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Psychological Health and Environmental Effect of using Green Recycled Amassed Concrete on Construction

Nawal Louzi [a], Haitham M. Alzoubi [b,*], Mounir El Khatib [c], Taher M. Ghazal [d], Muhammad Alshurideh [e], Saigeeta Kukunuru [f]

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[a] *Department of Civil Engineering, Al-Ahliyya Amman University, Jordan, n.alouzi@ammanu.edu.jo Orcid:- [0000-0002-6880-5468]*
[b*] *School of Business, Skyline University College, UAE, Orcid:- [0000-0003-3178-4007], haitham_zubi@yahoo.com*
[c] *Associate professor, Program Chair, Hamdan Bin Mohamad Smart University, Dubai, UAE, M.Elkhatib@hbmsu.ac.ae*
[d] *Center for Cyber Security, Faculty of Information Science and Technology, Universiti Kebangsaan Malaysia (UKM), 43600 Bangi, Selangor, Malaysia -School of Information Technology, Skyline University College, Sharjah, UAE, taher.ghazal@skylineuniversity.ac.ae, Orcid:- [0000-0003-0672-7924],*
[e] *Department of Marketing, School of Business, The University of Jordan, Amman 11942, Jordan. m.alshurideh@ju.edu.jo.*
Department of Management, College of Business Administration, University of Sharjah, Sharjah 27272, United Arab Emirates. malshurideh@sharjah.ac.ae. Orcid: [0000-0002-7336-381X]
[f] *College of Business, Alghurair university, UAE, saigeeta8@gmail.com*
*Corresponding author Email: Haitham_zubi@yahoo.com

Abstract:
In the paper we explored the effect of green recycled amassed concrete on civil construction. Waste materials have a lot of promise for making Green Concrete. Because of the use of waste materials and by-products in place of standard concrete components allows for the production of cost-effective and environmentally friendly concrete. It has been found that using waste products and alloying elements to replace conventional components increases compressive and flexural strength, as well as salt and sulphate resistance, reduced permeability, and improved workability. Waste materials such as quarry dust are used in concrete mixes, have a lower cost per unit volume than control concrete mixes. A comprehensive life cycle research of Green Concrete employing a variety of criteria is required in order to fully comprehend the concrete properties that result. The Waste materials generated on the site must always be evacuated at the appropriate intervals in order to avoid mixing and spilling into neighboring regions." It is vital to ensure the safety of both the equipment and the people who use it. To minimize CO2 emissions, switching completely to portland cement for construction is the most effective approach now available as part of a global solution to decrease CO2 emissions and health of people and their psychology. In this field, more study is being planned.

Keywords: Green, Recycled, Aggregate, Concrete, Civil Constructions, world-wide, Environmental, psychological impact.

I. INTRODUCTION

One of the most essential characteristics of the demand for sustainable development today is that it has emerged as a serious development concern around the world, as well as a guiding norm for the construction industry [1] [see Figure 1]. The use of more reinforced and raw materials, notably high-quality aggregates, is necessitated by technological advancements in the making of concrete and concrete [2]. "The ever-increasing scarcity of mineral and energy resources, as well as environmental protection legislation [3], make it difficult to carry out this problem. "As a result, the current goal is to apply all of low-quality raw material deposits and trash from associated industries [4]. Concrete debris reuse and recycling is a viable approach for attaining long-term sustainability [5]. Waste concrete is collected, crushed, and then implemented to substitute natural coarse aggregates (NCA) in structural concrete [6]. Different monitoring mechanisms have been devised by so many governments around the world to reduce its use of concrete mixtures and enhance the recycling of concrete debris for repurposing of materials wherever environmentally, technologically, and economically possible [7]. Rising landfill costs and land scarcity are known to aggravate environmental issues. Concrete waste may be used in sustainable development to help solve these issues [8].

