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Flakyness Effect of Local Coarse Aggregate on Workability and Compressive Strength of Concrete

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ABSTRACT :*In Concrete aggregate occupies 70% to 80% volume and it influences the strength and workability of concrete. The coarse aggregate have different shapes like rounded, angular, flaky and elongated depends upon the source. In this present study, the investigation carried out on the effect of flaky aggregate on the workability and strength properties of concrete. The main aim of this study is the optimum percentage of flaky aggregate is allowable in the concrete to obtain better workability and strength. For this experimental work design mix is prepared for M30 and the measurement of workability is carried out by slump cone test and compaction factor test. Locally available coarse aggregate of size 20mm, river sand as fine aggregate and water binder ratio is 0.45 maintained for the entire work. The cube specimens of size 150mmX150mmX150mm are prepared with and without using admixture for compressive strength at the age of 7 and 28 days curing period. The graded and flaky aggregate ratio is 80:20 and 75:25 carried out in this work. From the experimental work it is concluded that up to 25% of flaky aggregate is allowable in the mix.*
KEYWORDS - *flaky aggregate, workability, compressive strength, admixture*

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I. Introduction

Aggregate shape is one of the influencing properties of fresh concrete. The shape of coarse aggregate classified into rounded, angular, flaky and elongated aggregate. The quality and performance of concrete will depend on the aggregate. The interlocking between flaky and existing of angular type aggregate will produce better workability and strength of concrete.

II. Methodology

Materials were collected locally and the laboratory tests conducted on cement fine aggregate and coarse aggregate. After completion of laboratory tests on the above mentioned materials the mix design was prepared for M30 grade concrete using the referential codes of IS 10262-2009 and IS 456-2000.Based on the mix design the cube specimens were prepared for 7 and 28 days of curing period with and without using admixtures. The sizes of cube specimens were 150mmX150mmX150mm. The measurement of workability carried out by slump test and compaction factor test and the compression strength conducted after 7and 28days curing period. The average strength of three cube specimen results was taken in each mix for strength evaluation. From the final results we had done discussions and finally concluded the present work. The project follows the following flow chart for entire work.

III. Materials

1) **Cement:** Ordinary Portland Cement 43 grade (Sagar cement) was used in the concrete mix.
2) **Coarse Aggregates:** A coarse aggregate passing through 25mm IS sieve and retained on 20mm IS sieve and another one passing through 12mm IS sieve and retained on 10mm IS sieves were taken for this work.
3) **Fine Aggregates**: Dry River sand passing through 4.75 mm IS sieve and retained on 600µ IS sieve confirming zone – III was used.
4) **Water:** Available tap water was used for both mixing of concrete and curing of specimens.

IV. Experimental program

The experimental work was divided into two phases. In first phase, preliminary tests were conducted on materials. In second phase, concrete cube specimens were casted for compressive strength. The concrete is prepared by maintaining 15% of flaky in the existing aggregate of 20mm and 10 mm and adding 5%&10% of flaky aggregate to all the mixes. It means the graded and flaky aggregate ratios were 80:20 and 75:25 maintained in this work. The total Coarse aggregate is taken in the percentage of 70 &30 in the form of 20mm &

10mmrespectively. The water-cement ratio taken 0.45 for all the mixes. The workability of fresh concrete is measured by slump test and compaction factor test and cube specimens are tested for compressive strength of 7 and 28 days of curing.

Table 1 Quantities for $1m^3$ of concrete (with existing flaky aggregate) for control mix 1

Cement (Kg.)	Fine aggregate (Kg.)	Coarse aggregate (Kg.)		Water (Liters)
		20mm (70%)	10mm (30%)	
404.3	577.47	792.246	339.534	186

Table 2 Quantities for $1m^3$ of concrete (without flaky aggregate in the mix.) for control mix 2

Cement (Kg.)	Fine aggregate (Kg.)	Coarse aggregate (Kg.)		Water (Liters)
		20mm (70%)	10mm (30%)	
404.3	577.47	792.246	339.534	186

Table 3 Quantities for $1m^3$ of concrete for MIX-1

Cement (Kg.)	Fine aggregate (Kg.)	Coarse aggregate (Kg.)			Water (Liters)
		20mm (50%)	10mm (30%)	Total flaky aggregate (20%)	
		80%			
404.3	577.47	565.89	339.534	226.35	186

