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Experimental Study on Light Weight Concrete using Leca and Cinder as Coarse Aggregates

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***Abstract*: Light weight concrete is widely used in various civil engineering fields due to its low density compared to normal conventional concrete. The present study initiates on the analysis of light weight aggregate concrete using leca and cinder as coarse aggregates. The mix design is carried out for both M_{20} and M_{30} grade concrete mixes; the coarse aggregate proportion is fully replaced by blended aggregates (leca and cinder) in various percentages by volume. The experimental results shows that the full replacement of coarse aggregate proportion with 40% of leca and 60% of cinder aggregates have given the better results with high strength, less weight and low density.**

I.INTRODUCTION:

Concrete is one of the important adhesive material used in construction field. It is obtained by mixing of cement, fine aggregates, coarse aggregates and water along with some pozzolonas if required in a proportionate way as per the mix design.

Increased demand in the construction industry lead to increase in the cost of production of concrete .This increased cost of construction materials have paved the way for the researchers to introduce some new construction materials with low cost and high strength. Concrete, due to its high self weight increases the dead load on the structure. Many research works have been carried out in order to decrease the self weight of the construction materials on the structure which lead to the development of light weight concrete. With reference to this there is an increase in the demand for light weight concrete due to low density and high strength. The concrete whose density (1440 to 1840 kg/m3) is comparatively less than that of the normal conventional concrete (2240 to 2400 kg/m3) is termed as light weight concrete.

Research works are carried out either by using leca (ref:payam shafigh and et al,2011) or cinder (ref: Dr.V.Bhaskar Desai and et al,2014) as coarse aggregates instead of normal conventional aggregates.

But in the present study both leca and cinder aggregates are used as the coarse aggregate replacement in light weight cavities with low density which can float in water.

concrete. The light weight concrete is developed by preparing the mix design for normal conventional concrete; by replacing the coarse aggregate proportion by blended aggregates at various percentages and then the optimum strength is determined with reference to various tests conducted on it.

II. MATERIALS AND THEIR PROPERTIES

The materials which are used for the experimental procedure are as follows;

1) Cement- Cement is the most important ingredient which determines the fresh & hardened properties of concrete. Ordinary Portland cement of 43 grade (sp gravity-3.15) confirming to IS 12269-1987 is used in this experimental program.

2) Fine aggregates - The aggregates which are passing through 4.75mm size IS sieve and contains only that much of coarse grained materials as permitted by the specifications are generalized as fine aggregates. Fine aggregates confirming to zone II passing through 4.75mm IS sieve (sp gravity-2.52) is used in this experimental program.

3) Coarse aggregates: The aggregates which are retained on 4.75mm size IS sieve and contains only finer materials are generalized as coarse aggregates. Coarse aggregates
Passing through 12mm sieve and retained on 10mm sieve (sp gravity-2.63) are used in this experimental program.

4) LECA: It is abbreviated as LIGHT EXPANDED CLAY AGGREGATES. It is the special type of aggregate (sp gravity-0.510) which are formed by pyroclastic process in rotary kiln at very high temperature. LECA is non Destructible , non-combustible & impervious to attack by dry-rot, wet-rot & insects.

5) CINDER: Cinder is a naturally occurring light weight rock (sp gravity-1.512) of igneous origin. It is a pyroclastic
material which is similar to that of pumice and has many

III. METHODOLOGY

The raw materials are firstly cleaned such that it should be free from impurities and then they are subjected to the basic tests. Based on the appropriate water cement ratio the mix designs are obtained for both M_{20} & M_{30} grade concrete as per the codal provisions. For the obtained mix design the light weight aggregates such as LECA & CINDER are fully replaced in place of conventional aggregates with various percentages. The fresh concrete, slump test is carried for each proportion. For each blended proportioned percentage the cubes and cylinders are casted in order to determine hardened properties of concrete. The above specimens are kept for curing for 28days and then the test results are determined. The above process is carried for the two grades of conventional concrete. After testing the light weight aggregate concrete the proportion at which optimum strength obtained is determined. Further the optimum light weight aggregate concrete is compared with that of conventional grade concrete, so that the amount of strength gained with respect to normal conventional concrete is determined.

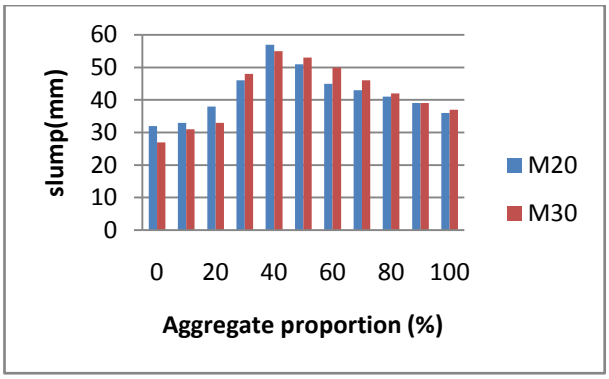
IV.EXPERIMENTAL ANALYSIS:

The fresh and hardened properties of concrete are determined by various tests as follows;

A) Test on fresh concreter: slump test
B) Test on hardened concrete:
   1) Compression strength test.
   2) Split tensile test.