However, most concrete factories have been found to be hesitant to generate and apply recycled concrete aggregates (RCAs) to their full potential [9]. Production facilities have yet to grasp the usage of RCA, not only because of its ambiguous properties for concrete, but also because of unknown manufacturing methods [10]. Most concrete batching facilities have been found to be reluctant to produce and implement RCA to its full potential [11]. However, it is now essential to investigate this issue in world scenario. The question is how to rebuild the cities while preserving the destroyed structures and buildings [12].

Extraction of everything from the earth's surface to comparatively small forms of something like the earth's surface; storage; covering with dirt; establishing a forest on top; manufacturing of new construction materials; and reconstruction of towns and communities [13]. As a result, the study's primary objective is to determine the influence of green cementations materials on civil building projects [57].

II. LITERATURE REVIEW

This is where we explored the second way out of this problem, in which damaged building and structure components are used to manufacture construction materials, which are then used to reconstruct and develop new buildings and structures in their place [14]. Due to natural catastrophes, the growth of transit lines, urban redevelopment, structural decay, and changes in purpose, the practice of deconstructing old structures and constructing new ones is common [15]. Every year, approximately 850 tons of building trash is generated in the European Union, accounting for about 30% of all rubbish [16].

In the United States, demolition debris alone accounts for roughly 123 tons each year [17]. When historic structures are demolished, massive amounts of concrete rubble are created, which is often disposed of in landfills, posing major health hazards [61] and hurting the environment [18]. RCA properties have been studied for over four decades [19]. Because of RCA's undesirable physical properties, including as high water absorption [64], the quantity of water needed for a given workability rises [20–22], and most research has been confined to the production of unstructured concrete. Because of its influence on the sector's developing dynamics, insufficient data on RCA manufacturing's long-term viability and sustainability is a crucial problem that demands immediate attention [23].

It's unclear if the cost savings of using RCAs as concrete components rather than natural concrete aggregates match the expenses of manufacturing, quality control, and output in typical RCA operations [24]. The previously existing facilities available to the manufacture of huge amount of ready to use mixed concrete [25] can be one reason for the delayed acceptance of RCA production. However, for particular reasons, contemporary models, in which RCA progressively replaces NCA in different structural designs, have continued to acquire prominence [26]. For example, RCA production ensures the long-term viability of concrete debris by encouraging recycling rather than landfill disposal [27]. It also emphasizes the unavailability of natural aggregates, which reduces the potential for them, and as a result, it allows for something like the maintenance of NCA natural aggregates that are removed from open pits [28].

Although despite the expensiveness many other characteristics have inspired an increase in interest in manufacture including the use of RCA in design [29, 30]. Insufficient data on RCA manufacturing's longevity and long-term viability is discovered to be a significant problem that needs immediate action because of its effect on changing elements of the industry. As a result, the goal of this research is to give a significant analysis of the RCAs used in the building of high-performance concrete structures in depth. The origin, uniqueness, kinds, service life forecast, characteristics, and properties of RCA are studied in this research. The impact of RCA on concrete durability, and the characteristics of virgin and hardened concretes, has received increasing attention. Consequently, in the existing industrial development of eco sustainable building structures, this review of the literature outlined the research observations that provide thorough direction for future implementations of RCA as raw, renewable, but also sustainable materials of building for the manufacture of greener concrete composites [56]. The study compares high-performance concrete buildings to natural materials in order to benefit RCA manufacturing operations [31, 32]. One method of accomplishing this objective is to implement RCA generated from destroyed concrete structures. In buildings, the use of recycled concrete components reduces the requirement for natural coarse aggregate [33].

As a result, the detrimental environmental effects of spontaneous aggregate recovery are reduced. As per the results, RCA interconnections among concrete and reinforcement are unaffected with RCA intrusions in concrete. NCA concrete, on the other hand, has been observed to have a bond strength which was 9–19 percent higher than RCA concrete [34]. Because of these discrepancies, further study related to the impact of RCA on concrete bond strength is required. As a result, RCA acts as an internal curing agent, improving the ITZ between aggregate particles and cement paste and, as a result, reducing the size of holes within the microstructure of the concrete [35].

