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EXPERIMENTAL INVESTIGATION ON REPLACEMENT OF COARSE AGGREGATES BY CERAMIC TILES INCONCRETE

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ABSTRACT: Concrete is most widely used construction material today. Concrete has attained the status of a major building material in all the branches of modern construction. It is difficult to point out another material of construction which is as variable as concrete. Concrete is the best material of choice where strength, durability, impermeability, fire resistance & absorption resistance are required. Ordinary Portland cement (OPC) is one of the main ingredients used for the production of concrete and has no alternative in civil construction industry. But, production of cement involves emission of large amount of carbon dioxide gas into the atmosphere which results into a global warming. So it is advisable to search for another material or partly replace it by other material that should lead to lowest environmental impact. The present study deals with the strength characteristics of M20 Grade of concrete by partial replacement of coarse aggregate with tile pieces .The variable factors considered in this study were M30 grade of concrete cubes and cylinders are prepared by using cubes of size (150 X 150 X 150)mm and cylinders of size 150mm(Dia) X 300mm (Depth) that were casted and cured in potable water for a period of 28 days. The specimens were then tested for split tensile strength , compression strength and flexural strength of the conventional concrete and high performance concrete at 7,14 & 28 days

Keywords: Crushed tiles, Compressive strength, coarse aggregates, Water absorption, Split tensile test.

1. INTRODUCTION: Concrete is most widely used construction material today. concrete has attained the status of a major building material in all the branches of modern construction. it is difficult to point out another material of construction which is as variable as concrete. concrete is the best material of choice where strength, durability, permeability, fire resistance & absorption resistance are required

Civil structures made of steel reinforced concrete normally suffer from corrosion of the steel by the salt, which results in the failure of those structures. Constant maintenance and repairing is needed to enhance the life cycle of those civil structures. There are many ways to minimize the failure of the concrete structures made of steel reinforce concrete. The custom approach is to adhesively bond fibre polymer composites onto the structure. This also helps to increase the toughness and tensile strength and improve the cracking and deformation characteristics of the resultant composite. Workability ,Strength and Durability are three basic properties of concrete. Amount of useful internal work necessary to overcome the internal friction to produce full compaction is termed as Workability. Size, Shape, Surface, Texture and grading of aggregates, water-cement ratio, use of admixtures and mix proportion are important factors affecting workability. Strength is to bear the desired stresses within the permissible factor of safety in expected exposure condition. The Compressive strength of concrete is one of the most important and useful properties of concrete. In most structural applications concrete is employed primarily to resist compressive stresses. In those cases where strength in tension or initial is of primary importance, the compressive strength is frequently used as a measure of this properties. Therefore, the concrete making properties of varies ingredients of mix are usually measured in terms of the compressive strength.For analyzing the suitability of these crushed waste tiles in the concrete mix, workability test was conducted for different mixes having different percentages of these materials. Slump cone test is used for performing workability tests on fresh concrete. And compressive strength test is also conducted for 3, 7 and 28 days curing periods by casting cubes to analyze the strength variation by different percentage of this waste materials. This present study is to understand the behavior and performance of ceramic solid waste in concrete. The waste crushed tiles are used to partially replace coarse aggregate by 10%, 20%, and 30%.

2. LITERATURE REVIEW:

PAUL O. AWOYERA (2016) The usage of ceramic tiles in concrete was observed in this paper. In this, both the coarse and fine aggregates are replaced with ceramic fine and ceramic coarse aggregates obtained from construction sites of Ota, Lagos and Nigeria in various percentages. The ceramic fine and coarse aggregates are replaced in conventional concrete individually and the strength parameters are studied. Finally, it states that usage of ceramic waste in concrete gives considerable increase in strength compared to conventional concrete.