SLUMP TEST

The slump test is carried out in order to determine the workability of concrete. Slump test is carried out for various proportions of light weight concrete and the test results shown in graph 1 as follows

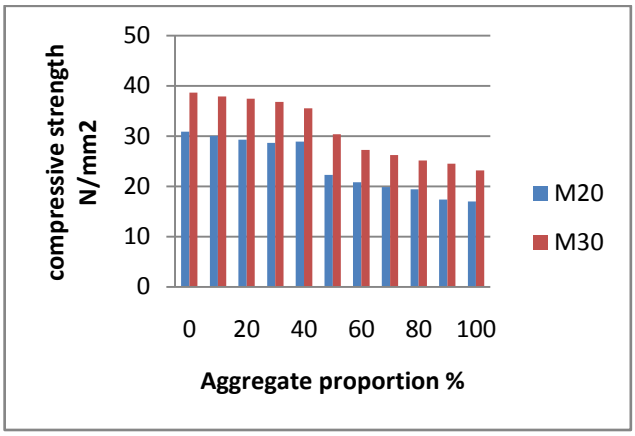


Graph1: comparison of aggregate proportion (%) verses slump (mm) for M_{20} and M_{30} grade concrete mixes.

From the above slump values it is observed that the slump goes on increasing up to 40% replacement of leca and 60% replacement of cinder. Further the values of the slump goes on decreasing till the last proportion, therefore from the graph it is analysed that the slump is highest for the 40% leca and 60% cinder replacement proportion.

COMPRESSION STRENGTH TEST

The cubes of 150x150x150mm are casted by varying the proportions of leca and cinder for both M_{20} and M_{30} grade concrete mixes. The results obtained are tabulated for the curing period of 28 days as shown below in graph 2



Graph 2: comparison of aggregate proportion (%) verses compressive strength for M_{20} and M_{30} grade concrete mixes

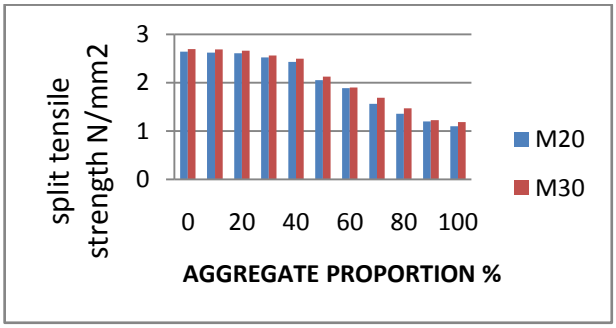
The compression test results which are obtained are plotted in graph 2, with compressive strength along y axis and the aggregate proportions along x axis.

With 0% replacement of leca and 100% replacement of cinder, compressive strength for M_{20} is 30.676 and that of M_{30} is 38.890.Variation in the strength is observed consecutively in same extent as the aggregate proportions are varied.

From the above compression test values it has been observed that the strength goes on decreasing from the first proportion to the last in a gradual sense.

It is also noted that the values for compressive strength for M_{30} is comparatively higher than that of M_{20} grade concrete, this implies that as the grade of concrete is increased the strength also increases.

SPLIT TENSILE TEST: The cylinders of 300X150mm are casted by varying the proportions of leca and cinder for both M20 and M30 grade concrete mixes. The results obtained are shown graphically for the curing period of 28 days as shown below



Graph 3: comparison of aggregate proportion (%) verses split tensile strength for M_{20} and M_{30} grade concrete mixes.

Split tensile test is carried out for both the grades by varying the aggregate proportions. From the obtained results; the graph is plotted with split tensile strength along y axis and aggregate proportions along x axis.

From the graph it is observed that the values for split tensile strength are almost same for both the grades up to 40% replacement of leca and 60% replacement of cinder. But after this proportion, there is a slight decrease in the strength values for m20 grade concrete as compared to that of m30 grade concrete.

It is also noted that the values of split tensile strength for M_{30} is comparatively higher than that of M_{20} grade concrete, this implies that as the grade of concrete is increased the strength also increases.

CONCLUSIONS:

From the above results the conclusion obtained are as follows

1) The slump value is found to increase gradually until the (40%,60%) leca and cinder proportions, and thereafter the slump goes on decreasing gradually .Therefore with 40% replacement of leca and 60% replacement of cinder the better workability are obtained for the both concrete mixes.

2) The compression test results are found to be decrease gradually until the (40%, 60%) leca and cinder proportion, but after this proportion there is a sudden decrease in strength to a larger extent.

3) The split tensile strength is decreasing from first proportion till that last proportion in a gradual way in a same way as that of the compression test results.

4) Therefore it can be concluded that with the replacement of 40% replacement of leca and 60% replacement of cinder better performance can be achieved with less weight and low density.

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