EXPERIMENTAL STUDY ON THE IMPACT ON STRENGTH OF CONCRETE WITH FLAKY AGGREGATES

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Abstract: In this paper, in this thesis effect of flakiness on the flexural strength of RCC beams have been studied using experiments. Total 12 beams have been cast using normal, 5% of 8 mm, 10 mm and 12 mm size of aggregates. NDT of the cast beams using rebound hammer and UPV have been also carried out. All the beams were tested for flexural strength and ultimate load were recorded. Using this flexural strength of the beam and calculated. Based on these data, comparative studies have been carried out to quantify the effect of flakiness. Salient conclusions on this are drawn.

Keywords: concrete, flaky Aggregate, partial replacement coarse aggregate, flexural strength, crushing loads.

1. INTRODUCTION

Concrete is a composite material, where coarse and fine aggregates are filler material and cement paste are binding material. Concrete is composite of sand, gravel, crushed rock, or other aggregate held together by a hardened paste of hydraulic cement and water. The thoroughly mixed ingredients, when properly proportioned, make a plastic mass which can be cast or molded into a predetermined size and shape. Upon hydration of the cement by the water, concrete becomes stone like in strength and hardness and has utility for many purposes. Concrete is a most popular construction material in the world. It is made by mixing coarse and fine aggregates, water, cement, and additives in a certain prescribed proportion.

Concrete has found use in hearty all types of construction form highway, canal, linings, bridge, and dams to the most beautiful and artistic of buildings. With the addition of reinforcement to supply needed tensile strength, advances in structural design, and the use of pre-stressing and post tensioning, it has become the foremost structural material. The maximum properties of concrete and workability of concrete depend on aggregate. J.W. Kelly(2001) said, “One would not think of using wood for a dam, steel for pavement, or asphalt for a building frame, but concrete is used for each of these and for many other uses than other construction materials. Even where another material is the principal component of a structure, concrete is usually used with it for certain portions of the work. It is used to support, to enclose, to surface, and to fill. More people need to know more about concrete than about other specialized materials”.

The first concrete like material produced in history was obtained when Greek and Roman builders discovered that by mixing claimed limestone, lime, water, sand and crashed stone together, a hardening mix could be produced. For a very long time engineers have explored the versatility of materials with such characteristics as to be molded in a plastic state and later be hardened into a strong and durable commodity.

The performance of such construction materials is dependent on the individual characteristics of its components. Concrete knowledge has progressed and evolved with the times and with new detections. In the latter part of the 19thcentury, concrete was ordinarily placed nearly dry and compacted with heavy tempers. The reinforcement was not used at that time in concrete. With the development of reinforced concrete in the early part of this century, very wet mixes become popular and much of the concrete was literally poured into the forms and had neither check.

The characteristic of concrete should be considered on a relative basis and in terms of the degree of quality that is required for any given construction purpose. A concrete that is durable and otherwise satisfactory under conditions which give it protection from the elements might be wholly unsuited in locations of severe exposure to disintegrate influences.

2. LITERATURE REVIEW

In this part we have talked about the distinctive materials which are much of the time utilized for mentioning the concrete and objective facts of the diverse creators by utilizing the diverse materials by literature review.

Ozturan(1997)et al., reported the influence of coarse aggregate variety taking place mechanical properties of concretes by different strengths. This paper is on the influence of the category of coarse aggregate on compressive, flexural and tensile strength going on concrete produced at various strength levels. Concretes with 28 days aim compressive strengths of 30, 60 and 90 MPa were made by basalt, limestone and gravel coarse aggregates. The gravel aggregate concrete with 90 MPaobjectstrong point was also simulated by using a cement of higher strength, keeping the additional parameters same. 28th day test results have specified that, in higher strength concrete, basalt shaped the maximum, whereas gravel provided the lowest compressive strengths. Standard strength concretes made with basalt and gravel gave similar compressive strengths even though the concrete having limestone achieved fairly higher strength. Higher tensile strengths were found with crushed basalt and limestone both compared to the gravel aggregate when used in higher strength concrete. In the reproduce mixture, almost

30 percent rises in flexural and splitting tensile strengths were found as a result of using stronger cement, whereas compressive strength was not precious at all.