N.NAVEEN PRASAD (2016) Crushed waste tiles and Granite powder were used as a replacement to the coarse aggregates and fine aggregate. The combustion of waste crushed tiles were replaced in place of coarse aggregates by 10%, 20%, 30% and 40% and Granite powder was replaced in place of fine aggregate by 10%, 20%, 30% and 40% without changing the mix design. M25 grade of concrete was designed to prepare the conventional mix. Without changing the mix design different types of mixes were prepared by replacing the coarse aggregates and fine aggregate at different percentages of crushed tiles and granite powder. Experimental investigation is carried out. The workability of concrete increased with increase in granite powder and it has been observed that the compressive strength is maximum at 30% of coarse aggregate replacement.

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coarse and fine aggregates are replaced with ceramic fine and ceramic coarse aggregates obtained from construction sites of Ota, Lagos and Nigeria in various percentages. The ceramic fine and coarse aggregates are replaced in conventional concrete individually and the strength parameters are studied. Finally, it states that usage of ceramic waste in concrete gives considerable increase in strength compared to conventional concrete.

P. RAJALAKSHMI (2016 Use of ceramic waste will ensure an effective measure in maintaining environment and improving properties of concrete. The replacement of aggregates in concrete by ceramic wastes will have major environmental benefits. In ceramic industry about 30% production goes as waste. The ceramic waste aggregate is hard and durable material than the conventional coarse aggregate. It has good thermal resistance. The durability properties of ceramic waste aggregate are also good. This research studied the fine aggregate replacement by ceramic tiles fine aggregate accordingly in the range of 10% and coarse aggregate accordingly in the range of 30%, 60%,100% by weight of M-30 grade concrete. This paper recommends that waste ceramic tiles can be used as an alternate construction material to coarse and fine aggregate in concrete irrespective of the conventional concrete, it has good strength properties i.e., 10% CFA and 60% CCA being the maximum strength.

PROF. SHRUTHI H. G. (2016)[l]**:** Ceramic tiles were obtained from manufacturing industries, from construction and demolition sites, this cause's environmental pollution. The utilization of crushed tile as a coarse aggregate in concrete would also have a positive effect on the economy. study, Ceramic tile waste were used in concrete as a replacement for natural coarse aggregate with 0%, 10%, 20% and 30% of the substitution and M20 grade concrete were used. The concrete molds were casted and tested for Compressive Strength and Split Tensile Strength after a curing period of 3, 7 & 28 days. The results indicate that, the maximum compressive strength is obtained for the 30% replacement of ceramic tile aggregate with natural coarse aggregate.

WADHAH M.TAWFEEQ (2016) This study investigated the effects of using crushed tiles (CT) as coarse aggregates in the concrete mix. The technology of concrete recycling is well established in the U.S. Recycling of Portland cement concrete, as well as asphaltic concrete, has been shown to be a cost-effective alternative for road, street and highway construction. It includes not only the water content and tiles but also the gravel/sand ratio. They concluded that as the water cement ratio decrease, the compressive strength increases. The paper consists of replacement of crushed tiles to 50% and 100% only. The results show that replacement of crushed tiles as coarse aggregate below 50% will have considerable properties.

3. MATERIALS AND PROPERTIES

MATERIALS USED:

Raw materials required for the concrete use in the present work are

- Cement
- Fine Aggregates
- Coarse aggregate

- Water
- Ceramic tiles

Cement: [IS: 8112-1989]: Ordinary Portland cement is used for general constructions. The raw materials required for manufacture of Portland cement are calcareous materials, such as limestone or chalk and argillaceous materials such as shale or clay. The manufacture of cement consists of grinding the raw materials, mixing them intimately in certain proportions depending upon their purity and composition and product formed by using the procedure is a "Portland cement".

Aggregate [IS: 383-1970]: Aggregate properties greatly influence the behaviour of concrete, since they occupy about 80% of the total volume of concrete. The aggregates are classified as

1) Fine aggregate
2) Coarse aggregate

The coarse aggregate are granular materials obtained from rocks and crushed stones. They may be also obtained from synthetic material like slag, shale, fly ash and clay for use in light weight concrete. The sand obtained from river beds or quarries is used as fine aggregate.

