Marble Powder and Quarry Dust as Apartial Replacement for Fine Aggregate on Concrete

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***Abstract*—This project deals with the This project deals with the characteristic strength of concrete using quarry dust and marble powder as partial replacement of fine aggregate tested at 7 and 28 days in M30 concrete. To replace the fine aggregate partially by using quarry dust and marble powder mix in various proportion.Compare the compressive and split tensile strength of replaced concrete specimen with normal onecharacteristic.**

I. INTRODUCTION:

Currently the world is poised for a major initiative in infrastructure development in construction of buildings and other structures where concrete plays a vital role in this initiative of development. Conventional building materials such as cement, aggregate, steel and timber are increasingly becoming expensive and scarce. River sand, which is one of the constituents used in the production of conventional concrete, has become very expensive and also becoming scarce due to depletion of river bed. This goes a long way in environmental protection and ecological balance. In the recent past good attempts have been made for the successful utilization of various industrial by products (such as quarry dust,marble powder, fly ash ,foundry waste) to prevent environmental pollution. A number of attempts have been made to provide local alternatives to the use of river sand as fine aggregate in conventional concrete. In addition to this, an alternative source for the potential replacement of natural aggregates in concrete has gained good attention in order to minimize the cost and maximize the strength.

In such a situation crushed rock dust could be an economical alternative to the river sand in the construction process. This paper reports the experimental study which investigated the influence of 60% replacement of sand with quarry dust and marble powder.

II. GENERAL:

The total number of 34 cubes for M30 concrete and cubes were cured for 7 and 28 days.

1. Materials Used

1.1Ordinary Portland Cement

IS: 8112-1989 for 53 Grade. The properties of cement tested were Fineness (90µSieve) = 6%, Normal consistency = 27.5%, Initial & Final setting time = 30 minute & 600 minute and Specific gravity of 3.1.

1.2 Marble Powder

Marble Powder collected in marble shops at Gangabaighat Rd Area, Nagpur. . The properties of marble powder tested were Fineness (90µSieve) = 8%, Normal consistency = 25%, Initial & Final setting time = 45 minute &300minute and a Specific gravity of 2.8

1.3Fine Aggregate

Locally available river sand passing through 4.75 mm IS sieve, conforming to grading zone-II of IS: 383-1970 was used. The physical Properties of sand like Fineness Modulus, Specific Gravity, water absorption and Moisture Content were 2.473, 2.60, and 1.5% and 0.8%.

1.4 Coarse Aggregate

Crushed natural rock stone aggregate of maximum nominal size up to 20mm and aggregate passing 10mm were used. The combined specific gravity, Bulk Density and water absorption of 20mm & 10mm were 2.91, 2492 kg/m3, 1.0% and 1.5% at 24hrs.Fineness modulus of 20mm & 10mm aggregate were 2.810.

1.5 Water

Water conforming to as per IS: 456-2000[19] was used for mixing as well as curing of Concrete specimens.

2. Preparation of Specimen

Preparation of test specimen includes following procedure

2.1 Batching

There are two types of batching available namely, weight batching and volume batching. We followed weight batching because it gives accurate proportion of concrete. The quantity of ingredients was arrived by conducting proper weigh batching and stored separately for mixing. We used balance of accuracy 0.01g

2.2 Mixing of Concrete

Proper mixing of concrete was carried out manually in a good way. Initially, the ingredients are mixed well in dry state. Then water is added little by little and mixed well to a workable state.

2.3 Placing

Mixed concrete is placed in a mould in such away that there is no chance of segregation. Proper compaction was done by using tamping rod.

2.4 Demoulding and curing

After one day the moulds are removed and the specimen was subjected to curing.

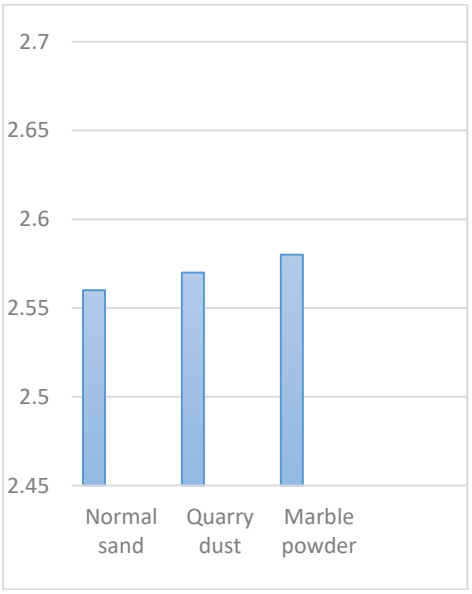
3. TESTING OF MATERIAL

3.1 SPECIFIC GRAVITY

The specific gravity of an aggregate is considered to be a measure of strength or quality of the material. Stones having low specific gravity are generally weaker than those with higher specific gravity values.

