

Experimental Study on the Strength of Ferrocement Roof Channel by Partially Replacing Cement with Marble Powder

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ABSTRACT: Roof is an important Building fabric in housing, which requires proper Design and Construction. ferrocement is a versatile construction material which has attained worldwide popularity in both structural and architectural fields. It is ideally suited for high levels of pre fabrication and has proven as an excellent material for housing construction particularly roofs, floor slabs and walls all because of its relatively low cost, durability and weather resistance. Ferrocement appears to be an economical alternative material for roofing many researchers have done investigations to improve the Flexural behavior and Durability of ferrocement using modified molar matrices. Leaving the waste materials to the environment directly can cause environmental problem. Hence reuse of waste material has been emphasized. In this paper, experimental study on ferrocement roof channel is done by partially replacing cement with waste marble powder generated from marble stone industry. This study involves experimental investigation of compressive strength characteristics of mortar cubes by varying the percentage of marble powder (0%,5%,10%,15%,20%,25%, and 30%) and incorporating the percentage with higher strength mortar mix to study the flexural behavior of Trough shaped ferrocement panels reinforced with skeletal steel and wire mesh layers. The slab panels are tested under flexural loading, applying line loads at 1/3rd points under loading frame.

Ferro-cement has received attention as a potential building material, especially for roofing of housing construction (National Academy of sciences 1973) and has been used for several applications (Naaman2000). 30% reduction in dead weight of the structure. There is a various types of material used in Ferro-cement e.g.

- Cement mortar mix
- Skelton steel
- Steel mesh reinforcement or fiber reinforced polymeric meshes

Marble dust

Marble dust is a waste product formed during cutting and dressing of marble stone. It has a good filling property and helps to increase the durability of a structure. The objective of this paper is to compare the strength of various Ferro-cement roof specimens made with marble powder as a partially replacement for cement.

Width of mould - 100mm

Inclined length - 50°

Thickness of mould - 30mm

Keywords:- Ferrocement, Marble powder, Trough, Wire mesh.

1. Introduction

Ferro-cement

Ferro-cement is a composite material used to form thin elements, composing of cement mortar, reinforcement including light steel fabrics and meshes. Ferrocement originated in the 1840 in France. It covers a wide range of applications and advantages such as low self-weight, economic behavior, lack of skilled workers, no need of frame work etc.

It is a construction material that proved to have superior qualities of crack control, impact resistance and toughness, largely due to the close spacing and uniform dispersion of reinforcement within the material.

One of the main advantages is that it can be constructed with a wide spectrum of qualities, properties, low cost according to customer's demand and budget.

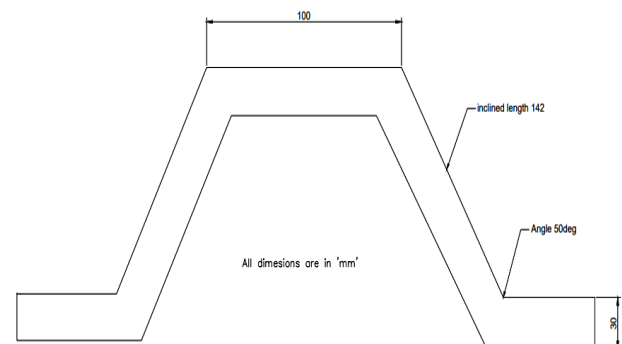


Fig-1 Trough shaped Mould Dimension



Fig-1.1 Real time Example of ferrocement panel



Fig-2 Wire mesh and Marble Dust Powder

2. Materials Used

2.1. Cement:

Ordinary Portland cement (OPC) is used. (M20 grade).

2.2. Sand:

River sand is used.

2.3. Wire Mesh:

Hexagonal meshes (Chicken mesh) are used in Ferrocement channel.

Dimension: 19 gauge, 0.7 mm wire.

2.4. Water:

In this research portable water free from organic substance was used for mixing as well as curing of concrete.

2.5. Mesh frames:

Mesh frames for trough shaped roof channel with hexagonal meshes and steel rod (6mm diameter).

2.6. Marble Dust powder (MDP):

- One of the major wastes produced in the stone industry during cutting, shaping and polishing is the MDP.
- During this process about 20- 25% of the process marble is turn into the powder form.
- India being the third (about 10%) top most exporter of marble in the world.

