and accumulation; and environmental impact and degradation. The amount of waste generated by the construction and demolition activity is substantial. Surveys conducted in several countries found that it is as high as 20% to 30% of the total waste entering landfills throughout the world. Moreover, the weight of the generated demolition waste is more than twice the weight of the generated construction waste. Other studies compared new construction to refurbishment, and concluded that the latter accounts with more than 80% of the total amount of waste produced by the construction activity as a whole.

The building activity at historical city centers tend to be an important waste generator because both refurbishment projects and new projects often include demolition. Construction site activities in urban areas may cause damage to the environment, interfering with the daily life of local residents, who frequently complain about dust, mud, noise, traffic delay, space reduction, materials or waste deposition in the public space, etc. Responsible management of waste is an essential aspect of sustainable building. In this context, managing waste means eliminating waste where possible; minimizing waste where feasible; and reusing materials which might otherwise become waste. Solid waste management practices have identified the reduction, recycling, and reuse of wastes as essential for sustainable management of resources.

II. AIMS & OBJECTIVES

1) To lack of waste minimization,
2) Using the questionnaire survey approach,
3) Overcome the lack of awareness about construction and waste minimization,
4) Effective strategies identified by this study.

III. LITERATURE REVIEW

[1] Mahesh H 1 & Manish D Mata2, "Construction Waste Control: "A case study In India, contractors play crucial role in C&D waste management. There are provisions according to which the Contractor has to dispose of demolition wastes at his cost. C &D wastes generally arrive of new construction, repair and renovation of structures, demolition of an old building/structure etc. Demolition contractors are hired when an old building has to be demolished owing to its deterioration or to create space for construction of a new building [5]. According to TIFAC study, the items

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which are recovered in the process of demolition are sold in the market at lower rates. Items that cannot be re-used, are disposed to landfill sites. Some municipal corporations allow the waste coming from construction and demolition in their landfills, while others restrict it. Contractors are reluctant to segregated different constituents prior to disposal. Builders/owners bear the cost of transportation. It is also observed that though guidelines are there regarding disposal of waste into landfills, the penal action against violators is generally not taken.

[2] A. A. Dania, J. O. Kehinde and K. Bala, "A STUDY OF CONSTRUCTION MATERIAL WASTE MANAGEMENT PRACTICES BY CONSTRUCTION FIRMS IN NIGERIA" The California Integrated Waste Management Board (2003) described Sustainable Construction as a whole building approach to design and construction that saves or reduces resources in five categories: site, water, energy, materials and environmental quality. Sustainable construction, according to Watuka and Aligula (2003) can also be said to be "the set of processes by which a profitable and competitive industry delivers built assets: building structures, supporting infrastructure and their immediate surroundings which: i. Enhance the quality of life and offer customer satisfaction ii. Offer flexibility and the potential to cater of user changes in the future iii. Provide and support desirable natural and social environments iv. Maximize the efficient use of resources while minimizing wastage."

[3] Minaxi Rani1, Alisha Gupta2 "CONSTRUCTION WASTE MANAGEMENT IN INDIA "Construction industry is largest economic expenditure in India. According to eleventh five-year plan, it is the second largest economic activity after agriculture. The impact caused to the environment by Indian construction industry is also large. Construction industry consumes high volume of raw materials and products. It generates high employment opportunity. Based on an analysis of the forward and backward linkages of construction, the effect in the construction on economy is estimated to be significant [2]. The boom in the economic growth in the country is attributed to the developments in the construction industry. Investment in construction accounts for nearly 11 per cent of India's Gross Domestic Product (GDP). Our construction sector is likely to continue to record a higher growth rate in the years to come due to the Governments recent initiative to allow cent per cent foreign direct investment in real estate development related projects. Based on the studies done by Technology, Information, Forecasting and Assessment Council –TIFAC (2000) the total construction works in the country for the five years during 2006-2011 has estimated to be for $847 billion. From the cost analysis of various modes of expenses in Indian construction industry, it has been seen that the component of material cost comprises nearly 40 to 60 per cent of the project cost. The material waste generation in construction industry is huge in monetary terms.

IV. PROPOSED METHODOLOGY

Cloud When determining reduction and management strategies for construction waste, the Government's objectives are to reduce waste generation, maximize reusing and recycling and reduce the intake of mixed construction waste at landfills. In order to develop and implement the waste reduction and management strategies at project level, proper quantification of construction waste generation is a prerequisite. Our research reveals that limited information is currently available for understanding the magnitude and composition of construction waste and for preparing an appropriate construction waste management plan for a project on new or existing facilities.
Proper Procedures to be followed for Construction Waste Management: -

1. **Reduce Construction Mistakes-** To prevent mistakes in construction, teams need to do their due diligence to focus on the quality of the product that they provide. Standardization is one method to achieve greater quality control implemented throughout all stages of construction.