Kaplon (1958) reported the effects of the properties of coarse aggregates on the workability of concrete. Thirteen coarse aggregates were investigated to determine the effects of their shape, surface texture and water absorptive capacity on the workability of concrete. An attempt has also been made to assess these effects quantitatively. The result of this research is changes in the angularity of coarse aggregates have a greater effect on the workability of concrete than changes in the flakiness of the aggregates. Increased angularity and/or flakiness leads to a reduction in the workability of concrete. Although there was a wide variation in the surface textures of the aggregates, no correlation was found between this property and the workability of concrete. The differences in the capacities of the aggregates to absorb water were insufficient to produce significant changes in the compacting factor. No correlation was, therefore, found between this property and concrete workability. This does not rule out the possibility that highly porous aggregates when used in a dry condition will affect the workability of concrete.
Patel et al., (2013) reported on the effect of coarse aggregate physical characteristics on strength properties of high efficiency concrete by using mineral and chemical admixture. This paper shows that by properly selecting aggregate and improving mixture proportions, the amount of cementations materials providing for workability can be minimized while achieving suitable workability and hard-bitten properties. The results of this research conform that the aggregate can play an important role in cement concrete mixture. The aggregate type has effect on the compressive strength of normal concrete. The compressive strength of concrete cube by using compression testing machine of capacity 2000 kN vary from 28.62N/mm2 to 62.50N/mm2 at 56 days. The maximum compressive strength is detected in type a coarse aggregate.

Rogers and Gorman(2008)reported a flakiness test for fine aggregate. This paper describes the development of a test for measuring the amount of flaky particles in fine aggregate. Commercially available slotted sieves for testing grain or seeds are used. Material in the pass 4.75 mm to 2.36 mm fraction is tested on a 1.8 mm slotted sieve and material in the pass 2.36 mm to 1.18 mm portion is tested on a 1.0 mm slotted sieve. The equipment is inexpensive and the test is not excessively time consuming. The measurement of flaky particles may also be used to compare the effect of different crushers and crusher systems on creation of flaky particles in fine aggregate. The results show the high amounts of flaky particles in a fine aggregate may warn of difficulty in compacting asphalt mixtures in which the material is used by itself as the fine aggregate.

3. MATERIAL & TESTS

A.GENERAL:- In this examination an endeavor has been made to think about the Flexural Strength of RCC Beams having Flaky and Normal Aggregates. The methodology took after, tests directed for determination of configuration blend is examined in this part.

1) Specific gravity Test :
- Specific gravity Test for cement
- Specific gravity Test for fine aggregates
- Specific gravity Test for coarse aggregates

2) Water absorption Test
- Water absorption Test for fine aggregates
- Test for coarse aggregates
- Sieve analysis
- Surface moisture Test
- Bulk density Test
- Water adsorption
- Fineness of cement Test .

3) Destructive Test
- Flexural Strength

MATERIAL USED:-

A) Materials:-

a) Cement:
Cement is a fine, grey powder. It is mixed with water and materials such as sand, gravel, and crushed stone to make concrete. The cement and water form a paste that binds the other materials together as the concrete hardens. Ordinary Portland cement having 28days compressive strength of 46 MPa (ASTM 1994) was used for preparation of all concrete cubes. By using one type of cement, the effect of varying the types of coarse aggregate in concrete is investigated.

