

Use of Plaster of Paris Waste in Civil Construction for Sustainable Development

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Abstract : Concrete is widely used in construction for its strength and durability, with compressive strength being a key quality parameter. To align with sustainable development goals, recent studies have explored incorporating waste materials into concrete. One such study investigated the use of Plaster of Paris (POP) waste, a non-biodegradable by-product, as a partial replacement for fine aggregates in M25, M30, M35, M40 grade concrete. Concrete cubes with varying POP content (5% to 30%) were tested for 28-day compressive strength. Results showed that POP waste can be used effectively without compromising the concrete's strength, promoting waste reduction and eco-friendly construction practices.

Keywords — Plaster of Paris (POP) waste, Concrete, reinforcement ratio, Cement replacement, Construction waste recycling, POP-based concrete, Gypsum waste reuse, curing.

I. INTRODUCTION

Concrete is one of the world's most extensively used construction materials, known for its versatility, strength, and durability. Still, the growing demand for sustainable construction practices has increased interest in incorporating waste materials into concrete mixes. One such waste material is POP (PLASTER OF PARIS), which is primarily composed of gypsum. Large quantities of POP waste are generated from industries such as construction, medical applications, and decorative works, posing significant environmental challenges due to its non-biodegradable nature. In this case, we explore the potential of incorporating POP waste into concrete as a partial replacement for fine aggregates. The primary objective is to research whether the addition of POP waste enhances the mechanical properties of concrete, specifically its compressive strength.

II. POP WASTE GENERATION

1) Design and Installation Stage

- **False Ceilings & Wall Panels:** POP is extensively used to induce decorative ceiling designs, partitions, and wall claddings. Waste is generated from:

2) Molding and Casting Works

- **Decorative Elements:** POP is used for preparing molds for cornices, medals, and other architectural features.

3) Repair and Maintenance

- During patchwork or modifications, POP structures are partly broken or modified, generating fractured waste.

III. METHODOLOGY

1) Material Selection

Ordinary Portland Cement (OPC), river sand, crushed coarse aggregates (10–20 mm), and clean potable water were used. POP waste was collected from construction and medical waste sources, ground to fine powder, and sieved (<90 μm) to ensure uniform blending.

2) Mix Proportions

Concrete of grades M25, M30, M35, and M40 were designed as per IS 10262:2009, with POP waste replacing fine aggregates at 0%, 5%, 10%, 15%, and 20% by weight.

3) Casting and Curing

Standard cubes of 150 mm were cast for each mix variation and cured in water at 27°C ± 2°C for 7, 14, and 28 days.

4) Testing

Hardened concrete was tested for compressive strength (IS 516:1959), split tensile strength (IS 5816:1999), and density. Material characterization included fineness, specific gravity, and setting time.

5) Analysis

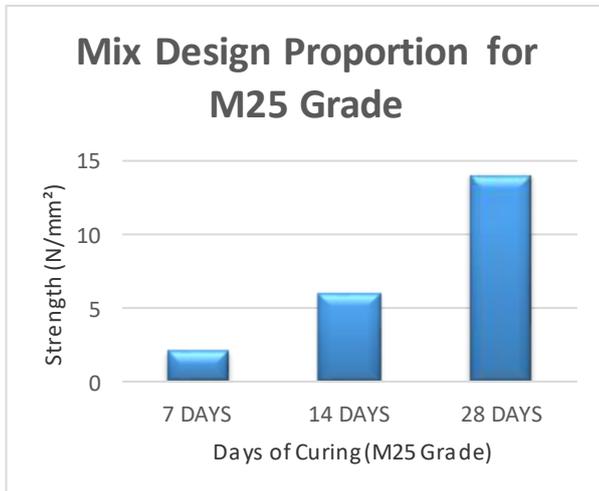
Results were compared to control mixes to estimate the effect of POP waste on concrete performance, concentrating on strength and workability parameters.

IV. RESULTS

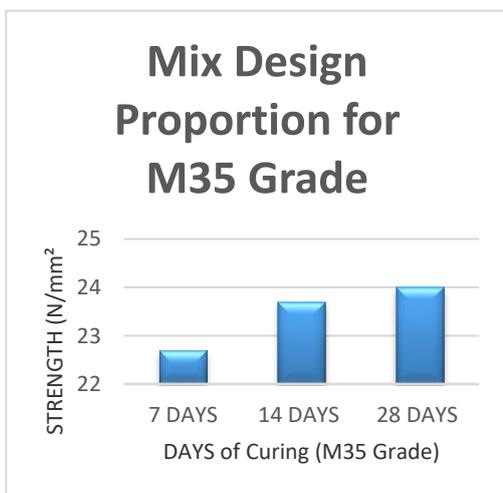
The results of the compressive strength tests are analyzed to determine the effect of POP waste on the strength of M25, M30, M35, M40 grade concrete.