Specific gravity of a material may be defined as the ratio of density of the material to the density of water at a specified temperature.

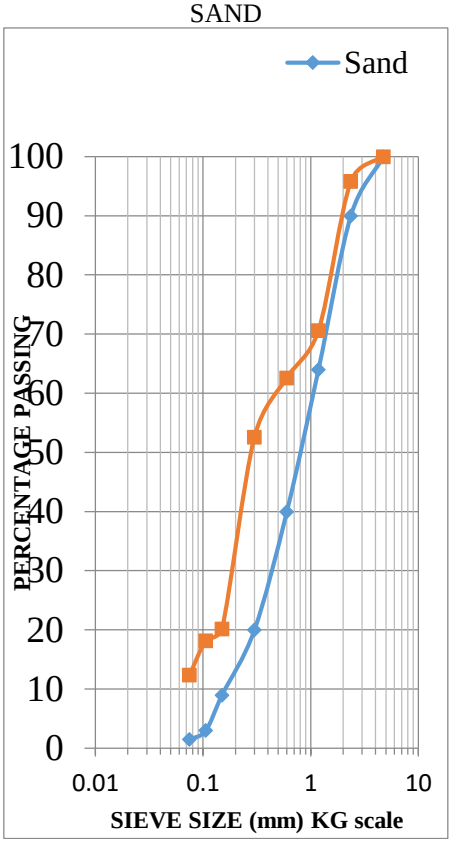
COMPARISON OF SPECIFIC RAVITY NATURAL SAND, QUARRY DUST & MARBLE POWDER



3.2 SIEVE ANALYSIS TEST

The grain size analysis is widely used in classification of soils. The data obtained from grain size distribution curves is used in the design of filters for earth dams and to determine suitability of soil for road construction, air field etc. Information obtained from grain size analysis can be used to predict soil water movement although permeability tests are more generally used.

COMPARISSION OF SEIVE ANALYSIS RESULT BETWEEN QUARRY DUST, MARBLE POWDER AND SAND

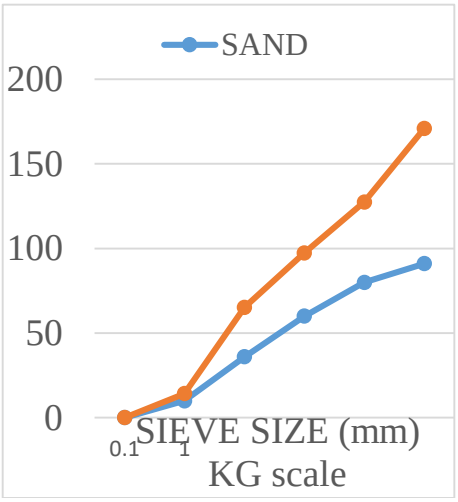


3.3FINENESS MODULUS TEST

OBJECTIVES:

To find the fineness modulus of fine aggregate and The Standard grain size analysis test determines the relative proportions of different grain sizes as they are distributed among certain size ranges.

FINENESS MODULUS OF SAND MARBLE POWDER & QUARRY DUST



4. TEST FOR CONCRETE;

General

This chapter deals with the mix design of M30 concrete and also batching, mixing and preparation of cubes and the test is done on the fresh concrete to determine the workability of that mix and the compression test is done on the hardened concrete at the 7^{th} day and 28^{th} day of the curing period to determine its compressive strength of the concrete.

Mix Design

4.1 General

One of the ultimate aims of studying the various properties of the materials of concrete, plastic concrete, hardened concrete, is to enable a concrete technologist to design a concrete mix for a particular strength and durability. The design of concrete mix is not a simple task on account of the widely varying properties of the constituent material, the conditions prevail at the site of work, in particular the exposure conditions, and the conditions that are demanded for a particular work for which the mix is designed. Design of concrete mix requires complete knowledge of the various properties of these constituent materials, the implication in case of change on these conditions at the site, the impact of the properties of plastic concrete on the hardened concrete and the complicated interrelationships between the variables. All these make the task of mix design more complex and difficult.

