EXPERIMENTAL STUDY ON CONCRETE BY PARTIAL REPLACEMENT OF FLY ASH AND MARBLE POWDER FOR CEMENT

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Abstract : *Now in the present days concrete is the most widely used material in the construction field for its good compressive strength and durability, they are the mixture of cement, fine and coarse aggregate and including water. To get its strength its been tested in the lab and then allowed for curing period of about 28 days for good hydration and to attain the strength that's been desired. Any unwanted causes during the curing process will damage the strength as well as the durability of the concrete. Admixtures are added in order to increase the strength and also to be a Eco-friendly component. So in here were are using fly ash and marble powder in the concrete, the main aim in adding the admixtures to the concrete is that to make the concrete Eco-friendly. Strength has been found for both M20 and M25 mixes by adding percentage by 5%, 10%, 15%. The strength is been found by compressive and split tensile strength method.*

Keywords: Fly ash, Marble powder, Mix design, Eco-friendly, Compressive Strength, Split Tensile, Modulus Rupture.

I. INTRODUCTION

The main important factor is the curing process; this has to be done correctly in order to obtain the strength and durability of the concrete. In conventional curing this is achieved by external curing applied after mixing, placing and finishing.

1.1ADVANTAGES:

1. It gives the strength equal to the conventional concrete or more.
2. It is Eco-friendly.
3. Does not affect the atmosphere.
4. Cost is less.
5. Good result after curing is done.
6. Give a good compressive strength and durability.
7. Can be used in building structures.

2.MATERIALS:

FLYASH AND MARBLE POWDER:

Fly ash is obtained from the thermal power plant etc., this the waste product that is used as the admixture in the concrete, this ash when its thrown away that creates a pollution to the industry, in order to avoid pollution this can be added to concrete as the secondary element and as well as the marble powder its is obtained during the extraction of marble it is replaced as the secondary element to the fine aggregate, this marble powder is the waste material that causes pollution when it goes waste this can be avoided by adding it in the concrete.

2. LITERATURE REVIEW

1. Jashandeep singh, Er. R S Bansal, "Partial replacement of cement with waste marble powder with M25 grade" concluded that the optimum percentage of cement was found out to be 12% and with this it also resulted in increase in both compressive strength and tensile strength.
2. V. M. Sounthararajan and A. Sivakumar "Effect of the lime content in marble powder for producing high strength concrete" concluded that high strength concrete was achieved when replacement of cement with marble powder was 10%.
3. Baboo Rai, Khan Naushad H., Abhishek Kr., Tabin Rushad S., Duggal S.K., "Study on influence of Marbel powder/granules in concrete mix" concluded that compressive strength of concrete reduces with increase in marble powder as replacement of cement as compared to normal concrete. But when they replaced sand with marble powder a consider increment in compressive strength was found at an optimum percentage of 20%.
4. Prof. Veena G. Pathan, Prof. Md. Gulfam Pathan , "Feasibility and need of use of Waste marble powder in concrete production" concluded that the combined use of quarry rock dust and marble sludge powder exhibited excellent performance due to efficient micro filling ability.

5. Prof. P.A. Shirule, Ataur Rehman, Rakesh D. Gupta, " Partial replacement of Cement with Marble dust powder" concluded that the compressive strength of cubes increased upto 27.4% with addition of the marble powder upto 10% and further addition resulted in decrease in its compressive strength. Also the split tensile strength of cylinders increased upto 11.5% 10 % replacement of cement with marble powder. The initial strength gradually decreases from 15 % addition of marble powder.

6. Er. Amritpal Kaur Er. Rajwinder SinghBansal, "Strength and Duriabilty Properties of Concrete with Partial Replacement of Cement with Metakaolin and Marble Dust" concluded that optimum percentage for replacement of cement with Metakaolin and Marble powder was 9% and 10 % respectively for both cubes and cylinders. After 9%MK and 10% MP, compressive strength as well as split tensile strength starts decreasing. 5. There is decrease in strength after 9% replacement of MK and 10% replacements of MP but durability properties go on increase with increase in percentage of MK-MP.

7. Noha M. Soliman, "Effect of using Marble Powder in Concrete Mixes on the Behavior and Strength of R.C. Slabs" concluded that Increasing the marble powder ratio replacement of cement led to the increasing as the compressive strength by about (25% and 8%) for the marble powder replacement ratios (5% and 7.5%) compared to the control mix. 4. Increasing the marble powder ratios higher than 5% decreased the compressive strength of concrete mixes.

8. Er. Tanpreet Singh and Er. Anil Kumar Nanda,"Influence of marble powder on mechanical properties of mortar and concrete mix" concluded that there is a marked reduction in compressive strength values of mortar mix with increasing marble powder content when compared with control sample at each curing age.

