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ROLES OF SUSTAINABILITY PILLARS IN CONSTRUCTION WASTE MINIMIZATION – A REVIEW

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ABSTRACT

Waste generation during construction is a major concern that affects sustainable development, and many professionals around the world have shown interest in proposing practices to reduce construction waste. The conventional construction method is based on a large-scale on-site concreting of frame structures, in which steel is used for reinforcement other structural members are (beams, columns) and roof in situ. Phases of construction are categorized into four different steps, leading to the accumulation of construction waste if not managed strictly. As the nature of the construction industry is unsustainable, these types of activities result in a huge amount of environmental harming gases, the cement emits dangerous CO_2, causing the greenhouse effect, these challenges can lead to long-term concerns of the construction industry. The construction industry using around 50% of material that is extracted from the earth contributing significantly to the depletion of natural resources. The decrease in natural resources of the earth is affecting the earth's ability to meet the demand to remain sustainable. These activities of extracting material have a great impact on the social pillar of sustainability, as it causes pollution, toxic substances, affecting drinking water and humans, impacting living conditions, cultural and religious values. Construction serve as financial support to the country's economy, by minimizing construction waste will boost long-term sustainability, as it provides job opportunities at domestic and international levels. Investors are seeking a solution to control environmental deterioration and climate change. The long-term strategies to minimize the waste in construction sector will support agencies of government and private firms to implement successful waste managing planes.

Keywords: *Sustainability, Construction waste minimization, waste management, building materials , pillars*

1. INTRODUCTION

David Carvajal-Arango et al. (2016) Stated that sustainable development and its implementation in the construction side have piqued the interest of the professionals and the people of academics in the field of design, construction and engineering, in correspondence with the modernization of current social practices. The deterioration of the natural surroundings caused by human actions also affects the ecosystem, economy, and culture from the point of this industry.

Assem Al-Hajj et al. (2011) stated that most countries are attempting to balance improving construction and the built environment and keeping the natural environment protected to achieve sustainable development. Miyatake et al. (1996) stated that, this balance can only be attained by switching from a straight to a cyclic manufacturing method based on material waste minimization, re-using, and recycling (Du Plessis, 2002). This research paper aims to discuss construction waste minimization and involvement of pillars of sustainability, Jiayuan Wang et al. (2013) stated essential aspects that might considerably impact the efficiency of building waste elimination.

2. CONVENTIONAL WAY OF CONSTRUCTION

Suresh et al. (2012) discussed that the industry has long been and direct source of waste generation and is often faced with the challenge of its better monitoring to limit the damage. The conventional method is based on large-scale cast-in-place execution in typical construction, the steel reinforcement can be used for reinforced concrete frame structures and beams, columns, and roofs in situ, and timber can also be used for reinforcing purposes. Steel ties, construction of prefabricated members, and concrete work are three independent techniques required for expert site workers and bricklayers. Wai Kiong Chong et al. (2009) Stated construction of structures is divided into four steps, first is scaffolding installation, second is making steel ties or rebar bending work, third is fresh concrete pouring into structures members, and 4rth is after concrete final time removal of formwork and scaffolding. The non-structural construction materials are brick and plaster. Fig.1 shows the conventional construction activates, and each phase can create different types of construction waste.

Phases	Building elements	Activities
I	Earthwork	• Land clearing • Cut and fill of earth
II	Sub-structure	• Basement • Foundation • Plant and equipment • Drainage • Underground services
III	Superstructure	• Column, beam, bearing wall, lift shaft, stairs, slabs, frames • External work – walls and roof • Internal Finishes – wall finishing, floor finishing, ceiling finishing • Fixtures and fittings • Services – sanitary appliances, disposal installations, water installations, ventilation system, electrical installation, protective installations, builder's works in connection
IV	External works	• Site works • Drainage and sewerage • External services • Landscaping

Figure 1: Phases of construction (Suresh Kumar Lachimpadi, 2012)

3. UNSTABLE NATURE OF CONSTRUCTION INDUSTRY

Tarun R. Naik et al. (2008) suggested about our earth's wellbeing and society's continuing progress, and human development all depends on the sustainability of construction. Concrete is one of the world's most extensively utilized building materials. However, the manufacture of Portland cement is an important part of concrete for construction, and it results in a large scale of CO2 emission, as one ton of Portland cement emits around one ton of CO2 along with other dangerous greenhouse gases (GHG).In addition to concerns related to natural resources, environmental challenges related to GHG play a major role in the cement and concrete industries' long-term viability. Table 1 shows environmental impact assessment of GHG emissions of different construction material (equivalent/kg produced material – eq. /kg):

Table 1: Emission of different building materials (Shady Attia, 2018).

