Effect of Marble Powder and Quarry Dust as Partial Replacement for Fine Aggregate on Concrete

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Abstract:- **Construction industry is one of the major users of the natural resources like sand, rocks, clay and other soils. Continuous use of natural resources had led to high escalation in their unit costs. Sand is one such material which continuous use has started posing serious problems with respect to its availability, cost and environmental impact.At the same time, increased concern is being expressed with respect to disposal of industrial wastes. Disposal of industrial wastes like fly ash, marble powder and quarry dust is becoming a serious threat to the environmental. Use of such materials as replacement for conventional building materials can achieve twin objectives of ''waste disposal'' and ''natural resources conservation '' together. This project deals with the experimental study of the characteristic strength of concrete using quarry dust as a complete replacement of river sand fine aggregate tested at 7 and 28 days. This paper report the experimental study which investigated the influence of 100% replacement of sand with quarry dust. Samples of concrete (cubes and cylinders) for one mix, namely 1:1.02:2.22 were made using quarry dust and marble powder as fine aggregate in concrete.**

INTRODUCTION

Currently the world is poised for a major initiative 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, foundary 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 alternatives 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.

METHODOLOGY

OBJECTIVE:

- Investigation on dust quarry and marble powder on high strength concrete.
- Casting of the test specimen.
- Comparing the performance of concrete with normal concrete.
- Comprehensive analysis of test results.

MATERIALS USED:

ORDINARY PORT LAND CEMENT:

IS: 8112-1989 for 53 Grade. The properties of cement tested were fineness (90 micro sieve) = 6%, normal consistency=27.5%, initial & final setting time= 30 minute& 600 minute and specific gravity of 3.1.

MARBLE POWDER:

The properties of marble tested were fineness =8%, normal consistency=25%, initial and final setting time= 45%300 minute and a specific gravity of 2.8.

FINE AGGREGATE:

Locally available river sand passing through 4.75mm IS sieve, conforming to grading zone -2 of IS: 383-1970 was used. The physical properties of sand like fineness modulus=2.473, specific gravity=2.60, water absorption=1.5%, and moisture content 0.8%.

COARSE AGGREGATE:

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

WATER:

Water conformation to as per IS: 456-2000 was used for mixing as well as curing of concrete specimens

PREPARATION OF SPECIMEN:

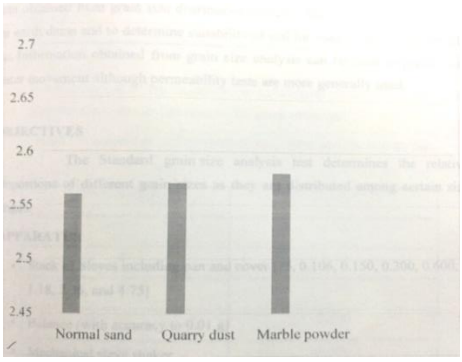
- Batching.
- Mixing of concrete.
- Placing.
- De moulding and caring.

TESTING OF MATERIALS:

A. 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 sand= 2.56
Specific gravity of quarry dust= 2.57
Specific gravity of marble powder=2.58



SIEVE ANALYSIS:

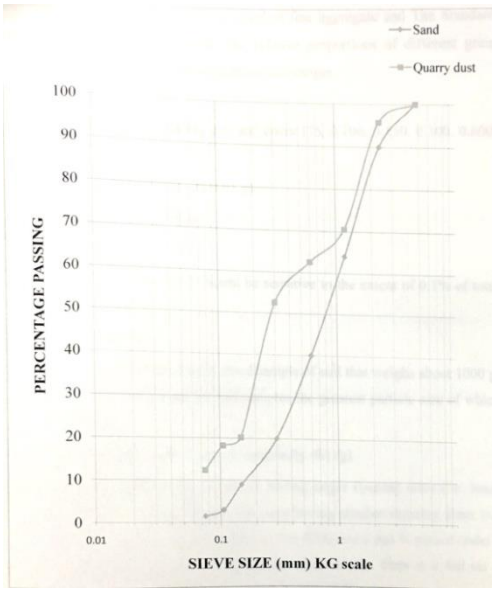
The grain sieve analysis is widely used in classification of soils. The data obtained from grain size distribution curves is used in the design of filters for earth dams and to determine suitability of soil for road construction, air field etc.

Table.1 SIEVE ANALYSIS OF SAND

Sieve number	Opening size	Mass of retained	% of retained	% of passing
4	4.75	0	0	100
8	2.36	100	10	90
16	1.18	260	26	64
30	0.600	240	24	40
50	0.300	190	20	20
100	0.150	110	11	9
140	0.160	60	6	3
200	75	25	2.5	1.5
pan	-	15	1.5	0

Table2. SIEVE ANALYSIS OF QUARRY DUST AND MARBLE POWDER

Sieve number	Opening ' size	Mass of retained	% of of retained	% of passing
4	4.75	0	0	100
8	2.36	42	4.2	95.8
16	1.18	242	25.2	70.6
30	0.600	80	8	62.6
50	0.300	100	10	52.6
100	0.150	324	32.4	20.2
140	0.160	14	1.4	18.2
200	75	66	6.6	12.4
pan	-	122	12.2	0



COMPARISON BETWEEN QUARRY DUST, MARBLE POWDER AND SAND.