3. SCOPE AND OBJECTIVE

1. The main scope is that it should be Eco-friendly.
2. The objective is to study the mechanical characteristics of concrete such as compressive strength, split tensile strength by adding percentage of fly ash and marble powder as 5%, 10% and 15% of both in M20 and M25.

4. EXPERIMENTAL PROGRAMME:

The main aim of this experimental program is that to find the strength of concrete by adding the admixtures as 5%, 10% and 15%. This was aimed to study the workability, compressive and split tensile strength. The properties mixes are M20 and M25

Table:1 Number of Cube, Cylinder and Prism

fly ash	marble powder	m_{20}			m_{25}		
		cube	cylinder	prism	cube	cylinder	prism
0	0	3	3	3	3	3	3
5	5	3	3	3	3	3	3
10	10	3	3	3	3	3	3
15	15	3	3	3	3	3	3
20	20	3	3	3	3	3	3

1. The size of each cube is 150*150*150 mm.
2. The size of each cylinder is 150 mm in dia and 300 mm in height.
3. The size of each prism is 100*100*400 mm.

5. MATERIAL USED:

The materials used are:

5.1Cement: Cement grade is 53 ordinary Portland cement IS: 12269: 1987.

5.2 Fine aggregate: The fine aggregate is obtained near the by river source. Conforming to zone 111 according to IS: 383-1970 is used.

5.3 Coarse aggregate: Coarse aggregate is obtained by crushing huge rocks as per the IS: 383-1970. The size use is 20mm as the maximum size.

5.4 Fly ash and marble powder: Fly ash is obtained from the thermal power plant that is used as the partial replacement in cement and marble powder which is obtained from the marble which is crushed is added as the partial replacement with the sand.

6. CASTING PROGRAMME:

Specimens are casted as per the IS: 10086-1982 by preparation of materials, weighing of materials and casting of cubes, cylinders, beams. According to the IS: 516-1959 the mixing, compacting and curing are done. The conventional samples of cubes, beams and cylinders are cured for 28 days and in the same way the concrete added with admixtures are cured for 28 days in the water tank or pond in a room temperature by placing them in the shade. The M20 and M25 grade of concrete are designed and the material required per cubic meter of concrete .

Table:2 Mix Calculation

Mix	Cement(Kg)	Fine Aggregate (Kg)	Coarse Aggregate(Kg)	Water (Kg)
M_{20}	340	610	1300	187
M_{25}	320	751	1356	169

7. TESTING

7.1 Slump Test & Compaction Factor.

Find the consistency of concrete with the method of Slump test which can be employed either in laboratory or at site of work. It does not measure all factors contributing to workability. Whatever it is accessible test for concrete in field work as well as it gives same quality of concrete from batch to batch. The compacting factor test is designed primarily for use in the laboratory but it can also be used in the field. It is more precise and sensitized than the slump test and particularly useful for concrete mixes of very low workability as are normally used when concrete is to be compacted by vibration. Such dry concretes are insensitive to slump test.

7.2 Compressive strength:

The cube specimens were tested on compression testing machine of capacity 3000KN. The bearing surface of machine was wiped off clean and sand or other material removed from the surface of the specimen. The cube was fix in the machine the load was applied on the specimen top. The axis of the specimen was carefully aligned at the centre of loading frame. The load applied was increased simultaneously at a constant rate until the resistance of the specimen to the increasing load breaks down and no longer can be sustained. The load applied on specimen the maximum load was recorded.

f_c=P/A, where,

p= load

A= area

7.3 Split tensile strength:

The cylinder specimens were tested on compression testing machine of capacity 3000KN. The bearing surface of machine was wiped off clean and looses other sand or other material removed from the surface of the specimen. The load was applied on the specimen that was increased simultaneously at a constant rate until the resistance of the specimen to the increasing load breaks down and no longer can be sustained. The maximum load applied on specimen was recorded.

f_{split}=2 P/πDL,

where

P=Specimen load,

D=Specimen diameter of cylinder,

L=Specimen length of the cylinder

7.4 Modulus of rupture:

The beam specimens were tested on universal testing machine for two-point loading to create a pure bending. The bearing surface of machine was wiped off clean and sand or other material is removed from the surface of the specimen. The two point bending load applied was increased continuously at a constant rate until the specimen breaks down and no longer can be sustained. The maximum load applied on specimen breaks along the span. The specimen was recorded. The modulus on where the specimen breaks along the span. The specimens while testing compressive strength, split tensile & Modulus of rupture.

