

ENHANCING FERROCEMENT PROPERTIES USING PARTIAL REPLACEMENT OF CEMENT WITH MARBLE AND FINE AGGREGATE WITH GRANITE POWDER

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Abstract: The cement is one of the significant materials of construction industry. For mortar formation cement is basic material. Cement is used as primary binding material in the process of civil engineering construction. But in the process of manufacturing cement large quantity of formation of CO₂ takes place and creates air pollution. There are numerous searches for the creation of alternate of binding material that is eco-friendly and contributes towards waste management. The use of waste materials in concrete production offers an acceptable solution to certain of the environmental issues and problems related to waste management. Ceramic waste like Granite powder, Marble powder are utilized as pozzolanic materials for the creation of blended cement. Few works are published regarding Granite powder application, Marble powder partial cement replacement material in relation to cement mortar. Application of Granite industry waste like granite powder and its ash has to be disposed off in proper manner for solid waste management. Granite powder, Marble powder is by-product of the granite cutting industries. Granite powder, Marble powder have pozzolanic characteristics. Thus, the aim of study waste explore the strength performance of cement Mortar include Granite powder, Marble powder as partial cement replacement. In this project work we have replaced the cement with various percentage i.e.,0%,10%,15%,20%,30% of both Granite powder, Marble powder. Compressive strength was tested by casting 15 standard cubes of size 70.6 mm x70.6 mmx70.6mm and cured for 7 days,14 days and 28 days. For compressive strength, it was observed that the compressive strength of 10% replacement of Granite powder, Marble powder provides more strength of 7 days and 28 days as compare to others. On the basis of experimental observation it was conclude that, replacement of Granite powder, Marble powder by 5%,10 % provides more compressive strength compared to conventional Mortar but 10% Granite powder and 10% Marble powder replacement provides more strength compared to other result

Keywords

Granite Powder , partial replacement, Cement mortar , compressive strength, Marble powder.

1. Introduction

The present investigation investigates the improvement of ferro cement through partial cement replacement with marble powder and fine aggregates with granite powder to achieve sustainability and performance. Marble powder, which is highly rich in calcium carbonate, improves the binding characteristics, whereas granite powder, which contains high

silica, increases strength and durability. The studies investigate the impact of these replacements on compressive strength, flexural strength, water absorption, and workability. By using industrial wastes, this method decreases the environmental footprint, decreases construction costs, and enhances the ferro cement's mechanical and durability characteristics for sustainable development.

1.1 Need and Necessity:

- **Environmental Impact of Cement Production:** Cement manufacturing is a major contributor to CO₂ emissions, leading to global warming. Using supplementary cementitious materials like fly ash reduces the carbon footprint.
- **Scarcity of Natural Sand:** Over-extraction of river sand causes environmental degradation, including riverbed depletion and habitat destruction. Alternative materials like granite fines can help conserve natural sand resources.
- **Waste Management:** Marble powder, a byproduct of thermal power plants, is often disposed of in landfills, causing environmental hazards. Granite powder, generated from stone-cutting industries, create disposal challenges.
- **Economic Benefits:** Fly ash and granite fines are industrial byproducts available at a lower cost than traditional materials.

Objectives

- To study the effect of cement mortar with ordinary Portland cement by partially replacing the cement with marble waste powder and partially replacing fine aggregates with granite waste.
- To enhance the strength and stability of the mortar used for ferro cement by testing the mortar with appropriate substitute percentages in molds like cube and rectangular
- To create a precast structure for household drainage systems by using ferro cement which reduces the labour cost, time and energy
- To reuse the waste produced from factories and industries by adding it for construction purpose which helps in reducing the cost of construction.
- To evaluate the mechanical properties. Assess the effects of marble powder and granite powder on the compressive strength, flexural strength, and tensile strength of ferro cement

2. Methodology:



Material selection and its properties

The selection of materials for this study is based on their availability, suitability for mortar production, and potential to enhance the mechanical properties of mortar. The primary materials used in this investigation include cement, marble powder, fine aggregate and granite fines. aggregate, and water.

Material	Test	Observations	IS values
Cement	1. Specific gravity	3.13	3.1-3.16
	2. Initial setting time	45 min	30 mins
	3. Final setting time	480min	600 mins
	4. Standard consistency		
Fine aggregate	1. Sieve analysis	Zone II	2.73
	2. Specific gravity	2.61	
Granite powder	1. Specific gravity	2.6	2.8

2.1 Preparation of Mortar cubes.

The preparation of concrete samples involves a systematic procedure to ensure uniformity, strength, and accuracy in testing. By batching, mixing, vibrating, moulding and demoulding, curing.



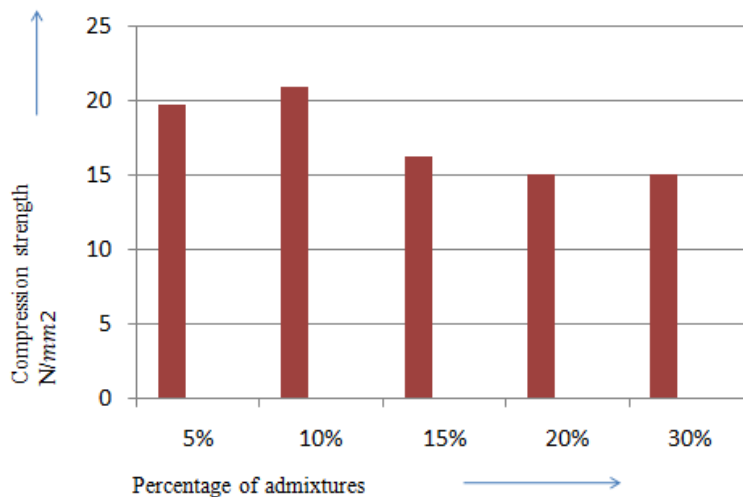
2.2 Testing and Analysis

Compression strength of concrete for 7 days

Table 5.2.1 : Compression strength for 7 days

Sl no	Percentage of Marble powder(%)	Percentage of Granite powder (%)	Compression strength (N/mm ²)
1	0	0	161.3 KN
2	5	5	98.5 KN
3	10	10	104.9 KN
4	15	15	81.5 KN
5	20	20	75.1 KN
6	30	30	65.6 KN

