

# Green Concrete by Using Industrial Waste Material

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DOI: 10.5281/zenodo.20645904

## ABSTRACT

*Green concrete is a concept of using eco-friendly materials in concrete, to make the system more and more sustainable. This concrete should not be confused with its colour. Fly ash is not highly reactive; the heat of hydration can be reduced through replacement of part of cement with fly ash. Industrial wastes such as marble powder, quarry dust, fly ash etc. to reduce energy and pollution of the environment. So, by reuse of the industrial waste materials, we reduce impact on environment and also reduce disposal problem of industries. The concrete mixture was produced which tested and compared by conducting compressive test and Split tensile test for 7days, 14days and 28days. In M25 concrete mix 50% of cement was replaced by fly ash and sand was totally replaced by 50% of quarry dust and 50% of marble powder. Green concrete is an eco-friendly concrete that reduces environmental impact by using waste materials like fly ash, slag, and recycled aggregates, partially replacing traditional cement and virgin resources to lower CO<sub>2</sub> emissions and conserve natural materials, often matching or exceeding the strength of regular concrete. It supports a circular economy by diverting industrial by-products and demolition waste from landfills.*

*Keywords: -Green concrete, fly ash, quarry dust, marble powder, compressive strength, split tensile strength.*

## 1. INTRODUCTION

Green concrete is an eco-friendly concrete using recycled materials (like fly ash, slag, plastic, foundry sand) and alternative binders, manufactured with less energy and water, to significantly cut the carbon footprint, reduce landfill waste, and conserve resources compared to traditional concrete, offering improved durability, strength, and performance for sustainable construction. It's about minimizing environmental impact throughout its lifecycle by repurposing industrial by-products and optimizing material use for better, longer-lasting structures. Green concrete is an eco-friendly concrete that reduces environmental impact by using waste materials like fly ash, slag, and recycled aggregates, partially replacing traditional cement and virgin resources to lower CO<sub>2</sub> emissions and conserve natural materials, often matching or exceeding the strength of regular concrete. It supports a circular economy by diverting industrial by-products and demolition waste from landfills.

### 1.1 Properties of Green Concrete

- **Improved Workability:** Often easier to mix, place, and finish, with better pumpability, making it suitable for various applications.
- **Reduced Heat of Hydration:** Emits less heat during setting, which minimizes thermal cracking and improves stability.
- **Enhanced Strength:** Can achieve comparable or even higher compressive strength than traditional concrete, especially over time, due to supplementary cementitious materials (SCMs).
- **Higher Durability:** Better resistance to sulfates, salts, and freeze-thaw cycles, extending the life of structures.
- **Lower Permeability:** Reduced water and liquid penetration, protecting reinforcing steel from corrosion.
- **Reduced Shrinkage & Creep:** Less prone to cracking and deformation compared to conventional concrete.
- **Cost-Effective:** Can lower construction costs due to reduced cement usage, a major cost factor.

### 1.2 Important of Green Concrete

- **Green Building Credits:** Helps projects achieve green building certifications (like LEED).
- **Long-Term Savings:** Lower maintenance and repair costs offset potentially higher initial costs, making it economical over a structure's lifespan.
- **Lower Maintenance:** Its enhanced durability and resistance reduce the need for repairs and replacements,

saving costs in the long run.

- **Superior Strength:** Can achieve higher compressive strength than traditional concrete over time, especially with supplementary cementitious materials (SCMs)

### 1.3 Objectives of Green Concrete

- To reduce CO<sub>2</sub> emissions.
- Conserve natural resources (like sand, gravel, limestone) by using recycled materials.
- Manage waste by incorporating industrial byproducts (like fly ash, slag) into the mix.
- Creating a sustainable, durable, and cost-effective construction material that lowers the overall environmental footprint of buildings.

## 2. METHODOLOGY

In the project following methodology have been decided to measure and manage the construction projects from the Concrete methodology is mostly preferable as per study. Green concrete methodology focuses on reducing environmental impact by replacing traditional Portland cement and aggregates with waste materials like fly ash, slag, recycled concrete.

