

Experimental Investigation on Partial Replacement of Cement with Cowdung Ash and Marble Chips with Fine Aggregate in Concrete

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ABSTRACT: Concrete is most widely used in construction material in the world, with about two billions tons of utilization worldwide during each year. Concrete is widely used in all types of infrastructural application because it offers considerable strength. The study focuses on the compressive strength, split tensile strength and flexural strength performance of the blended concrete containing different percentage of cow dung ash and marble powder as a partial replacement of cement and fine aggregate. The fine aggregate in concrete is replaced accordingly with the percentage of 20%, 30%, 40%, by weight of F.A and 5%, 10%, 15% is added by weight of cement. Sand is a prime material used for preparation of mortar and concrete and which plays a major role in mix design. Now a days erosion of rivers and considering environmental issues, there is the scarcity of river sand will affect the construction industry. The production of cement poses many environmental problems due to emission of gaseous pollutants. Cowdung is used as a fuel for the domestic purpose, which generates solid waste as ash. This work examines the possibility of using cow dung ash and marble powder as partial replacement of cement and fine aggregate for new concrete. Concrete are made for m-40 grade mix and tested for its compressive strength up to 7, 14, 28 days of age and compared with conventional concrete.

KEYWORDS: cowdungash, marble chips, compressive strength, blended concrete.

I. INTRODUCTION

Concrete is the most widely used man made construction material in the world. It is obtained by mixing cementitious materials, water, aggregate, and sometimes admixtures in required proportions. Fresh concrete or plastic concrete is freshly mixed material which can be moulded into any shape and hardens into a rock like mass known as concrete. The hardening is because of chemical reaction between the water and cement, which continues for long period leading to stronger with age. The utility elegance as well as the durability of concrete structures, built during the first half of the last century with ordinary Portland cement (OPC) and plain round bars of mild steel, the easy availability of the constituent material (whatever may be their qualities) of concrete and the knowledge that virtually any combination of the constituents leads to a mass of concrete have bred contempt. Strength was emphasized without a thought on the durability of structures. As a consequence of the liberties taken, the durability of concrete and concrete structures which was constructed since 1970 or there about by which time the use of high strength rebar's with surface deformation started becoming common, significant changes in the constituents and properties of cement were initiated, and engineers started using supplementary cementitious materials and admixtures in concrete, often without adequate consideration. The setback in the health of newly constructed concrete structures prompted the most direct and unquestionable evidence of the last two/ three decades on the service life performance of our construction and the resulting challenge that confronts us is the alarming and unacceptable rate at which our infrastructure systems all over world are suffering from deterioration when exposed to real environment. The ordinary Portland cement is one of the main ingredients used for the production of concrete and has no alternatives in the civil

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construction industry, unfortunately, production of cement involves emission of large amounts of carbon dioxide gas into the atmosphere, a major contributor for green house effect and the global warming. Hence it is inevitable either to search for another material or partly replace it by some other material. The search of any such material can be used as an alternative or as a supplementary for cement should lead to global sustainable development and lowest possible environmental effects. The strength, durability and other characteristics of concrete depends on the properties of its ingredients, proportion of mix, method of compaction and other controls during placing and curing. The introduction of fibres is generally taken as a result, the mechanical behavior of the concrete is critically influenced by crack propagation. Concrete in service may exhibit failure through cracks which are developed due to brittleness. The production of cement poses environmental problems due to emission of gaseous pollutants. Due to emission of poisonous gases like CO₂, NO etc by cement production company they have depleted the natural environment pollution. Therefore there is a need to search for supplementary cementitious material or utilization as partial substitute for cement. Several researchers have used different material like sawdust ash, rice husk ash, fly ash, granulated blast furnace slag, as partial replacement of cement in concrete. Waste is the undigested residue of plant matter which comes from cows gut. In cow dung nitrogen, calcium, carbon, potassium, and phosphorus have a high content of about 28% water in fresh state, 34% of cow dung become ash when it is burned. According to a survey of 2012 there are about 51.2 crore cattle in India. Cow dung was habitually used in concrete and so one may suppose there were particular benefits.

II. MATERIAL PROPERTIES

2.1 MATERIALS

In the design of high performance concrete the selection of proper ingredients evaluating the properties and understanding the interaction between different materials plays a major role in performance of the concrete. The ingredients used are cement, cow dung ash, natural sand, coarse aggregate, marble chips.

MARBLE CHIPS

Marbles are metamorphic rock made from lime stone. It gives soft appearance and high porosity. It is sensitive to acids such as lemon juice and vinegar. The cost of marbles approximately ranges from Rs .50 to Rs .2000 /sq.ft. It is soft rock you need to lay floorings lost its shining then you can do polishing one more time so that you will get the first look. This will be one advantage in case if you are going for a marble. Generally cost wise it will be little lesser. Marbles layer can create very nice patterns out of it. If conditions are right the rock will be heated and compressed beneath the earth where it will transform into marble. This investigation was started with the study of marbles, and it was intended to complete this material before taking up another type. The laboratory work, however, has been confined to the developed quarries, owing to the difficulty of securing samples from the undeveloped deposits. It is proposed to supplement this report with subsequent studies of other marbles deposits, together with more extensive experiments on the weathering qualities types here reported. The samples secured from the quarries for testing in this investigation were approximately 1 by 1 by 2 feet. The test specimens were prepared from these blocks by sawing them, first into slabs with in 48-inch carborundum tooth wheel and then into cubes, beams, etc., with a 30-inch carborundum –rim wheel. The briquets for tension tests were prepared as far as possible from the pieces used in determining the transverse. The grooved pieces were then sawed transversely, giving briquets with a cross section of 1 square inch