FINENESS MODULUS:

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.

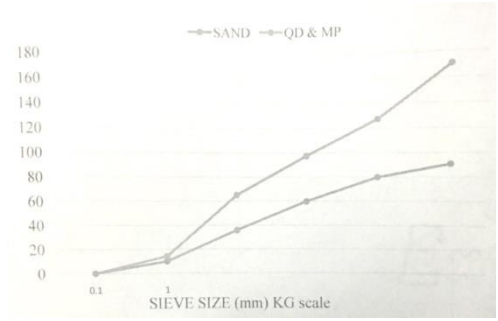
Table.3. FINENESS MODULUS OF QUARRY DUST
AND MARBLE POWDER

Opening size	Mass of retained	% of retained	%of retained	Cumulative % retained By mass
4.75	0	0	100	0
2.36	42	4.2	95.8	4.2
1.18	242	25.2	70.6	29.2
0.600	80	8	62.6	37.4
0.300	100	10	52.6	47.4
0.150	324	32.4	20.2	79.8

Table.4. FINENESS MODULUS OF SAND

Opening size	Mass of retained	% of r retained	% of passing	Cumulative% Retained by mass
4.75	0	0	100	0
2.36	100	10	90	10
1.18	260	26	64	36
0.600	240	24	40	60
0.300	190	20	20	80
0.150	110	11	9	91

Fineness of sand =2.77 to 2.98
Fineness of marble and quarry dust= 1.98to 2.43



COMPARISON BETWEEN SAND, MARBLE

POWDER AND QUARRY DUST.

Bulk density and percentage voids:
This method is applicable to aggregates not exceeding
125mm in nominal maximum size.

Bulk density of quarry dust and marble powder=1.74kg/lt
percentage of voids =38.7%

I.TEST FOR CONCRETE

A. MIX DESIGN:

The process of selecting suitable ingredients of concrete an determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible.

B. CONCEPT OF MIX DESIGN:

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

C. WORKABILITY:

Workability is the ease with which fresh concrete can be mixed, transported, placed, and compacted in the moulds
or forms.Concrete should have good flow until it completely fills up the mould, surrounding the reinforcements without voids.

D. 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.

E. MIX DESIGN OF M30 GRADE CONCRETE:

TABLE5. PROPORTIONING OF MATERIALS FOR M30

Percentag Of replac ment	Cement (kg)	MP/QD (kg)	Fine Aggregate (kg)	Coarse Aggregate (kg)
0%	6.8	-	6.95	15.12
15%	10.2	3.40	19.27	22.68
30%	10.2	6.80	15.88	22.68
45%	10.2	12.47	10.20	22.68
60%	10.2	13.60	9.07	22.68
75%	10.2	17.16	5.72	22.68

TEST ON HARDENED CONCRETE

F. COMPRESSION TEST ON CONCRETE CUBE:

COMPRESSIVE STRENGTH = LOAD/AREA.

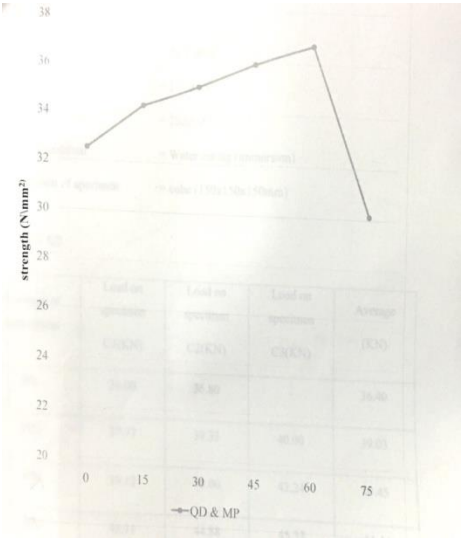
RESLUT AND DISCUSSION

A. REPORT OF COMPRESSIVE STRENGTH 7 DAYS:

Age of specimen =7 days
Curing condition= water curing
Dimension of specimen= cub(150*150*150mm)

Table.6. COMPRESSIVE STRENGTH OF 7DAYS

Percentage Of replacement	Load on Specimen (KN)	Load on Specimen (KN)	Load on Specimen (KN)	Avg compressive Strength(KN)
0%	32	33	-	32.54
15%	33.77	34.44	34.67	34.29
30%	33.77	35.11	36.45	35.11
45%	35.50	36.00	36.45	35.98
60%	36.00	36.80	37.34	36.71
75%	30.34	31.76	32.13	30.14