This would be because to a deeper inter-bond here between cement paste as well as aggregate particles, that gives cross-linking locations for cement paste, leading to better cement wetting as well as a more consistent ITZ [59]. The aggregate fracture value, size, and porosity of ITZ have contradictory impacts on the transport characteristics of concrete. As a result, the disparities in the current level of knowledge between RCAs and NCAs have been emphasized, as have various study ideas for further investigation.

III. METHODOLOGIES

- *Research Design And Strategies*

Research design and strategies is a descriptive research. We start with the current study framework, and then go on to secondary collecting information along with their management. We should investigate this context when the data has been collected. We were taught how to use common data collection techniques as well as how to improve new gadgets used in engineering and medicine.

- *Primary Collection of Data*

A fundamental source provides direct or firsthand from which we can gain first-hand knowledge or original information about a subject matter from genuine people. In this study, the differences between conventional and sustainable concrete were compared in terms of diffusion coefficient, particle density, LA abrasion, sodium carbonate, magnesium sulphate, chloride content, strength properties, and strength and flexural strength (Recycled Concrete Aggregate). The advancement of broken pieces of destruction building structures and structures results in the formation of large amounts of low molecular weight heparin smashing Portland cement with a size range of 0–5 mm [36, 37], which really is challenging to be used in the preparation of cement attributed to the prevalence of a substantial amount of dusty relatively small portion in their composition.

Concrete mixes were manufactured in two different ways. The first set was made using new aggregates, whereas the second set was made with recycled aggregates. Consequently, a water to cement ratio with 0.6 was chosen in the current investigation. Compare and contrast the strength properties of virgin and green concrete.

- *Green Concrete Manufacturing Process*

Controlling waste processing [58], as well as further filtering, breaking, classifying, & grading aggregates for use in the concrete construction sector, necessitates extra caution. Wood, metals, plastics, hardboard, papers, as well as other imported materials are frequently encountered in construction and demolition debris. As a result, appropriate process plan needs to be put in place.

- *Secondary Data Collection*

We shall gather secondary data from companies' printed publications [38-55], for example journals, articles, books, and the internet. This is a minor aspect of the study, but it is nonetheless significant. This type of information has been gathered and documented by some other person or group, sometimes for quite unusual reasons.

IV. RESULTS AND DISCUSSIONS

Concrete is the most important building material. A huge amount of material is accumulated during the demolition of buildings, which would then be deposited in low-lying areas or wastelands, preventing groundwater sources drains and rainwater storage sites from functioning properly. Many recycling facilities repurpose demolished materials, allowing for the production of building material (mostly coarse aggregate and sand) from destroyed waste or waste ready mix materials, which can then be utilised in the construction projects. Similarly, there are cement alternatives that decrease CO_2 emissions. Green Concrete is concrete that is made from recycled or waste materials or replacements and has a lower environmental effect. Green concrete is a building material composed of environmentally friendly elements. Construction and demolition wastes are repurposed materials.

It is estimated that the urban production in developing countries (like in India) accounts for an estimated 35% of the country's total population. Construction materials will be in high demand in the years 2021-22 (may be due to lifestyle change in CORONA pandemic), with an expected need of around 380 million tonnes of cement, 50 million tonnes of steel, 600 billion bricks, 400 million cubic meters of aggregates, and 40 million cubic kilometers of wood. Conventional and conventional construction equipment is in short supply in developing countries, which is a major source of concern. Fine aggregates have been imported in recent years, and synthetic sand/stone dust has been implemented in their purpose.

Most of the total cement manufacturing trash comes from the restoration of residences and infrastructural facilities, as well as new building to fulfil growing demand. Waste generation accounts for a significant share of overall municipal solid waste. It has been shown that irresponsible discarding and non-utilization of produced debris result in fugitive environmental degradation and other risks associated with waste management [62] in sewers, marine systems, unoccupied plots, and mixing with municipal solid trash [63], to name a few examples.

