AN APPLICATION ON THE EFFECT OF FLEXURAL STRENGTH OF RCC BEAMS HAVING FLAKY AND NORMAL 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, Rebound hammer, crushing loads.

I. 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 heartily 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 crushed 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.

II. 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 MPa object strong 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.

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MATERIAL USED:-
A) Materials:-

1) 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 28 days 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.

2) 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.

3) 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: \( \frac{\text{thickness}}{\text{length}} > 2.5 \)

IV. RESULT AND DISCUSSION

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%.

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>
<thead>
<tr>
<th>S.No</th>
<th>Type of sample</th>
<th>Water absorption%</th>
<th>As per lab test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Natural course Aggregate</td>
<td>Maximum 2%</td>
<td>1.50%</td>
</tr>
<tr>
<td>2</td>
<td>Natural course (flaky) aggregate</td>
<td>Maximum 2%</td>
<td>1.48%</td>
</tr>
</tbody>
</table>

CALCULATION AND RESULTS VARIATION

5.3.1 Rebound Hammer Test Results

Discussion of results

It can be observed that maximum of Rebound strength (MPa) is in the case of normal aggregate and minimum is in the case of 5% of flaky aggregates having 8 mm size and 95% of normal aggregates mix in concrete admixture, and similarly increasing in order to 5% of flaky aggregate with 95% of normal aggregate having 10 mm size then after 12 mm size also.

5.3.2 UPVTest Results Average

Discussion of results

It can be observed that maximum of velocity (km/sec) is in the case of normal aggregate and minimum is in the case of 5% of flaky aggregates having 8 mm size and 95% of normal aggregates mix in concrete admixture, and similarly increasing in order to 5% of flaky aggregate with 95% of normal aggregate having 10 mm size then after 12 mm size also.
5.3.3 UTM Test Results Average

![Average flexural strength (MPa) by UTM](image)

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 5% of flaky aggregates having 8 mm size and 95% of normal aggregates mix in concrete admixture, and similarly increasing in order to 5% of flaky aggregate with 95% of normal aggregate having 10 mm size then after 12 mm size also.

V. CONCLUSION

Following are the salient conclusions of the study:-

A). Rebound hammer
- It can be observed that RCC concrete beams show higher strength with normal aggregate concrete mix.
- Rebound strength reduces by adding the flaky aggregates in all the cases.
- Rebound strength in flaky aggregates concrete is found to be higher with increase in aggregate size.

B). UPV test
- It can be observed that RCC concrete beams show higher pulse velocity with normal aggregate concrete mix.
- Pulse velocity reduces by adding the flaky aggregates in all the cases.
- Pulse velocity in flaky aggregates concrete is found to be higher with increase in aggregate size.

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

FUTURE SCOPE OF THE WORK

- The presence of flaky aggregates is considered in the thesis opens a future scope of work for the followings:
- The present research has been carried out only for the M20 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.
  - The research needs to be further extended for cubical and cylindrical specimens also.
  - 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.
  - Effect of flakiness may be also studies for impact and thermal loadings.

REFERENCES