Material	Mass per volume (kg/m^3)	GHG emissions (gCO^2 eq,/kg)
Steel reinforcement	7850	440
Lightweight concrete	700	330
Mortar	880	270
Ready-mixed concrete	2400	200

James M.W. Wong at el. (2010) stated that excessive and unnecessary changes made in construction activity are undesired, but a thorough and planned strategy implementation is needed to maintain the construction sector's growth. M.R. Abdul Kadir et al. (2006) Stated, consider the significance of growth by sustainable methods for this industry, and strategic induction of rules in construction is mainly confined as seen from the organization's perspective. For the construction sector to execute efficiently and its inefficient expansion rating, a viable and stable framework is essential. The industry, along with producers of construction material, supports it and is among the largest world exploiters of resources, including physically and biologically. The industry consequently contributed very considerably to the unsustainable cause of industry at the present time that affects the development of the world's economy. Tarun R. Naik et al (2008) Stated, In 2002, the United States generated 140 million tons of waste of construction and demolition or roughly 1.4 kilograms per person waste generated each day, according to construction and demolition C&D waste 2003. C&D waste takes up between 25 to 40 percent of landfill spaces. McKay's book was published in 2004. If this trend continues, the cost of landfilling will rise, as will the possible health and environmental problems associated with landfill bi-products.

4. CORRELATION OF SUSTAINABILITY TOWARDS CONSTRUCTION WASTE MINIMIZATION

This construction industry is an essential aspect of the financial backbone taken by countries all around the world. Fig.2 illustrates the aspects of sustainability pillars. The effect on one lead to disturbance of other [source Anders Klang: 2003]. Jingkuang Liu et al. (2020) stated construction waste minimization is a method to decrease the quantity of harmful waste created during the project construction even to the smallest amount possible; hence minimizing the waste will lower environmental impact and boost the construction industry's long-term sustainability. Effie Papargyropoulou et al. (2011) stated the construction sector is a significant provider to the growth of a country by providing the infrastructure and physical structures required for everyday work such as trading or business, services, and utility. M Agung Wibowo, (2009) discussed by offering other countries and domestic investors opportunities, the sector gives job opportunities and introduces financial support into the country's economy. With such advantages to this industry, it contributes to climate change, waste, and deterioration of the environment (Jones & Greenwood, 2009). Zuhairi Abd Hamid et al. (2016) Sated with the increasing development in under-developed nations, construction activities have led to an increase in the accumulation of construction waste. The poor management of waste produced during construction show bad impact on the surroundings such as climate change, disturbance in water quality and making soil polluted, decrease in quality of air and effect on ecosystem making it imbalance, social as well as general wellbeing (potential health risk, effect on species of insects and impact on works safety) and the economic system causing a decrease in natural resources and increase in energy consumption, also have impacted the tourist industry). Despite the awareness of the effect of construction waste, the rules and regulations being regulated to handle it in all the countries have been at an unsatisfactory level. Fig.2 shows the relation between the interconnection of sustainability by preserving natural resources without affecting the economy and maintaining the excellent quality of people's lives.