2. **Store Your Materials Properly -** This is a no-no when it comes to storing construction materials safely. Instead, always use a pallet or wooden planks between layers. This creates a stable, flat surface for upper layers to rest upon. In order to ensure you make the most of your materials, you should store similar items together.

3. **Order the Right Number of Materials -** Quantities of materials for concrete such as cement, sand and aggregates

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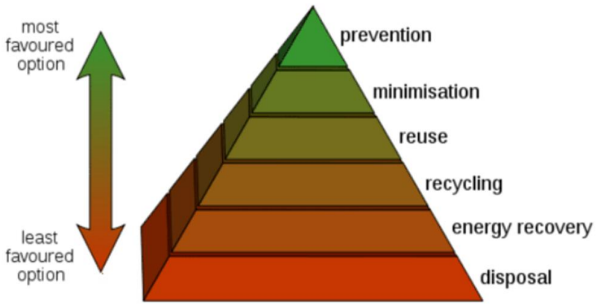
for production of required quantity of concrete of given mix proportions such as 1:2:4 (M15), 1:1.5: 3 (M20), 1:1:2 (M25) can be calculated by absolute volume method. This method is based on the principle that the volume of fully compacted concrete is equal to the absolute volume of all the materials of concrete, i.e., cement, sand, coarse aggregates and water.

4. **Choose Building Products with Minimal Packaging -** Reducing packaging materials and minimizing waste are two big components of sustainable packaging. And when implemented correctly, they lead to more efficient storage, so you can limit the space required to house your products (thus lowering storage costs), or open up additional space to store more merchandise.

V. ADVANCE STRATEGY

Sustainable development is the need of the hour that needs to be incorporated by every industry in every country around the globe. The construction industry is one of the most contributing industries to the major economies around the world. Moreover, the waste it generates needs to be strategically taken care of. In most countries including Jordan, the management of waste generated by the construction industry does not have a proper disposal system.
The long-recognized hierarchy of management of wastes, in order of preference consists of prevention, minimization, recycling and reuse, biological treatment, incineration, and landfill disposal



1. **Waste Prevention-** In building of mega cities, the construction industry is contributing to alarming volumes of construction materials waste being generated causing an imbalance in the world's ecosystem. The study developed a framework for construction waste prevention strategies as a sustainable tool in building mega cities. Using content analysis of various literatures reviewed, the study developed a framework for preventing waste generation in construction projects in mega cities. In the building of present and future mega cities, there is need to submit mandatory construction waste prevention strategies as part of the contract documentation to the client, client representatives and the town planning authorities in order to build livable and sustainable cities.

2. **Waste Minimization-** Waste minimization design (WMD) is a key strategy for effectively minimizing

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construction waste at an early stage. However, it seems that appropriate methods for estimating the effect of various design measures on construction waste reduction with consideration of the interrelationships of potential design strategies are lacking. This study proposes a model for quantitatively assessing the effect of various waste management strategies and policies at the design stage on waste reduction.
Simulation results show that (1) the use of prefabricated components exerts the largest influence on the design of construction waste reduction, followed by few design modifications and waste reduction investment, (2) mutual effects exist among potential design strategies, and (3) the combined effect of multi-design strategies is more significant than the simple sum of the effects of all single-design strategies and thus demands full consideration of the combined effect of relevant potential design strategies.

3. **Recycling and Reuse-** It is well known that reserves of non-renewable resources are limited and that waste emitted into the air, soil and earth pollute the environment. In addition to proposing a change in the architects' way of thinking, the climate change further requires an improvement in the environment, politics and social consciousness. The chase for sustainable architecture must also consider the end of the life cycles of materials. The aim of this work is to introduce new concepts regarding materials and building elements that reach the end of their first life cycle and to evaluate the potential for recyclability of those materials.
The research method is based on a hierarchic upside-down pyramid that gives priority to the reuse and recycling of materials and afterwards allows for the creation of recyclability levels of the materials and elements. The results show that the concepts created regarding recycled, intracycle, reused and infused materials are more suitable to the current situation. The indexes of recyclability quantify the betterment of the environment in the construction processes of buildings that are made from recycled or recyclable materials.