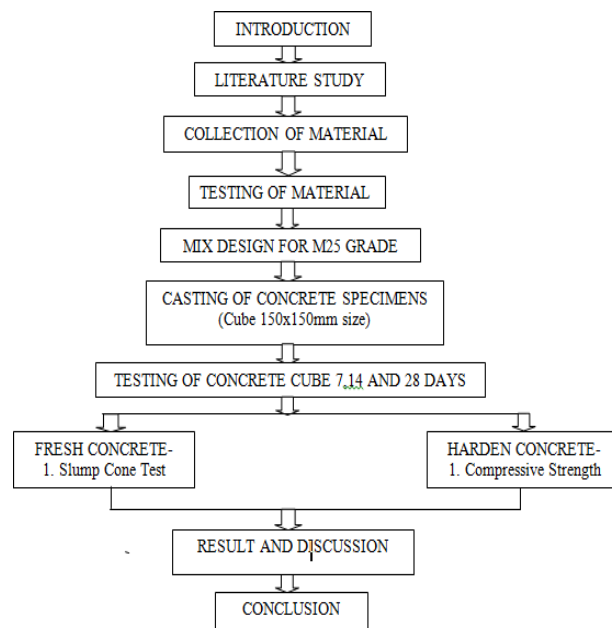


Fig-1- Flow Chart of Planning

### 2.1 Following Various Material use in concrete.

- **Cement:** The most common cement used is Portland Pozzolana Cement (Part I-Fly ash based) conforming to IS: 1489 (PART-1) 1991 is being used.
- **Coarse Aggregate:** Crushed Coarse aggregate passing through sieve of size 12.5- 20mm and normal continuous grading is used. The specific gravity is 2.4.
- **Quarry Dust:** The most widely used fine aggregate for making of concrete is the natural sand mined from the riverbeds. However, the availability of river sand for the preparation of concrete is become scarce due to excessive non-scientific methods of mining from the riverbeds, lowering of water table, sinking of bridge piers, etc. are becoming common problems. The present scenario demands identification of substitute materials for the river sand for making concrete. Quarry Dust as a by product from crushing process during quarrying activities is one of those materials that have recently gained attention to be used as concreting aggregates, especially as fine aggregates. In concrete production it could be used as a partial or full replacement of natural sand. Besides, the utilization of quarry waste, which itself is a waste material, will reduce the cost of concrete production.
- **Marble Powder:** Marble has been commonly used as a building material since ancient times. Disposal of the waste materials of the marble industry, consisting of very fine powders, is one of the environmental problems worldwide today. However, these waste materials can be successfully and economically utilized to improve some properties of fresh and hardened properties of mortar and concrete. Marble waste powder is an industrial waste containing heavy metals in constituent. Fineness with 90% of particles passing by 300µm sieves. Marble powder was collected from

the deposits of marble factories during shaping. It was retained on IS-150-micron sieve before mixing in concrete.

- **Water:** Water used for manufacturing of green concrete is potable and simply a tap water.
- **Fly Ash:** - When pulverized coal is burnt to generate heat, the residue contains 80% fly ash and 20% bottom ash. Fly ash produced in Indian power stations are light in colour and have the appearance of cement powder. Use of Fly ash concrete in place of PCC will not only enable substantial savings in the consumption of cement and energy but also provide economy. The use of fly ash has a number of advantages. Fly ash benefits concrete by reducing the mixing water requirement and improving the paste flow behavior.

**Table -1:** Material Properties

Materials	Color	Specific Gravity	Methods
Cement	Grey	3.15	Pycnometer
Fly ash	Grey	2.08	Pycnometer
Coarse aggregate	Grey	2.4	Perforated Basket
Marble powder	White	1.95	Pycnometer
Quarry dust	Black & Gray	2.26	Pycnometer

**Table -2:** Mix design proportion of standard (M25) grade concrete

Material(kg)	Mix1 (Normal M25)	Mix2 (A+B)	Mix3
Cement	382	190	0
Fly ash	0	190	382
Fine aggregate	528.60	0	0
Coarse aggregate	1145.38	1145.38	1145.38
Marble powder	0	398.5	398.5
Quarry dust	0	465.2	465.2
Water in lit.	185	185	185
W/c ratio	0.5	0.5	0.5

(A= Marble powder, B= Quarry dust)

**Table -3** Mix Proportion (M25 Grade)

	Normal concrete C: FA:CA	Green concrete C: FA:MP: QD:CA
Weight ratio	1:1.35:2.78	1:1:2.1:2.30:5.57
W/C ratio	0.5	0.5

### 3. TESTING OF CUBE

Compressive strength was conducted on various specimen as per guidelines given in IS 516-1959. The specimen was surface dried before testing the same on Compression Testing Machine of 200 tones capacity. The result of compression test using industrial waste as 50% replacement of cement at the dry curing age of 7 days, 14 days & 28 days are presented in table **Compressive Strength Test (N/mm<sup>2</sup>)**.

**Table -4** Compressive Strength of Concrete Cube

Days		7	14	28
Normal concrete	1	21.22	23.40	27.11
	2	21.50	23.90	26.85
	3	20.49	24.20	26.65
<b>Average</b>		<b>21.07</b>	<b>23.83</b>	<b>26.87</b>
Green concrete	1	19.73	20.85	23.18
	2	18.63	20.80	23.10
	3	17.85	21.00	22.90
<b>Average</b>		<b>18.73</b>	<b>20.88</b>	<b>23.06</b>

**Table -5** Cost Comparison

Material	Normal concrete		Green concrete	
	Kg/m <sup>3</sup>	RS.	Kg/m <sup>3</sup>	RS.
Cement	380	2150	190	1064
Fly ash	00	00	190	700

Fine aggregate	523.70	800	00	00
Coarse aggregate	1138.83	600	1138.83	600
Marble powder	00	00	401.5	240
Quarry dust	00	00	473.2	200
<b>Total cost</b>		<b>3550 /-</b>		<b>2804 /-</b>

#### 4. CONCLUSIONS

The water absorption of green concrete is slightly higher than Normal concrete. Compressive Strength of Green Concrete is nearly same to the Normal concrete with low costing, so this concrete is more economical for low-cost house construction. The replacement of total fine aggregates with 50% of marble powder and 50% of quarry rock dust gives an excellent result in strength aspect and quality aspect. Increase the marble powder content by more than 50% improves the workability. As per to cost comparison Green concrete is cheaper than Normal Concrete.

#### 5. ACKNOWLEDGEMENT

I sincerely acknowledge the support and guidance provided by our faculty members of the Department of Civil Engineering during the preparation of this research paper on green concrete. Their expert advice and constructive suggestions significantly improved the quality of this work. We also thank the laboratory technicians and staff for their assistance in material preparation, testing, and data collection. The facilities and resources provided by our institution were essential for conducting the experimental work successfully. We express our gratitude to all those who directly or indirectly contributed to the completion of this research.

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