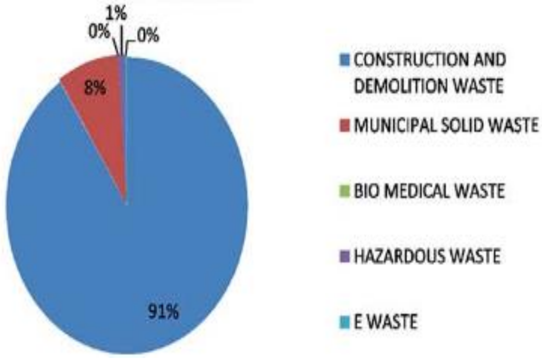

Figure 1: Solid Generation Waste

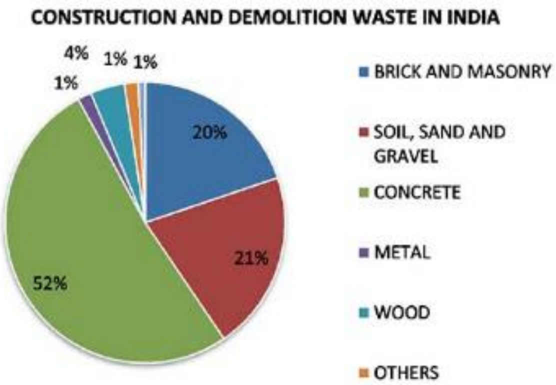

Figure 2: Construction and Waste Demolition

All Governments are running “cleanliness programs” aims to treat all solid waste, including building and demolition debris, in major cities and towns. All states should create construction and demolition wastes facilities for recycling throughout all towns and cities having populations of even more than a million of people.

The proper management and treatment of cement manufacturing debris would be beneficial to all stakeholders involved in the process. Avoiding indiscriminate dumping, pollution of the ground and air [60, 63], and providing access to construction equipment that are now in short supply are all advantages of this approach.

A reduction in the amount of strain placed on environmental assets, which are currently being plundered for development as well as for the production of carriageway components, would have been a positive development. The government is concentrating on making full use of trash from the building and demolition sectors. Concrete contains the bulk of the components in construction and demolition debris, as measured by percentage.

Construction and demolition waste accounted about 91 percent of total trash, as per the data, having concrete which accounts for more than ½ of all other construction and demolition wastes. However, just 1% of countries construction and demolition debris is recycled.

Concrete building projects are becoming more common worldwide for infrastructure development, which raises demand for construction materials. Concrete is mostly made up of aggregates. The supply of aggregates has recently become a significant issue due to continual blasting mining. There is a pressing need to discover alternatives / replacements to some degree in order to overcome this. As a result of the expansion of recycling factories, waste building material are now reused and refurbished.

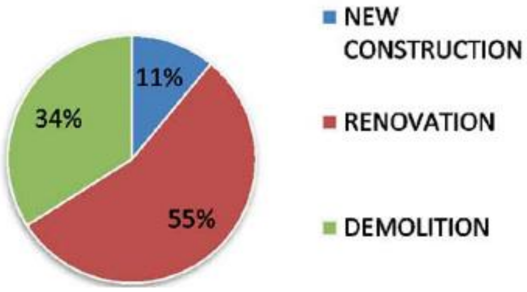

Figure 3: Construction and Demolition Waste for Residential Structures in Civil Structures

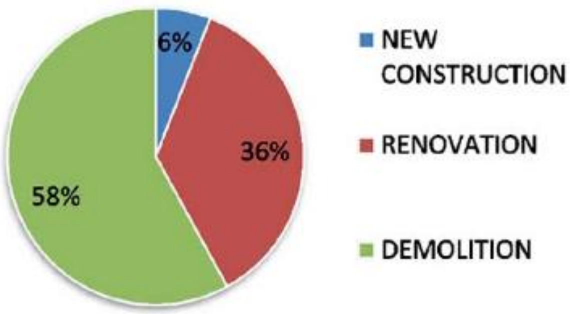

Figure 4: Construction and Demolition Waste in Civil Constructions for Non-Residential Structures

Similarly, there are cement alternatives that decrease CO_2 emissions. Green Concrete is concrete that is made using recycled or waste materials or replacements and has a low environmental effect. It's a method for turning the surroundings into concrete that consider everything from raw - materials manufacture via structural design, design mix, construction, including serviceability.