Table-2.1 Properties of sample ingredients

Material	Cement	Fine Aggregate	Marble Powder
SPECIFIC GRAVITY	3.275	2.304	2.555
FINENESS MODULUS	4.466	0.508	1.05

Table-2.2 Composition of materials

Materials	M 0%	M 5%	M 10%	M 15%	M 20%	M 25%	M 30%
Cement(g)	200	190	180	170	160	150	140
Marble Powder(g)	0	10	20	30	40	50	60
Sand(g)	400	400	400	400	400	400	400

3. Specimen Details And Optimum Value

- Cement mortar cubes ratio (1:2)
- Cement marble powder mortar cubes-cement is partially replaced by Marble powder (0%,5%,10%,15%,20%,25%,30%)
- Water cement ratio : 0.45
- Ferro-cement specimens with cement and marble powder. (thickness :30 mm, wide :350mm,
- length :500mm



Fig-3 Casted mortar cube with MDP and without MDP

Table-3.2 Mortar cube 28days strength

MARBLE POWDER REPLACEMENT (%)	COMPRESSIVE STRENGTH (N/mm ²)
0%	23.106
5%	23.97
10%	33.67
15%	26.946
20%	22.893
25%	24.34
30%	18.70

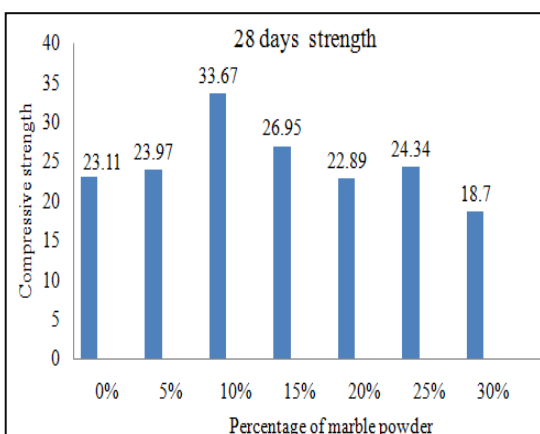


Fig-3.2a Graph showing Compressive strength of Mortar cube using MDP for 28days strength

Noted that Including Waste Marble Powder the compressive strength of mortar cube progressively increases to be certain limit and then steadily decrease in certain percentage. (as of in 7days and 28days curing and testing).



Fig-3.3a Trough shape reinforcement



Fig- 3.3b Three layer Mesh frame

4. Experimental Setup

4.1 Casting of panels:

The Ferrocement roof channel is casted using the closed mould system. The mortar is poured into the mould and it is compacted using vibration table.



Fig-4 Trough shaped roof channel mould

4.2 Casting procedure:

- Placing reinforcement in the mould
- Mortar is applied from the top of mould
- Compaction is done with the help of vibrating table



Fig-4.1 Placing of concrete



Fig-4.2 Trough shape roof specimen after casting



Fig-4.2a Trough shape roof specimen after casting

4.3 Curing :

The Ferrocement channel and mortar specimens were cured in a fresh water tank for a period of 28 days.

5. Testing

- Mortar cubes are tested after 7 days and 28 days curing.
- Cement marble powder mortar are tested after 7 days curing using compressive testing machine (CTM).
- Maximum strength is attained in 10% of marble powder partially replaced.
- Ferrocement roof specimen is casted with 10% of marble powder partially with cement.
- Ferrocement specimens are tested after 28 days curing in the loading frame to find cracks, deflection, ultimate load.



Fig-5 Roof panel testing setup



Fig-5a Tested Specimen showing crack details

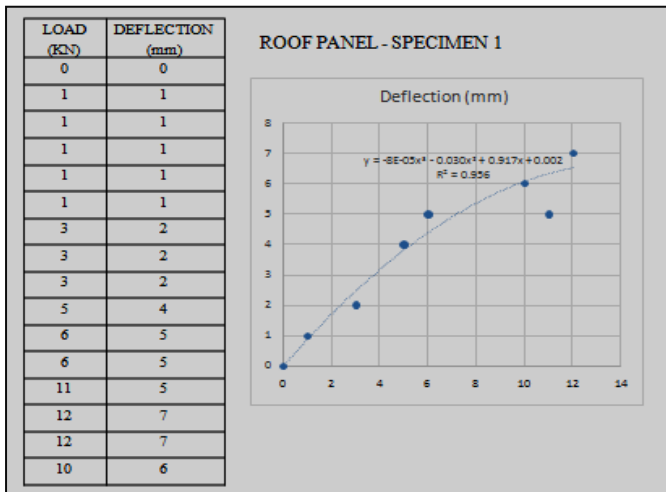


Fig.5b Graph showing Defection under maximum load for sample specimen-1

6. Conclusion:

This project work is intended to analyse the feasibility of using marble dust as replacement of cement. The result of mortar cube using marble dust shows that up to 10% replacement of marble powder for cement is recommendable.

From this result we can get deflection in marble roof specimen is lesser. Even if the load is maximum in marble roof specimen the deflection will be minimum compare to the deflection in cement roof specimen. So the marble roof specimen is recommended to give a good strength.

7. References:

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