TABLE:-I Properties of cement

S. No.	Characteristics	Values obtained	Standard values
1	Normal consistency	35%	
2	Initial Setting Time	52 min	Not less than 30 min.
3	Final Setting Time	579 min.	Not Greater than 600 min.
4	Sp.Gr.	3.12	
5	Fineness	4.8	

b) Fine Aggregate:
The sand used for the experimental programmed was locally procured and conformed to Indian Standard Specifications IS: 383-1970. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust.

c) Coarse Aggregate:
The broken stone is generally used as a coarse aggregate. The nature of work decides the maximum size of the coarse aggregate. Locally available coarse aggregate having the maximum size of 20 mm was used in our work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per Indian Standard Specifications IS: 383-1970.

d) Flaky Aggregate Flaky is the term applied to aggregate or chippings that are flat and thin with respect to their length or width, Aggregate particles are said to be flaky when their thickness is less than 0.6 of its mean size. The flakiness index is found by expressing the weight of the flaky aggregate as a percentage of the aggregate tested. This is done by grading the size fractions, obtained from a normal grading aggregate, in special sieves for testing flakiness. These sieves have elongated rather than square apertures and will allow aggregate particles to pass that have a dimension less than the normal specified size, i.e. 0.6 of the standard size. This grading process is normally performed by hand because flaky chippings tend to 'lie' on the sieve surface rather than fall through the aperture. There are a number of material and aggregate specifications that have a maximum amount of flaky material allowed, e.g. surface dressing chippings. Flaky aggregate has less strength than cubical aggregate, and does not create the dense matrix that well graded cubicle aggregate is able to do, and it will provide less texture when used in surface dressing. Granular sub-base with a high proportion of flaky aggregate tends to segregate and be difficult to compact, although performing a normal aggregate grading test will show it conforms to specification. Flaky chippings do not create the surface texture that a cubicle or angular chipping is able to produce.

Criteria for describing particle shape according to ASTM D 2488-00.

A grain is classified as flaky aggregate if: $\frac{\text{thickness}}{\text{width}} > 2.0$

A grain is classified as elongated aggregate if: $\frac{\text{thickness}}{\text{length}} > 2.5$

4. RESULT AND DISSCUSSION

4.1 CONSISTENCY OF CEMENT TEST

The Normal Consistency of Cement is portrayed as that level of water required to convey a bond paste of standard consistency. For affirmation reason, run of the mill consistency is taken as the water content at which vicat's plunger penetrates up to a condition of 5 to 7 mm from the base of the vicat's frame. When we add water to the bond, the paste starts solidifying and gets quality. The fundamental point is to find the water content required to make a security paste of standard consistency as demonstrated by the May be: 4031 (Part 4) – 1988. The control stick had normal consistency of 35%.

Standard initial and final setting time of cement

Type of cement	Initial setting time			Final setting time		
Portland-pozzolona cement 43 grade	As per IS (IS 4031: PART 5)		Test time	As per IS (IS 4031: PART 5)		Test time
	Minimum	Maximum	52 min	Minimum	Maximum	579 min
	30 min	55 min		190 min	600 min	

4.2 Water Absorption Test

Water absorption test is done to determine the water absorption capacity of aggregate. More water content in aggregate shows poor strength. Test procedure are mention in IS: 2386(part III)-1963 for this test a model not less than 2000gm should be used.

Water absorption test results for natural aggregate are given in Table 4.4.

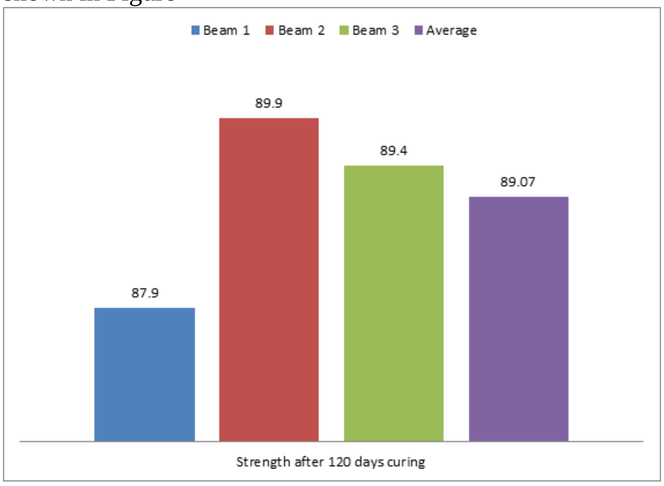
Table 4.4: Water absorption results for natural coarse aggregate