4. **Biological Treatment-** Landfill disposal of wastes containing significant organic fractions is increasingly

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discouraged in many countries, including the United States. Such disposal practices are even prohibited in several European countries. Since landfilling does not provide an attractive management option, other techniques have been identified. One option is to treat waste so that biodegradable materials are degraded and the remaining inorganic waste fraction (known as residuals) can be subsequently disposed or used for a beneficial purpose.

Biodegradation of wastes can be accomplished by using aerobic composting, anaerobic digestion, or mechanical biological treatment (MBT) methods. If the organic fraction can be separated from inorganic material, aerobic composting or anaerobic digestion can be used to degrade the waste and convert it into usable compost.

5. **Incineration-** Use of incinerator ash in construction of highway pavement layers may have the potential to significantly reduce the quantity of ash that must be disposed of. However, the physical properties of ash are not optimal for construction of normal asphalt pavement. When designed and applied properly, foamed asphalt provides a way of obtaining good coating on granular materials made from ash and hence adequate cohesion of pavement materials. Also, foamed asphalt provides a way of using materials with relatively high percentage of fines and moisture content. This paper briefly reviews foamed asphalt and its use, production of aggregate from incinerator ash, and describes design, construction, and evaluation of a parking lot pavement using foamed asphalt-treated ash.

   Based on the results obtained from mix designs it was recommended that 2% lime be added to a mix with 100% ash (at optimum moisture content), and that 1% lime be used when 75% ash is combined with 25% recycled concrete-the recycled concrete being minus 12.5 mm material. For both 100% ash and the combination of 75% ash and 25% recycled concrete (minus 12.5 mm material) a design foamed asphalt content of 4.5% was recommended. Laydown and compaction of experimental foamed asphalt treated recycled ash mix was

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completed without any major problems. Results of Benkelman beam test showed that the foamed asphalt treated recycled ash mix layer cured and gained adequate stiffness within a period of 24 h.

VI. Benefits of Construction Waste Management

Construction waste is generated from the various construction activities of building, maintaining, renovating, and demolishing infrastructure facilities. These materials include, but are not limited to, concrete, rubble, fiberglass, asphalt, bricks, wood, and scrap metals. In the last few decades, there has been a significant increase in the volume of construction and demolition (C&D) waste materials in the United States (U.S.). Between 1990 and 2017, the total increase in debris generation has surpassed 320%. According to U.S. solid waste management statistics, more than 50% of C&D waste has been and continues to be transported to landfills. The disposal of C&D waste materials in landfills can adversely affect the environment and is not viable economically. Also, C&D waste materials left on construction sites can threaten the safety of construction workers. The application of strategic C&D waste management practices through reducing, recycling, and reusing waste materials is essential for sustainable management of limited resources and thereby can benefit the environment, construction safety, and the economy. For example, the advantages of C&D waste management include reduced environmental pollution, expanded job opportunities, savings in construction project expenses, and enhanced safety for construction workers.

APPROCH- A literature review was conducted to gather information on project characteristics and its classification, construction waste management, waste management plan and its benefits. Subsequently, a set of questions was

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formulated to gain insight and opinion on the selection of project characteristics and particular benefits of construction waste management. A set of questions pertaining to different project characteristics linked with benefits of waste management was sent to each of the personnel for their views.

FINDINGS - The results of this study establishes that the key materials used in projects, project size in terms of total installed costs, and project type have perceptual impacts on benefits from construction waste management.

ORIGINALITY/VALUE- Understanding how project characteristics will affect the benefits can help the construction industry to identify projects to which the waste management should first be applied, maximizing its benefits.

SITE WASTE MANAGEMENT PLANS - A Site Waste Management Plan (SWMP) provides a framework which can help contractors or project managers to forecast and record the amount and type of construction waste that is likely to be produced in a project, as well as assist in setting up appropriate management actions that reduce the amount of waste that will be sent to landfill (WRAP, 2007). A construction waste management plan aims to improve materials resource efficiency by implementing reuse, recovery and recycling as well as to minimize issues such as illegal dumping by properly documenting waste removal processes (Defra, 2009).
In the next stage, the series of waste prevention, waste reduction, waste management and recovery actions to be taken during the design, procurement and construction will be agreed and recorded by the project team. Following this, the type, source and quantity of waste arisings anticipated from the project are forecasted with the aid of benchmarks for the various types of development (residential, education, health, infrastructure, commercial, retail etc.).