If the specimen breaks at the middle third the span then the modulus of rupture is given by

$f_{rup}=(WL)/(bd^2)$

If the specimen breaks at a distance of 'a' from any if the supports then the modulus of rupture is given by $f_{rup}=(3Wa)/(bd^2)$, where W=load at failure,

L=length of specimen (400mm)

b=width of specimen (10mm)

d=depth of specimen (100mm)

8. RESULTS&DISCUSSION

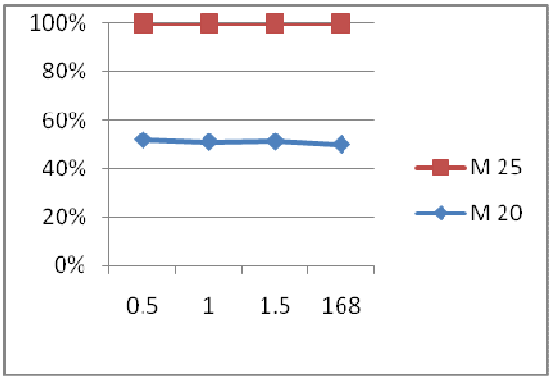
8.1 Slump and Compaction Factor Test:

The results of the slump & compaction factor test are given in Table. The graphical representation of the slump & compaction factor results is shown reactively. As the % of fly ash and marble powder is increased the slump and compaction factor is found to increase. But, the rate of increase in slump & compaction factor for M_{25} concrete is less than that of M_{20} conventional concrete.

Table:3 Slump and Compaction factor

Fly ash	Marble powder	Slump(mm)		Compaction factor	
		M_{20}	M_{25}	M_{20}	M_{25}
0	0	80	74	0.88	0.78
5	5	92	86	0.90	0.85
10	10	112	107	0.91	0.87
15	15	140	133	0.93	0.88
20	20	175	168	0.96	0.89

Fig:1 Slump Value



VARION OF SLUMP

8.2 Compressive Strength:

The compressive strength result is represented and the graphical representation is shown. The compressive strength was found to increase up to 1% fly ash and marble powder and then decreased for M_{20} grade. In the case of M_{25} compressive strength increased up to 0.5% and then decreased. The increase in compressive strength was 7.23% at 1% of fly ash and marble powder compared to conventional concrete for M_{20} ,while the increase is 1.24 % at 0.5 % of fly ash and marble powder in case of M_{25} grade of concrete .

Table:4 Compressive Strength of concrete

Fly ash	Morble powder	f_c(N/mm^2)		f_{rup}(N/mm^2)	
		M_{20}	M_{25}	M_{20}	M_{25}
0	0	26.6	24.5	3.5	3.3
5	5	27.6	26.7	3.7	3.6
10	10	28.4	27.3	3.8	3.6
15	15	26.7	25.6	3.6	3.4
20	20	25.0	24.4	3.5	3.3

8.3 Split tensile strength:

The split tensile strength are represented the graphical representation .the split tensile strength was found to increase up to 1% fly ash and marble powder then decreased for M_{20} .in case of M_{25} split tensile strength increased up to 0.5% and then decreased. The increase in split tensile strength was 11.60 % at 1% fly ash and marble powder compared to conventional concrete for M_{20} ,while the increase is 3.30% at 0.5% of fly ash and marble powder in case of M_{25} grade of concrete.

Table:5 Split tensile Strength of concrete

Fly ash	Morble powder	f_{split}(N/mm^2)	
		M_{20}	M_{25}
0	0	1.81	1.52
5	5	1.96	1.78
10	10	2.02	1.98
15	15	1.92	1.89
20	20	1.85	1.76

8.4 Modulus of rupture:

The modulus of rupture are represented the graphical representation .the modulus of rupture was found to increase up to 1% and then decreased for M_{20} grade. In the case of M_{25} modulus of rupture increased up to 0.5 % and then decreased. The increase in modulus of rupture was 8.57% at 1% of fly ash and marble powder compared to conventional concrete for $M_{20,}$while the increase is 2.81 % at 0.5 % of fly ash and marble powder in case of M_{25} grade of concrete.

Table:6 Modulus of rupture:

Fly ash	Morble powder	f_{rup}(N/mm^2)	
		M_{20}	M_{25}
0	0	3.5	3.3
5	5	3.7	3.6
10	10	3.8	3.6
15	15	3.6	3.4
20	20	3.5	3.3

9. CONCLUSION:

1. As the percentage of fly ash and marble powder are increased for both M20 and M25 grade of concrete.
2. This concrete gives the best result in the strength and durability.
3. Thus this type of concrete can be used in order to avoid the pollution and be a Eco-friendly.
4. It gives the strength equally or more than the conventional concrete.
5. Thus this gives the best result in using the concrete.
6. This concrete is the trustable concrete in the construction site.

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