S.No.	Type of sample	Water absorption%	
		As per IS	As per lab test
1	Natural coarse Aggregate	Maximum 2%	1.56%
2	Natural coarse (flaky) aggregate	Maximum 2%	1.48%

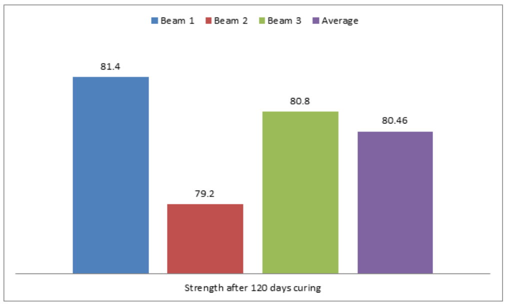
5. CALCULATION AND RESULTS VARIATION

5.3.3 UTM Test Results Average

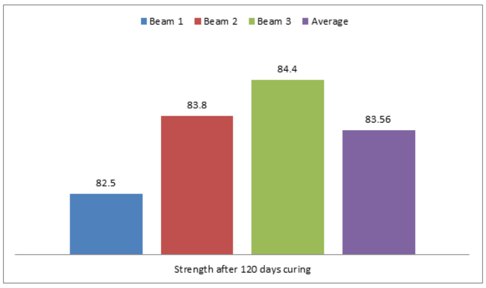
1. UTM test for flexural strength, result for M25 grade concrete beam with nominal mix of concrete with natural aggregate results are given the Table 5.9, and in graph form shown in Figure



2. UTM test for flexural strength, result for M25 grade concrete beam with nominal concrete mix with 90% natural aggregates and 10% flaky aggregate mix 8mm size passing with flakiness index, results has shown the Table 5.10, and in graph form shown in Figure



3. UTM test for flexural strength, result for M25 grade Concrete beam with nominal concrete mix with 90% natural aggregates and 10% flaky aggregate mix 10mm size passing with flakiness index, results has shown



4. UTM test for flexural strength, result for M25 grade concrete beam with nominal concrete mix with 90% natural aggregates and 10% flaky aggregate mix 12mm size passing with flakiness index, results has shown the Table 5.12, and in graph form shown in Figure

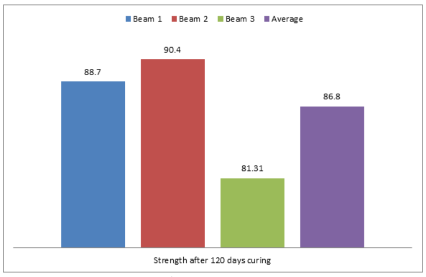


Figure 5.15: Average flexural strength (MPa) by UTM

Discussion of results

It can be observed that maximum of flexural strength is in the case of normal aggregate and minimum is in the case of 10% of flaky aggregates having 8 mm size and 90% of normal aggregates mix in concrete admixture, and similarly increasing in order to 10% of flaky aggregate with 90% of normal aggregate having 10 mm size then after 12 mm size also.

6. CONCLUSION

Following are the salient conclusions of the study:-

a) Flexural test

1. It can be observed that RCC concrete beams show higher strength with normal aggregate mix.
2. Normal aggregate mix shows the less strength with flaky aggregate due to size variation.
3. Flexural strength in flaky aggregates concrete is found to be higher with increase in aggregate size which is same as rebound hammer result.

7. FUTURE SCOPE OF THE WORK

The presence of flaky aggregates is considered in the thesis opens a future scope of work for the followings:

1. The present research has been carried out only for the M25 grade of concrete mix having normal aggregates with mixture of 5% flaky aggregates in three different sizes (8 mm, 10 mm, 12 mm). The scope of research could be further extended and research needs to be carried out on different percentages and grades also.
2. The research needs to be further extended for cubical and cylindrical specimens also.
3. This quality control system should be developed to be used in the construction of bridges, flyovers, tunnels and various concrete structures etc. using flaky aggregates.
4. Effect of flakiness may be also studies for impact and thermal loadings.

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