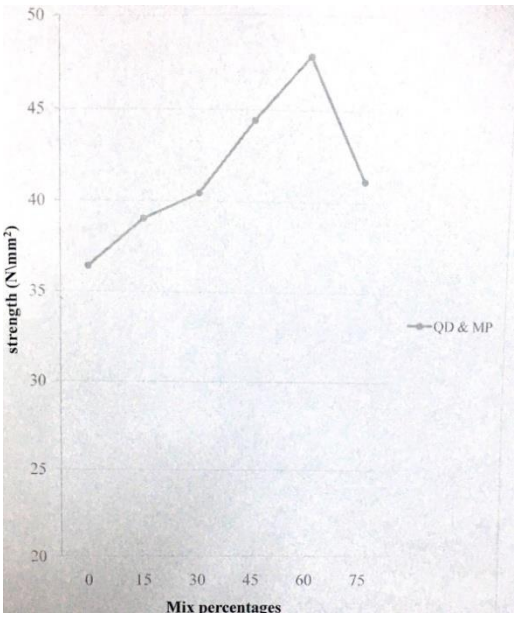
COMPRESSIVE STRENGTH OF 7 DAYS

B. REPORT OF COMPRESSIVE STRENGTH 28 DAYS:

Age of specimen= 28 days
Curing condition=water curing
Dimension of specimen =(150*150*150mm)

Table.7COMPRESSIVE STRENGTH OF 28 DAYS

% of replacement	Load on Specimen (KN)	Load on Specimen (KN)	Load on Specimen (KN)	Average (KN)
0%	36.00	36.80	-	36.40
15%	37.77	39.33	40.00	39.03
30%	39.12	40.00	42.24	40.45
45%	43.11	44.88	45.33	44.44
60%	46.67	48.00	48.89	47.85
75%	40.21	41.32	40.95	41.16

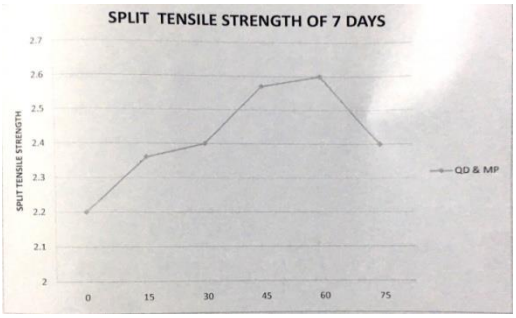


C. REPORT OF SPLIT TENSILE STRENGTH 7 DAYS:

Age of specimen= 7 days
Curing condition = water curing
Dimension of specimen = cylinder(150*300)

Table.8.SPLIT TENSILE STRENGTH 7 DAYS

Percentage of Replacement	Split tensile Strength(N/mm2)
0%	2.2
15%	2.36
30%	2.40
45%	2.57
60%	2.6
75%	2.4

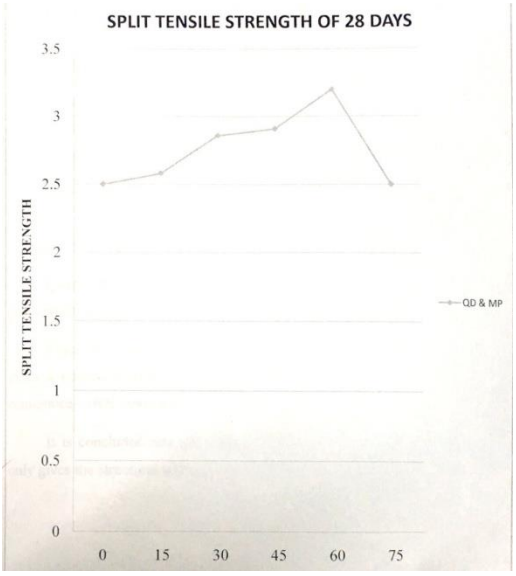


SPLIT TENSILE STRENGTH OF 7 DAYS

D. REPORT OF SPLIT STRENGTH 28 DAYS:

Age of specimen= 28 days
Curing condition = water curing
Dimension of specimen=cylinder(150*300mm)

TABLE.9.SPLIT TENSILE STRENGTH 28 DAYS



SPLIT TENSILE STRENGTH OF 28 DAYS

Percentage of replacement	Split tensile Strength(N/mm2)
0%	2.5
15%	2.58
30%	2.86
45%	2.91
60%	3.2
75%	2.5

CONCLUSION

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.

Analysis made on the influence of quarry dust and marble powder in the cost of the concrete revealed that significant cost variation is observed for mixes with partial replacement of the quarry dust and marble powder with natural one.

Quarry dust offers a viable alternative to the natural sand if the problem associated with the workability of the concrete mix can be resolved.

Hence by partially replacing of sand by quarry dust and marble powder not only gives the structural strength and protect the environment too.

REFERENCES

[1] Ilangovan R, Mahendran N and Nagamani k(2008), "strength and durability properties of concrete containing quarry dust as fine aggregates", ARPN Journal of engineering and applied science, vol.3(5),pp.20-26.
[2] prof. veena G. pathan 1,prof.md. gulfam pathan2, feasibility and need of use of waste marble powder in concrete production IOSR Journal of civil engineering (IOSR-JMCE)e-ISSN:2278-1684,p-ISSN:2320-334Xpp23-26
[3] concrete, 'Indian concrete journal' ,pp53-56.
[4] Bureau of Indian standards, New delhi.
[5] Hand book on concrete mixes(sp:23-1982), bureau of Indian strandard, new delhi.