Project Stage	SWMP Actions
Project Set Up	• Enter project details
Concept Design	• Record waste prevention actions
Detail Design	• Forecast waste • Record waste reduction actions
Pre Construction	• Specify waste carriers • Plan waste destinations • Record waste management and recovery actions
Construction	• Enter actual waste arisings, reduction, recovery and management activities. • Carry out training, monitoring and recording.
Post Construction	• Compare actual against forecast waste management activities • Assess performance based on KPIs • Suggest improvement for next project

VII. GUIDELINES

Responsible management of waste is an essential aspect of sustainable building. In this context, managing waste means eliminating waste where possible; minimizing waste where feasible; and reusing materials which might otherwise become waste. Solid waste management practices have identified the reduction, recycling, and reuse of wastes as essential for sustainable management of resources.
Many opportunities exist for the beneficial reduction and recovery of materials that would otherwise be destined for disposal as waste. Construction industry professionals and building owners can educate and be educated about issues such as beneficial reuse, effective strategies for identification and separation of wastes, and economically viable means of promoting environmentally and socially appropriate means of reducing total waste disposed. Organizations and governments can assume stewardship responsibilities for the orderly, reasonable, and effective disposal of building-related waste, promotion of public and industry awareness of disposal issues, and providing stable business-friendly environments for collecting, processing, and repurposing of wastes. Businesses can create value through the return of wastes back to manufacturing processes, promoting and seeking out opportunities for incorporation of recycled materials

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into products, and prioritizing reduction of building-related wastes through efficient jobsite practices.

DUTIES OF WASTE GENERATORS-

- Every waste generator shall segregate construction and demolition waste and deposit at collection center or handover it to the authorized processing facilities.
- Shall ensure that there is no littering or deposition so as to prevent obstruction to the traffic or the public or drains,
- Large generators (who generate more than 20 tons or more in one day or 300 tons per project in a month) shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition or remodeling work.
- Large generators shall have environment management plan to address the likely environmental issues from construction, demolition, storage, transportation process and disposal / reuse of C & D Waste.
- Large generators shall segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar.
- Large generators shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities.

DUTIES OF SERVICE PROVIDERS AND CONTRACTORS-

- The service providers shall prepare a comprehensive waste management plan for waste generated within their jurisdiction, within six months from the date of notification of these rules.
- Shall remove all construction and demolition waste in consultation with the concerned local authority on their own or through any agency.

DUTIES of STATE GOVERNMENT and LOCAL AUTHORITIES-

- The Secretary, UDD in the State Government shall prepare their policy with respect to management of construction and demolition of waste within one year from date of final notification of these rules.
- The concerned department in the State Government dealing with land shall provide suitable sites for setting up of the storage, processing and recycling facilities for construction and demolition waste with one-and-a-half years from date of final notification of these rules.
- The Town and Country planning Department shall incorporate the site in the approved land use plan so that there is no disturbance to the processing facility on a long-term basis.
- Shall procure and utilize 10-20% materials made from construction and demolition waste in municipal and Government contracts.

Duties of Central Pollution Control Board, State Pollution Control Board or Pollution Control Committee

- The Central Pollution Control Board shall prepare operational guidelines related to environmental management of construction and demolition waste.
- SPCB shall grant authorization to construction and demolition waste processing facility
- Monitor the implementation of these rules by the concerned local bodies

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- Submit annual report to the Central Pollution Control Board and the State Government.

Standards for Products of Construction and Demolition Waste

- The Bureau of Indian Standards need to prepare code of practices and standards for products of construction and demolition waste.
- Indian Roads Congress need to prepare standards and practices pertaining to products of construction and demolition waste in roads construction.

Duties of Central Ministries

- The Ministry of Urban Development, and the Ministry of Rural Development, Ministry of Panchayat Raj, shall facilitate local bodies in compliance of these rules.
- The Ministry of Environment, Forest and Climate Change shall review implementation of these rules as and when required.

Facility for processing / recycling facility

- The operator of the facility shall obtain authorization from State Pollution Control Board or Pollution Control Committee.
- The processing / recycling site shall be away from habitation clusters, forest areas, water bodies, monuments, National Parks, Wetlands and places of important cultural, historical or religious interest.

The processing/recycling facility exceeding five Tonnes per day capacity, shall maintain a buffer zone of no development around the facility.

VIII. CONCLUSION

The survey results show that the general practice of Solid Construction Waste Management and site waste management as a whole is very poor and has room for a lot of improvement. The construction Professionals' understanding of construction waste management was found to be deficient, and the adoption and practice further hampered by lack of sufficient legislation or Government incentives to encourage the teachings of sustainable construction.

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