Green Concrete is significantly less expensive to create than conventional concrete since waste material are being used as a supplementary cementations material, disposal costs are decreased, manufactured electricity demand can be lowered, and the longevity of the concrete is increased.

Waste may be recycled into new products or utilized as additives in other products, allowing for more effective use of natural resources and the prevention of waste deposits. Because of increased environmental consciousness, government regulations, and economic advantages, concrete recycling is on the rise.

➢ *Environmental Effects on Concrete*

The cement industry is among the largest emitters of carbon dioxide, contributing approximately 5 percent of worldwide man-made carbon dioxide emissions, involving chemical processes contributing approximately 50percent and fuel combustion responsible about 40 percent. The amount of CO_2 emitted through producing concrete is directly related to the quantity of cement used throughout the mixture; for each and every ton of cement produced, 900 kilograms CO_2 gets released, contributing about 88 percent of emissions associated with a standard concrete mix.

The formation of carbon dioxide whenever calcium carbonate is substantially destroyed, the manufacture of lime as well as carbon dioxide in during high-temperature synthesizing of cement clinker, and the expenditure of energy each contribute to the production of greenhouse gases throughout cement production. Lime is a key component of cement, which leads to blasting and mine excavation, among other things, resulting in the depletion of natural resources.

The environmental harm caused by cement in concrete can be lowered by decreasing its consumption. Another strategy has been to partially replace traditional clinker with by-products from other sectors, including as bottom ash, fly ash and slag, which would otherwise wind up in landfills**.**

➢ *Green Concrete Properties*

In accordance with Table 1, the parameters of virgin and recycled concrete aggregate have been tested, including absorption, gravity, abrasion, sodium and magnesium sulphate and chloride content.

Table 1: Properties of newly mined and recycled aggregate or concrete

Parameter	**Virgin or newly mined Aggregate**	**Green or Recycled Aggregate)**
Absorption Capacity	0.7% to 3.8%	3.8% to 8.8%
Specific Gravity	2.5 to 2.8	2.2 to 2.5
L.A Abrasion	16% to 29%	21% to 46%
Sodium Sulphate	6.9% to 20.5%	17.5% to 58.5%
Magnesium Sulphate	3.9% to 7.1%	1.01% to 9.10%
Chloride Content	.0 Kg/m^3 to 1.20 Kg/m^3	.58 kg/m^3 to 8.14 Kg/m^3

Table 2 compares the overall strength of virgin and green concrete. IS 516 was used to estimate the compressive strength (N/mm^2). Before testing, the specimen has been properly cured. The concrete mix was made according to IS 10262, using a 1:2:4 binder-sand-aggregate ratio. Concrete mixes were manufactured in two different ways. The first set was made using new aggregates, whereas the second set was made with recycled aggregates. As a result, the current study used a water to cement ratio of 0.6. Table 2 shows compressive strength of virgin concrete and green concrete. In Figure 5, a bar chart representing the comparison has been created.

Table 2: Newly mined and recycled concrete Compressive Strength

Days		**6**	**12**	**18**
Virgin or Newly mined Concrete	1	22.1	23.92	26.11
	2	22.03	24.39	27.9
	3	21.04	25.29	27.12
Average		**21.72**	**24.53**	**27.04**
Green or Recycled Concrete	1	19.53	21.73	23.05
	2	16.63	21.8	22.19
	3	16.65	21.2	23.58
Average		**17.60**	**21.57**	**22.94**

Similarly, for Virgin Concrete and Green Concrete, the SPS (Split Tensile Strength) according to IS 516) of cylindrical specimens was measured and presented in Table 3.