Design of concrete mix needs not only the knowledge of material property and property of concrete in plastic condition, it also needs wider knowledge and experience of concreting. Even then the proportion of the materials of concrete found out at the laboratory requires modification and readjustment to suit the field condition.

4.2 Concept of Mix Design

It will be worthwhile to recall at this stage the relationships between aggregate and paste which are the two essential ingredients of concrete. Workability of the mass is provided by the lubricating effect of the paste and is influenced by the amount and dilution of paste. The strength of concrete is limited by the strength of paste, since mineral aggregates with rare exceptions, are far stronger than the paste compound. Essentially the permeability of concrete is governed by the quality and continuity of the paste, since little water flows through aggregate either under pressure or by capillarity. Further, the predominant contribution to drying shrinkage of concretes is that of paste.

Since the properties of concrete are governed to a considerable extent by the quality of paste, it is helpful to consider more closely the structure of the paste. The fresh paste is a suspension, not a solution of cement in water.

The more dilute the paste, the greater the spacing between cement particles, and thus the weaker will be the ultimate paste structure. The other conditions being equal, for workable mixes, the strength of concrete varies as an inverse function of the water/cement ratio. Since the quality of water required also depends upon the amount of paste, it is important that as little paste as possible should be used and hence the importance of grading.

Mix design is the process of determining required and specifiable characteristics of a concrete mixture. Prescriptive approach (limits on materials). Performance approach (desirable characteristics). Mix design requirements are based on intended use, environment, etc. The mix design can be defined as the process of selecting suitable ingredients of concrete such as cement, fine aggregate, coarse aggregate and water to optimize their relative proportions to meet the requirements of design i.e.,

a) Compiles with the specifications of structural strength required.
b) Compiles with the durability requirements in the environment in which it is used.
c) Meet with workability requirements. i.e., it is capable of being mixed, transported and compacted as efficiently as possible ,and
d) Be economical without sacrificing requirements at (a) and (b) above.

4.3 Workability

Workability is the ease with which fresh concrete can be mixed, transported, placed and compacted in the moulds or forms. Some forms can be large and some may be very thin. Some may have high reinforcement and some may have how. Concrete should have good flow until it completely fills up the mould, surrounding the reinforcements without voids. For this, concrete when green should have good flow without separation of constituents and ability to get compacted. The degree of workability depends on location of the concrete, the shape of the element to be corrected, thin or thick and the method of compaction, mechanical or manual. Depending upon these factors workability of the concrete should be decided.

4.3.1 Water content

Cement requires about 38% of water by its weight for complete chemical reaction and occupies the space with gel pores. But with this quality of water the concrete is very stiff and cannot be poured and compacted. So more water is added to concrete to make it workable. The upper limit is up to 65% in plain concrete and 55% in RCC. The excess water added evaporates and leaves voids. This affects the durability. Therefore the water cement ratio is very important in mix design. Both the water and cement are measured by weight. Better workability with low water cement ratio can be obtained by adding admixtures. The workability of concrete is measured by measuring slumps in the slump cone test.

5. TEST ON FRESH CONCRETE

5.1 Slump cone test

The slump cone test is done to determine the workability of fresh concrete by slump test as per IS: 1199 - 1959.workability is the relative ease or difficultyof placing and consolidating concrete.

5.2 Mix design of M30 grade concrete

The detailed description about the M30 grade concrete is given below as follows,

a) The mix ratio of the M30 grade concrete is 1:1.02:2.22, which implies that one part of cement, one part of fine aggregate and two parts of coarse aggregates.
b) The water cement ratio is taken as 0.65 for the preparation of cubes.
c) Totally 34 cubes were prepared in the M30 grade concrete, 4 cubes were prepared without any replacement to determine the normal compressive strength of the M30 grade concrete, 6 cubes were prepared with 15% replacement, 6 cubes were prepared with 30% replacement and 6 cubes were prepared with 45% replacement , 6 cubes were prepared with 60% and 75% replacement of total weight of the sand by MP and QD separately.
d) The weight of sand, MP, QD, cement , coarse aggregates are taken as per the below table
.