Table 2.1: PROPERTIES OF MARBLE CHIPS

S.NO	PHYSICAL PROPERTIES	RESULT
1	Specific gravity	2.97
2	physical form	chips
3	Size	2.36mm
4	Color	White

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COW DUNG ASH The properties of the concrete tested, include compressive and split tensile strength. Specimens of 150×150mm cube 150×300mm cylinder were cast and stripped after 24h and then cured for 28d in normal water. The compressive strength test was performed as per provisions of IS 516 and split tensile strength test was carried out as per IS 5816. Compressive strength of concrete is evaluated compression testing machine of 3000KN capacity.

Table 2.1: PROPERTIES OF COW DUNG ASH

S.NO	PHYSICAL PROPERTIES	RESULT
1	Specific gravity	3.02
2	physical form	powder
3	Size	90mic
4	Color	blackish



III. MIX DESIGN

3.1 Mix proportions

Water	Cement	Fine aggregate	Coarse aggregate
197	492.5	780	992.7
0.40	1	1.58	2.0

IV. EXPERIMENTAL PROGRAM

4.1 MECHANICAL PROPERTIES

4.1.1 COMPRESSION TEST

Concrete is strong in compression and in contracture also concrete is mainly used in compression. Higher the compressive strength, better is the durability and bond strength. Resistance to abrasion and volume stability improve with the compressive strength which is very important in quality control of concrete. 15cm, cube size is normally used. But 10cm size can also be used if the aggregate size is not greater than 20mm. The apparatus used are Cube mould 15cm size, towels, tamping rod 16mm diameter and 60cm long, compression testing machine.

$$\text{Compressive strength } C = P/A$$



Fig 4.1 Test set up for compressive Strength Test

4.1.2 SPLIT TENSILE STRENGTH

The tensile strength is one of the basic and important properties of the concrete. The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. The splitting tests are well known indirect tests used for determining the tensile strength of concrete sometimes referred to as split tensile strength of concrete. The test consists of applying compressive line loads along the opposite generators of concrete cylinder placed with its axis horizontal between the compressive flaten. Due to the compression loading a fairly uniform tensile stress is developed over nearly 2/3 of the loaded diameter as

$$Q_{sp} = 2p/\pi dl$$



Fig 4.2 Test set up for Split tensile Strength Test

4.1.3 FLEXURAL STRENGTH OF CONCRETE

Direct measurement of tensile strength of concrete is difficult. Neither specimens nor testing apparatus have been designed which assure uniform distribution of the pull applied to the concrete. While a number of investigation involving the direct measurement of tensile strength have been made, beam tests are found to be dependable to measure

the flexural strength property of concrete. In the symmetrical two point loading, the critical crack may appear at any section, not strong enough to resist the stress within the middle third, where the bending moment is maximum.

Flexural strength, $F = \frac{pl}{bh^2}$

Where,

P= load in newton

L = length of rectangular prism in mm

b = breath of rectangular

h = height of rectangular



Fig 4.3 Test set up for Flexural Strength Test

V. RESULT AND DISCUSSION

5.1 GENERAL

This chapter deals with the results obtained from the various experiments conducted to access mechanical properties. The aim of the study to determine the compressive strength, flexural strength and split tensile strength. So the results of test specimen are presented. the discussion on the results also presented in this chapter.

5.2 Mechanical properties

5.2.1 Compressive strength

The compressive strength of replacement of cowdung ash and marble chips is arrived.

Table 5.1: Compressive strength of cube with partial replacement of CDA and MC

S. no	% of cow dung ash added	% of marble powder added	7 days compressive strength N/mm ²	14 days compressive strength N/mm ²	28 days compressive strength N/mm ²
1	0	0	16	22	30.27
2	5	20	27.5	31.11	39.33
3	10	30	29.77	33.33	40.55
4	15	40	15.55	17.77	38.11

5.2. SPLIT TENSILE STRENGTH

Table 5.2 Split tensile strength of cylinder with partial replacement of CDA and MC

Sl no	% of cowdung ash added	% of marble powder added	7 days split tensile strength N/mm ²	14 days split tensile strength N/mm ²	28 days split tensile strength N/mm ²
1	0	0	1.41	1.51	2
2	5	20	1.556	2.123	3.680
3	10	30	2.83	4.387	5.661
4	15	40	2.68	2.97	3.397

5.3 FLEXURAL STRENGTH

Table 5.3 Flexural strength of beams

S. no	% of cowdung ash added	% of marble powder added	7 days flexural strength N/mm ²	14 days flexural strength N/mm ²	28 days flexural strength N/mm ²
1	0	0	1	1	2
2	5	20	1	1.48	2
3	10	30	1	2	3
4	15	40	1	2	2

VI. CONCLUSION

The replacement of cement with cow dung ash 5% and 10% leads to increase in compressive strength whereas the percentage replacement of 15% leads to decrease in compressive strength and the replacement of fine aggregate with marble chips 20% and 30% leads to increase in compressive strength and 40% percentage of marble chips is decrease. The workability of concrete had been found increase with decrease of CDA and marble chips. The concrete preparation is for eco-friendly and cost effective. These materials are locally available and they can also reduce the cost of producing concrete. The CDA has an advantage that offers lightness of weight that makes it useful construction material.

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