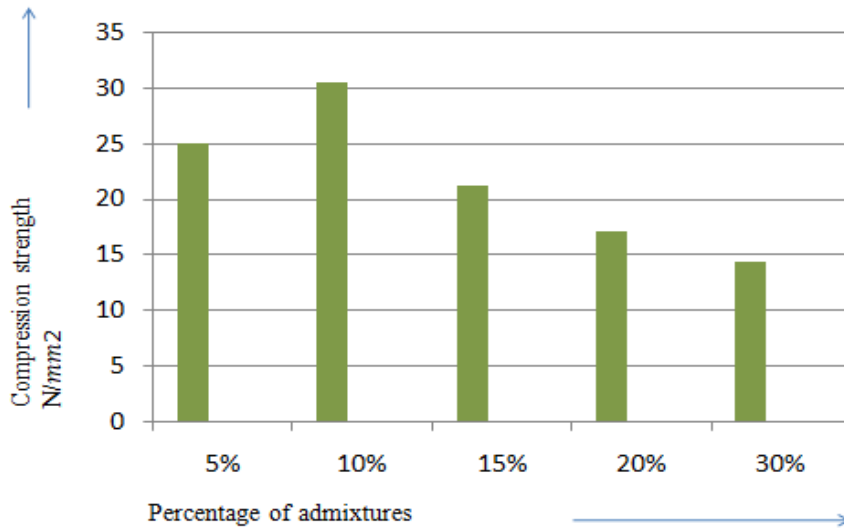
Chart 5.2.1 : Compression test for 7 days



b) Compression strength of concrete for 14 days

Table 5.2.2 Compression strength for 14 days

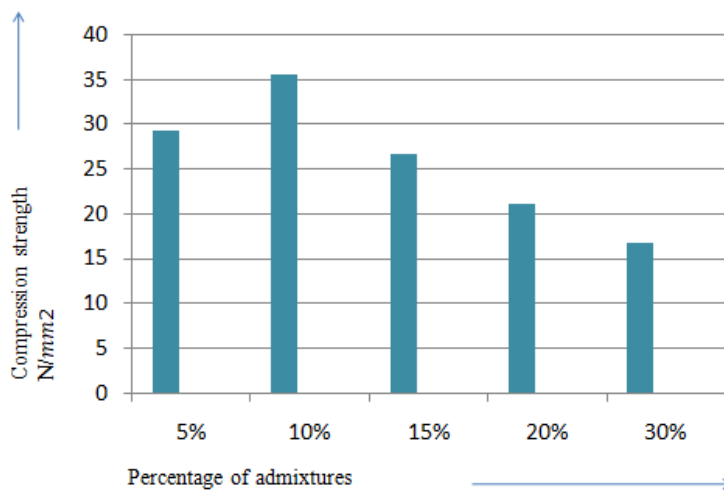
Sl no	Percentage of Marble powder(%)	Percentage of Granite powder (%)	Compression strength (N/mm ²)
1	0	0	195.5 KN
2	5	5	145.3 KN
3	10	10	152.4 KN
4	15	15	87.6 KN
5	20	20	75.3 KN
6	30	30	63.8 KN



c) Compression strength of mortar for 28 days

Table 5.2.3 : Compression strength for 28 days

Sl no	Percentage of Marble powder (%)	Percentage of Granite powder (%)	Compression strength (N/mm ²)
1	0	0	198.5 KN
2	5	5	160.5 KN
3	10	10	172.5 KN
4	15	15	89.2 KN
5	20	20	74.6 KN
6	30	30	56.3 KN



2.3 Product development



Material used – chicken mesh , cement mortar , reinforcement Precast drain blocks can be linked continuously to form a drain channel in rural areas where it can be time and cost efficient and also helps in rapid urbanization. First an reinforcement of 6mm is welded in trapezoidal pattern with both the ends open , covering with chicken mesh and plastering with replaced cement mortar.

3. Discussion

This research promotes ferro cement technology and precast structures by the use of 10% granite and marble powder as a partial replacement for cement, making mortar more efficient and sustainable. The findings show that a 5%–10% replacement enhances strength but more than 10% decreases compressive strength because of extreme dilution. This method increases mechanical performance, decreases CO₂ emissions, and solves industrial waste disposal. The results help justify sustainable building by incorporating the waste materials while still ensuring they remain structurally sound. Continued study of their long-term durability and mechanical strengths can further fine-tune using them in buildings..

4. Conclusion

The research indicates that partial cement replacement with Granite powder and Marble powder significantly influences the compressive strength of cement mortar. From the experimental

results, it was observed that the incorporation of these waste materials as a cement replacement enhances the mechanical properties of mortar, particularly at certain replacement levels. Among the different percentages of replacement employed (0%, 10%, 15%, 20%, and 30%), the 10% replacement of Granite powder as well as Marble powder had the maximum compressive strength at both 7 days and 28 days curing. It suggests that an optimal proportion of these materials is responsible for enhanced particle packing and enhanced pozzolanic activity and therefore better strength properties.

5. References

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