Table 3: Newly mined and recycled Concrete Compressive Strength

Days		**6**	**12**	**18**
Virgin or newly mined Aggregate	1	1.19	1.58	1.68
	2	1.24	1.29	1.67
	3	1.30	1.23	1.57
Avg.		1.24	1.36	1.64
Green or recycled aggregate	1	0.78	0.75	1.24
	2	0.70	0.9	1.12
	3	0.79	0.87	1.19
Avg.		0.756	0.84	1.18

Overall compressive strength of concrete significantly reduced if we use recycled aggregates rather than newly mined aggregates. As a result, it might be utilized as a partial replacement for natural aggregates for goods like plinth protection, flooring, and paver, and so on.

The lower compressive strength using recycled aggregate concrete has been linked to the need for an upper water cement proportion to allow proper mixture, this due to the consumption of recycled tiny particles/elements. Because of the attached mortar containing recycled materials, Concrete using recycled aggregate shall hold more water than regular concrete. With recycled aggregate concrete, an increased water to cement ratio causes a small improvement throughout drying shrinkage.

Table 4: Provisions of Deployment of Green or recycled Concrete as per IS 383

Sl. No.	**Construction/Demolition Waste according to Is 383**	**Plain Concrete (in percentage)**	**Reinforced Concrete**	**Lean Concrete (in percentage)**	**Extent of Utilization**
1	RCA	25%	20 (upto grade m 25)	100%	As coarse or grainy concrete.
2	Recycled Aggregate (RA)	None	None	100%	As coarse or grainy concrete.
3	RCA	25%	20 (upto grade m25)	100%	As fine or sand like concrete.

Table 5: Auxiliary Ingredients can be used in Green or Recycled Concrete

S.No	Conventional Components	Auxiliary Ingredients can be used in Green or Recycled Concrete
1	CEMENT	Eco-Cement, Blast furnace slag. Municipal solid waste, Sludge Ash, fly ash,
2	Coarse or Grainy concretes	Aggregates made from recycled materials include waste glass, waste ready to use mix concrete, and crushed glass. Aggregates made from recycled materials also contain silica fume and recycled aggregates containing crushed glass. Insulators' waste earthenware and cemented portions are disposed of in this manner.
3	Fine recycled aggregate	Fine recycled aggregate is used in the construction of roads and bridges. Quarry dust, demolished brick debris, waste glass powder, rock dust and pebbles, and other similar materials are used. Limestone sludge powder, artificial sand, and other materials and micro silica are all used in the production of micro silica.

Carbonation resistance is better in recycled aggregate concrete. The primary causes are porosity reused aggregates as well as the existence of old mortar coupled to crushed stone aggregate. Concrete made from recycled aggregates is more resistant to freezing and thawing than concrete made from natural materials.

According to IS 383, Table 4 outlines the requirements to use green concrete using construction and demolition waste as coarse or grainy and/or sand like aggregate. Table 5 also shows alternative article for conventional Green or recycled Concrete components.

➢ *Aggregates Made from Recycled Materials*

C& D are two different things. All around the world, rubbish removal is now becoming a major source of contention. In order to assure efficient removal and, subsequently, appropriate use of all wastes, it is necessary to establish waste management strategies that are well thought out. It has long been known that collecting and recycling damaged waste for use in value-added applications offers substantial potential for optimizing environmental and economic advantages. Therefore, the recycling industry has progressed.

Several efforts have now been launched with the purpose of reducing the use of main aggregates as well as supporting recycle and reprocessing when it is practically, economically, as well as environmentally viable. In many areas of the globe, recycling businesses transform low-value trash into secondary building materials including aggregate grades, road materials, and aggregate fines [66-69]. Green Concrete is being used in filling in the gaps, bank security, drainage structure base or fill, walkways, kerbstones, pavements, and gutters, among other applications.

Natural broken aggregates can be substituted with recycled aggregate to the extent that they account for around thirty percent of the total. Pavements, as well as other locations that have been subjected to pure compression as a result of highway construction policies and rules, are subject to an additional 50percent rise in this percentage.