Table No : 1 .M25 Grade :- Design Proportions

Quantity	CEMENT	CRUSHED SAND	20 mm Agg	WATER
Per Cum in Kg	360	830	1133	176
Per Batch of 50 Kg	50	115	157	24
By CFT	35	67	101	17
W/C Ratio	0.489	Target Mean Strength		33.3 N/mm ²



Graph No 1: M25 Grade Design Proportions

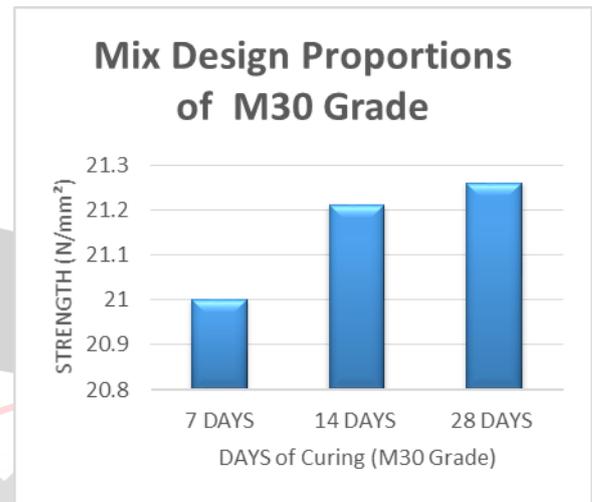


Graph No : 3 M35 Grade Design Proportions

Table No: 2 M35 Grade Design Proportions

Sr. No.	Cube ID	Cube Age	Cube Wt.	Actual size in (MM)	Compressive Load (KN)	Compressive strength (N/mm ²)
1.	As Above	7	8891	150x150x150	510.8	22.70
2.	-	-	8878	150x150x150	531.7	23.63
3.	-	-	8873	150x150x150	538.2	23.92

Graph No: 2 M30 Grade Design Proportion's



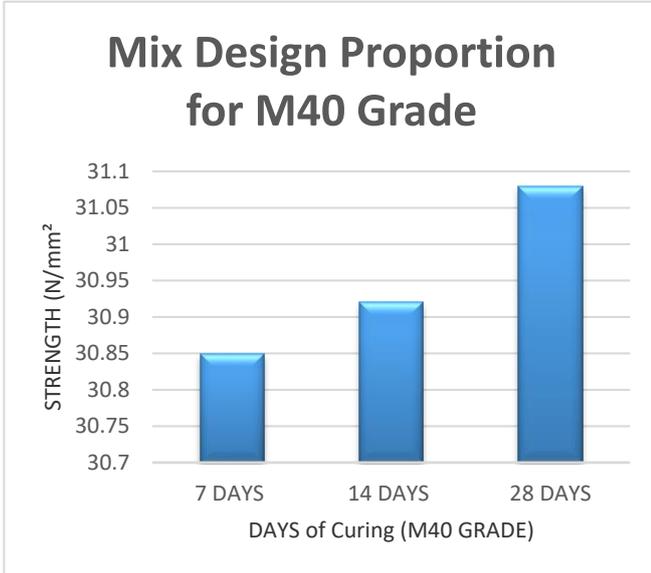
M30 Grade Design Proportions

Sr. No.	Cube ID	Cube Age	Cube Wt.	Actual size in (MM)	Compressive Load (KN)	Compressive strength (N/mm ²)
1.	As Above	7	8813	150x150x150	510.8	22.70
2.	-	-	8899	150x150x150	531.7	23.63
3.	-	-	8863	150x150x150	538.2	23.92

Table No: 3M35 Grade has slightly higher and increasing strengths, averaging **23.41 /mm²**

Table No : 4 M35 Grade:- Design Proportions

Sr. No.	Cube ID	Cube Age	Cube Wt.	Actual size in (MM)	Compressive Load (KN)	Compressive strength (N/mm ²)
1.	As Above	7	8846	150x150x150	694.3	30.85
2.	-	-	8894	150x150x150	695.7	30.92
3.	-	-	8901	150x150x150	699.4	31.08



Graph No:4 M40 Grade displays even higher strength values, with an average of **31.08 N/mm²**.

V. ADVANTAGES

- Waste Utilization:** Helps in recycling POP waste, reducing environmental pollution and landfill burden.
- Cost Reduction:** Replaces a portion of cement, leading to reduced construction costs.
- Improved Workability:** POP has fine particles that can enhance the workability of concrete.
- Energy Saving:** Reduces cement demand, indirectly saving the energy used in cement production.

VI. CONCLUSION

As the construction industry shifts towards eco-friendly practices, POP waste can be a valuable component in green building materials. Future exploration can concentrate on optimizing the proportion of POP waste in concrete mixes for different structural applications, potentially leading to standardized methods for its use in residential and commercial projects. This project could pave the way for regulations supporting recycled material use in concrete, supporting in resource conservation and waste control.

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