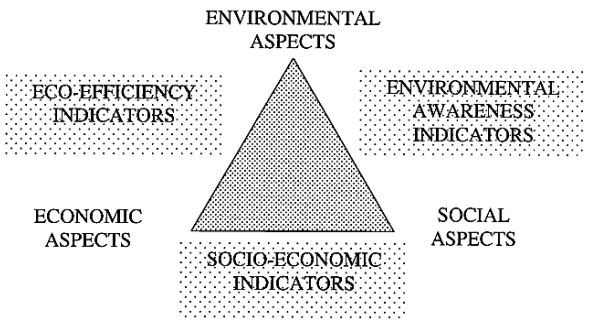

Figure 2: Relation of sustainability pillars (Anders Klang, 2003)

4.1 Economic

Jiayuan Wang et al. (2014) stated "Waste management investment" managed to obtain the 2nd position in importance, obtaining a significance ranking of 3.535. Wilson Lu et al. (2013) stated Examples of financial management of waste could also support or encourage professionals to apply construction waste practices that also include workforce employs for on-site waste collection, trying to sort and ability to handle it, acquiring waste disposal machines and equipment, designing and executing waste management plans, motivating professionals to reduce construction waste and trying to improve the operative's waste processing abilities via training. Zhen Chen et al. (2002) stated by definition, construction is not even an environment-friendly industry.

Moreover, economic profit is the primary aim of different construction investors. The members have little motivation to naturally seek environmental and social performance without any funds for waste management. This behaviour concludes that compensation plans drive construction parties to expand their involvement in reducing waste strategies.

4.2 Social

Marcela Spišáková et al. (2021) discussed about construction business has significant opportunities for minimizing waste. Most of the material created during construction and demolition is dangerous and hence can be recycled. The unfortunate truth is that there are always many hurdles to effective waste management. Serdar Durdyev et al. (2018) stated the industry provides a substantial contributor to the sustained advancement of the whole economic system by accomplishing overall objective growth like creating jobs, re-distribution, and generating revenue. Anders Klang et al. (2003) discussed ways to recycle and re-use material can reduce the negative impact on social aspects, and waste management has the potential to create sustainable growth. The goal is to give the idea to communities, or even countries, how they are moving toward sustainability or far away from it (Rees et al. 1994).

4.3 Environmental

Nurzalikha Saadi et al. (2016) Stated that the construction sector is just being ignorant about its environmental impact and is often known as a profit-oriented business. Sasitharan Nagapan et al. (2013) Stated, the industry contributes significantly to both infrastructure and economic growth. The industry has long been recognized as one of the most significant involvements in negatively impacting the environment. To control the adverse consequences, a thorough study of waste management is needed to develop. Furthermore, the amount of waste has increased gradually due to construction activities for the past several years. The building sector generated a tremendous amount of waste, around 21.5 million tonnes of waste generated by construction in 2005, with 11% of it going to landfill and the other 89% to local filling places (L. Jaillon et al. 2009). Peter Glavic et al. (2007) stated environmental rules define the terms that show environmental and social effects to reduce the material that can harm the environment, material, and resources. Environment regulations specify the criteria that indicate environmental and social effects in the process to minimize the use of potentially harmful materials, substances, and equipment. James M.W. Wong et al. (2009) stated even though a Construction Industry Review Committee (CIRC) was established to completely evaluate that condition of construction and to offer improvement strategies, the suggestions tend to be of a list of agenda. Strategic implementation seems the most effective solution for the long-term success of the industry. Otherwise, the construction industry will suffer permanently if proper policies and plans are not introduced, which might affect the country's economy (S. Thomas Ng et al., 2009).

5. CONCLUSIONS

Sustainability for growth from the perspective of social, environmental, and economical is essential. Construction industry activities can cause unforeseeable effects on the environment, economic and social aspects. Waste minimization as a critical strategy can be achieved for long-term sustainability. This paper is about the minimization of construction waste by adopting sustainability pillars in construction projects. From the current research, it is concluded that.

- Environmental guidelines will be effective against any construction waste having the potential to harm and deteriorate the environment.
- According to Jiayuan Wang et al. (2014) economic pillar has the second most important in construction as it is backbone of the country's economy and sustainability, motivating professionals to reduce construction waste.
- Social aspect is third important aspect. Some investors try to ignore the waste concerns having negative impacts on social life of people and its surroundings.

There is a need to adopt sustainability pillars by depth in construction projects. It is recommended that a survey be conducted to check the construction sites in terms of sustainability pillars adoption specifically for developing countries.

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