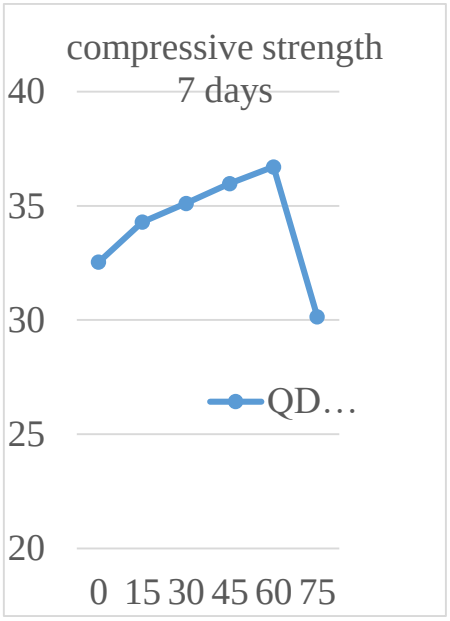
Percentage of replacement	Cement kg	MP/QD kg	Fine Agg. kg	Coarse Agg. kg
0%	6.8	–	6.95	15.12
15%	10.2	3.4	19.27	22.68
30%	10.2	6.8	15.88	22.68
45%	10.2	12.4	10.20	22.68
60%	10.2	13.6	9.07	22.68
75%	10.2	17.1	5.72	22.68

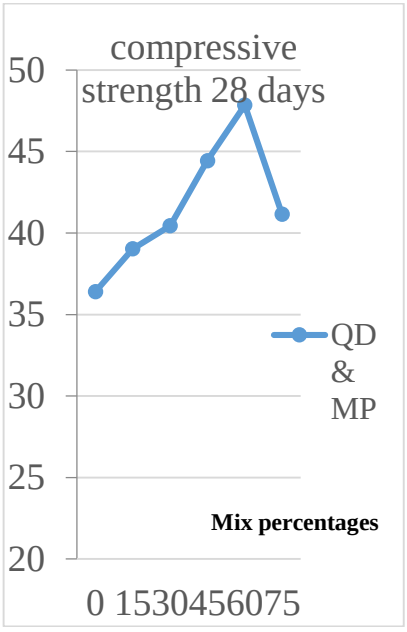
6. TEST ON HARDEN CONCRETE:

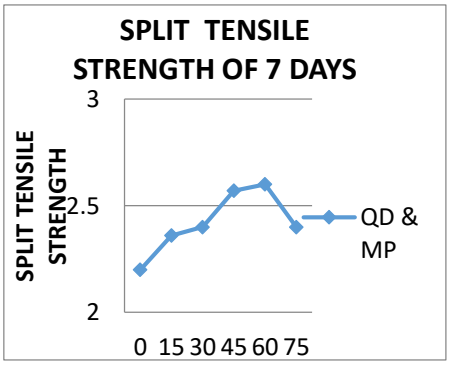
6.1 Compression Test on Concrete Cube

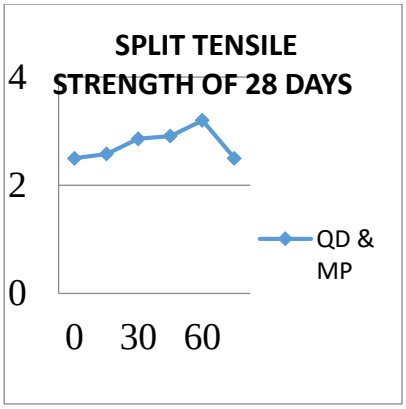
The test is done to determine the compressive strength of concrete specimens as per IS: 516 - 1959.Tests should be done at recognized ages of the test specimens,usually being 7 and 28 days. The ages should be calculated from the time of the addition of water to the drying of ingredients.

Compression test is the most common test conducted on hardened concrete, partly because is an easy test to perform, and partly becomes most of the desirable characteristic properties of concrete are qualitatively related to is compressive strength. The compression test is carried out on specimens cubical or cylindrical in shape. The cube specimen should be in the size 150 × 150 × 150 mm.









III. CONCLUSIONS

The use of Quarry dust and marble powder in producing concrete for normal strength were studied and after the Project work is done, the following conclusions are made and recommendations are forwarded.

The compressive strength of concrete using partial replacement of quarry dust and marble powder as fine aggregate gives about 30% to 40% more strength than that of conventional concrete mix

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[3] Shetty, M.X., (2000) "concrete technology" etc.,