Drainage material, a layer on sports facilities, soil enhancement [65], carrying capacity increase, for example, below garden walls and retaining walls, are all examples of applications. These types of groundwork include things like repairing line trenches and working areas, boosting soil current population, soil swaps, and other similar things.

Stones such as burned bricks, lime bricks, or light in weight concrete, as well as bituminous and anti-freeze base layers, hydraulically bounded base layers, and concrete base layers are all used as input materials in concrete, mix-in-place concrete, ready-mixed concrete, and concrete base layers. They are also used as input materials in mortar and as input materials in concrete mix. Environmentally friendly concrete is being used in various civil engineering elements such as paver blocks, kerb stones and tiles, concrete jalis and blocks, bollards and wall cladding, park benches and posts, precast compound walls and planters, drain covers and pavements, on-site construction toilets, and other relatively insignificant buildings in the field of civil engineering.

➢ *Green/Recycled Concrete Advantages*

In comparison to ordinary concrete, Green Concrete requires little modification in the preparation process. The following are some of the benefits of green concrete:

- It lowers pollution.
- It has excellent heat and acid resistance.
- Some materials have higher compressive and split tensile strength.
- Cement usage is reduced overall.
- More cost-effective than traditional concrete, as demonstrated in Table 6.
- Makes use of locally sourced repurposed materials
- Green concrete has a lower heat of hydration than conventional concrete, resulting in a reduced temperature increase.
- Green concrete lowers the structure dead weight, allowing for easier handling and lifting with less weight; as a result, the total consumption of cement is reduced.
- Why Saves money: Green concrete increases a building's damping resistance. It requires fewer upkeep and repairs. It is easier to work with than traditional concrete. In fact, implementing Green Concrete saves money when compared to other options.
- Reduces CO_2 emissions: Portland cement, one of the essential aspects of regular cement, is made by heating pulverized clay, limestone, as well as sand approximately 1450 degrees Celsius with coal and natural gas. This system is essential for approximately 5percent to 8percent of carbon Dioxide emissions. Green Concrete production produces up to 80percent less heat than traditional concrete, leading to decreased Carbon dioxide emissions.

➢ *Green/Recycled Concrete Disadvantages*

As with any currency, there are certain drawbacks to using Green Concrete that should not be overlooked.

- High absorption of water.
- High creep and shrinkage as associated with the traditional concrete.
- Low flexural strength.
- Structures made of green concrete have a shorter lifetime.
- The cost of construction will rise if stainless steel is used.
- The tensile strength is reduced.

V. CONCLUSION

Green concrete is traditional concrete produced from waste cementations materials; its usage lowers the environmental effect of traditional concrete; as a result, it is suggested that construction and demolition waste be used instead of traditional concrete components. Cement, the principal component of concrete, has a substantial environmental impact throughout its manufacturing process since it emits carbon dioxide during the process (CO2). As with extensive stone mining to make coarse aggregates, intensive stones mining to manufacture coarse or grainy aggregates create many additional problems in the existing mountainous topography, making it more sensitive to earthquake and redirecting away the water from its natural course. The river channel is being altered as a result of extensive sand mining, resulting in floods.

The total financial management has been that the selling costs of finished building construction items made from recycled C&D discard would be however 20 percent lower than the actual conventional methods utilized, such as the tipping fee paid by the C&D waste generators. Upto 20% of total material, so mostly governments and rehabilitation programs advised that upto 20% of total material, recycled material should be used.

For new private structures, repurposed C&D waste commodities may be needed to account for approximately 10percent of the total similar materials used. For quality evaluation and certification of salvaged goods and their re-use, certain mechanisms and standards must be developed. The consequences of dumping construction and demolition trash indiscriminately are many. Cities with a construction and demolition waste generation rate of greater than 2000 TPD may have more than one centralised processing facility. The number and placement of collection sites should be such that a modest amount debris generator/citizen may reach one within a distance of 2-3 kilometres. Hence the more research need which is aviated in this fields for making future greener infrastructures.

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