Fine aggregate are materials passing through an IS sieve that is less than 4.75mm gauge beyond which they are known as coarse aggregate. From the main matrix of the concrete whereas fine aggregate from the filler matrix between the coarse aggregates. The most important function of the fine aggregates is to provide workability and uniformity in the mixture. The fine aggregate also helps the cement paste to hold the coarse aggregate particles in suspension.

According to IS 393-1970 the fine aggregate is being classified in to four different zones, that is zone-I, zone-II, zone-III, and zone-IV. Also in case of coarse aggregate maximum 20mm coarse aggregate is suitable for concrete work. But where there is no restriction, 40mm or large size may be permitted.

Fine aggregate [IS: 383-1970]: The size of the fine aggregate is below 4.75mm.Fine aggregates can be natural or manufactured. The grade must be throughout the work. The moisture content or absorption characteristics must be closely monitored. The fine aggregate used is natural sand obtained from the river Godavari conforming

to grading zone-II of table 3 of IS: 10262-2009. The results of various tests on fine aggregate are given in table 2.2.

The fine aggregate shall consist of natural sand or, subject to approval, other inert materials with similar characteristics, or combinations having hard, strong, durable particles. The use of concrete is being constrained by urbanization, zoning regulations, increased cost and environmental concern.

Coarse aggregate [IS: 383-1970]: Crushed angular granite aggregate conforming to IS: 383-1970 is used for preparation of concrete. Coarse aggregate of size 20mm, having the specific gravity of 2.74 is used. It is free from impurities such as dust, clay particles and organic matter etc. The coarse aggregate is also tested for its various properties.

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CERAMIC TILE AGGREGATE: Broken tiles were collected from the solid waste of ceramic manufacturing unit and from demolished building. The waste tiles were crushed into small pieces by manually and by using crusher. The required size of crushed tile aggregate was separated to use them as partial replacement to the natural coarse aggregate. The tile waste which is lesser than 4.75 mm size was neglected. The crushed tile aggregate passing through 16.5mm sieve and retained on 12mm sieve are used. Crushed tiles were partially replaced in place of coarse aggregate by the percentages of 10%, 20% and 30% individually.

4. TEST RESULTS

Compressive strength:

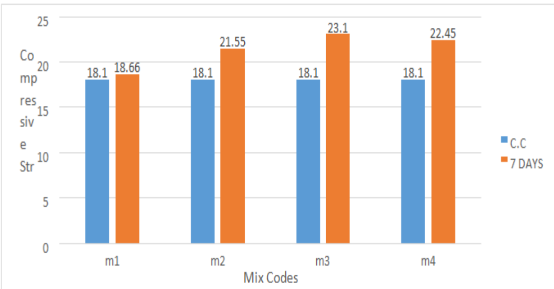

Figure 1: Comparison of Compressive strength of M20 at 7 days

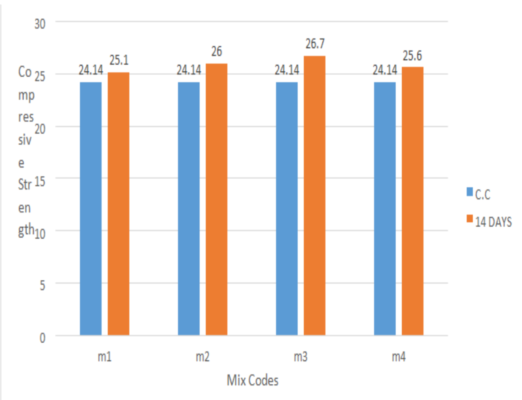

Figure 2: Compressive strength of M20 concrete at 14 days

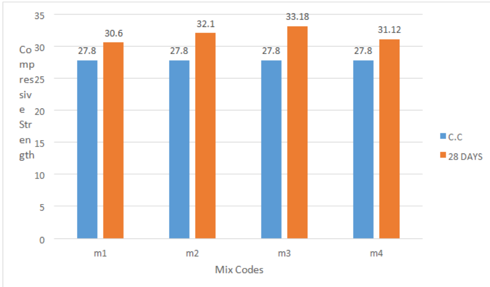

Figure 3: Compressive strength of M20 concrete at 28 days

Split Tensile strength:

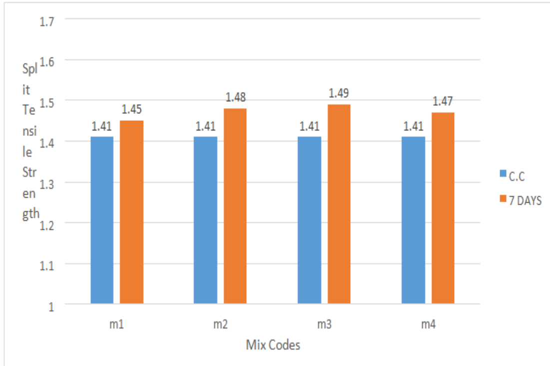

Figure 4: Split tensile strength of M20 concrete at 7days

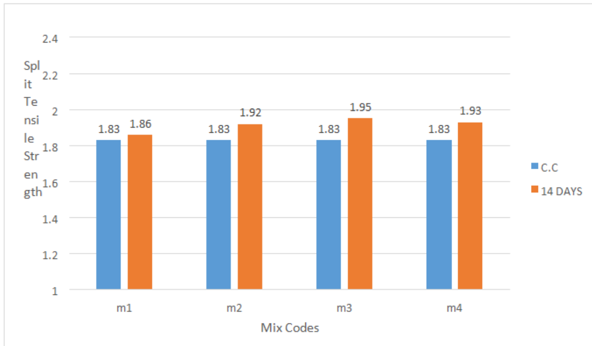

Figure 5: Split tensile strength of M20 concrete at 14days

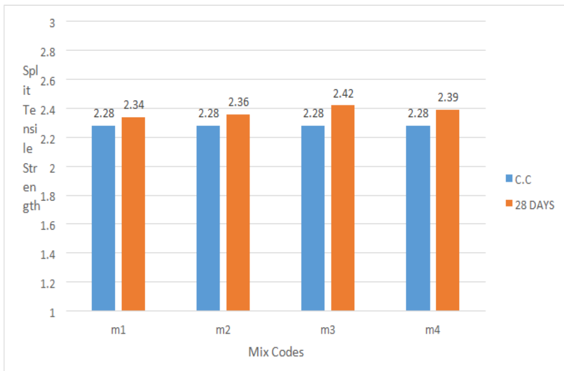

Figure 6: Split tensile strength of M20 concrete at 28days

5. CONCLUSIONS

- The Compressive strength of concrete varies as 3.1%, 19.1%, 27.6% and 24.0%, for m1, m2, m3 and m4 compared with the conventional concrete after 7days of curing.
- The Compressive strength of concrete varies as 3.9%, 7.7%, 10.6% and 6.04% for m1, m2, m3 and m4 compared with the conventional concrete after 14days of curing.
- The Compressive strength of concrete varies as 10.1%, 15.5%, 19.3% and 11.9% for m1, m2, m3 and m4 compared with the conventional concrete after 28days of curing.
- On comparing the strengths of all mixes m3 mix has the highest i.e., 30% replacement of coarse aggregate.
- The split tensile strength of concrete varies as 2.83%, 4.9%, 5.6% and 4.2% for m1, m2, m3 and m4, compared with the conventional concrete after 7days of curing.
- The split tensile strength of concrete varies as 1.6%, 4.9%, 6.5% and 5.46%, for m1, m2, m3 and m4, compared with the conventional concrete after 14days of curing.
- The split tensile strength of concrete varies as 2.63%, 3.5%, 6.14% and 4.82%, for m1, m2, m3 and m4 compared with the conventional concrete after 28days of curing.
- On comparing the split tensile strengths of all mixes m3 mix has the highest i.e., 30% replacement of coarse aggregate.

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