Table 4 Quantities for $1m^3$ of concrete for MIX-2

Cement (Kg.)	Fine aggregate (Kg.)	Coarse aggregate (Kg.)			Water (Liters)
		20mm (45%)	10mm (30%)	Total flaky aggregate (25%)	
		75%			
404.3	577.47	565.89	339.534	282.945	186

Table 5 Quantities for $1m^3$ of concrete for MIX-3

Cement (Kg.)	Fine aggregate (Kg.)	Coarse aggregate (Kg.)			Water (Liters)	1% Admixture by weight of cement (Liters)
		20mm (50%)	10mm (30%)	Total flaky aggregate (20%)		
		80%				
404.3	577.47	565.89	339.534	226.35	169.74	4.04

Table 5 Quantities for $1m^3$ of concrete for MIX-4

Cement (Kg.)	Fine aggregate (Kg.)	Coarse aggregate (Kg.)			Water (Liters)	1% Admixture by weight of cement (Liters)
		20mm (45%)	10mm (30%)	Total flaky aggregate (25%)		
		75%				
404.3	577.47	735.7	339.534	113.178	169.74	4.04

V. Results And Discussion

All the laboratory tests performed as per the Indian Standard codes. From the laboratory tests the following results are obtained.

Table 1 Tests on cement

S.NO	Name of the Test	Result
1.	Fineness test	1.9%
2.	Specific gravity of cement	2.85
3	Standard consistency of cement	29%
4	Initial setting time	45 minutes
5	Final setting time	8 Hours(480Minutes)

Table 2 Tests on fine aggregate

S.NO	Name of the Test	Result
1	Sieve analysis	Zone III
2	Specific gravity	2.53
3	Bulking of sand	28.6%

Table 3 Tests on coarse aggregate

S.NO	Name of the Test	Result
1	Specific gravity	2.67
2	Flakiness index	13.63%

Table 4 Workability test results

S.NO	MIX	Workability	
		Slump(mm)	Compaction Factor
1	Control Mix-1	60	0.96
2	Control Mix-2	30	0.89
3	Mix–1	55	0.93
4	Mix–2	53	0.88
5	Mix–3	36	0.95
6	Mix–4	28	0.93

Table 5 Compressive strength results at the age of 7 and 28 days of curing period

S.NO	Cube specimens	Compressive strength(N/mm2)	
		7 days	28 days
1	Control Mix-1	31.25	40.29
2	Control Mix-2	23.1	34.96
3	Mix–1	31.69	36.43
4	Mix–2	26.51	32.33
5	Mix–3	35.55	43.10
6	Mix–4	28.58	34.66

VI. Discussion

- The compressive strength of control mix is 40.25N/mm2 for 28 days of curing period and having medium workability (slump value lies 50-100 and C.F. is 0.92).
- The compressive strength is gradually decreased when adding of 20% and 25% of flaky aggregate to the concrete mix. The ratio of the graded aggregate and the flaky aggregate is 80:20 and 75:25 respectively. The values are low comparatively with control mix. But in both mixes the 28 days strength is satisfactory and the measurement of workability is medium.
- The strength of control mix 2 is fall down when compared to control mix1 due to lack of inter locking between aggregates.
- It proves that flaky aggregates within the permissible limit is necessary in the mix for better inter locking with angular aggregates.
- The compressive strength is gradually increased when adding of 20% and 25% of flaky aggregate including 1% of super plasticizer to the concrete mix. These values are high when compared with same mix without using admixture. But while using admixture the 25% of flaky aggregate mix strength is fall down when compared to the 20% of flaky aggregate mix.
- The workability is low when considering the slump values, but the compaction factor values not correlated with the slump values in this case. The flaky aggregate have more surface area and it requires more cement paste in the mix. So there is no availability of paste for better workability. Due to no proper interlocking

between flaky and angular aggregate in the mix, the strength is fall down but the overall percentage of flaky aggregate within the permissible limit in the mix will be considerable.

VII. Conclusion

- From the experimental work it is concluded that 20% of flaky aggregate is acceptable in the total coarse aggregate for getting better strength and workability. Hence the optimum percentage of flaky aggregate in the concrete is 20%.
- By addition of admixture, the concrete with 20% of flaky aggregate also shown good improvement in strength and workability.

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