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# Experimental Research on Flexural Behaviour of Filler Slab with Activated Carbon

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***Abstract*: Concrete is most frequently used composite material. Concrete is the combination of M-Sand, coarse aggregate and binding medium of concrete paste. Next to the water demand which is increased in concrete day by day, in this project we incorporate Activated carbon in Filler slabs. Filler slab is the sustainable concept which reduces unwanted concrete in the tension zone. The main perspective of this project is to study the characteristic behaviour of concrete with activated carbon. Also, to maximize the rate of Compressive strength of the concrete and to Filter air pollutants and to investigate the flexural behaviour of filler slab with activated carbon. Filler slab with Activated carbon in cement greatly increases the sustainability. Compression test and Flexural test were carried out by three different proportion of Activated carbon in cement from these mixes results are obtained. Further morphological arrangements are to be carried out.***

***Keywords: fine aggregate, coarse aggregate, filer slab, Activated carbon.***

## I. INTRODUCTION

Filler slab is other stand-in slab establishment technology where a part of concrete in base of slab is supplanted by filler substance [1]. The major principle of filler slab is that, concrete in base half of RCC slab is structurally not required. So, this partition of the concrete mixture is replaced by low cost, light weight filler substance. Activated carbon, which can also be called as activated charcoal, is a type of carbon refined to have small, low-volume pores that increases the surface area thereby having available space that adsorbs unwanted polluted gases or other chemical reactions. Activated is sometimes substituted with active. Here it is used in cement composite to maximize the compressive rate of concrete and to filter the polluted air. The major scope of this project is to utilize the waste material such as Activated carbon as a binder material which helps to increase the mechanical resistance of concrete. Also, the strength of concrete in filler slab at tension zone can be increased by using activated carbon and to incorporate the architectural benefits through structural engineering concepts.

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## II. LITERATURE REVIEW

Many researchers have done their work in studies on Activated carbon and Filler slab.

To provide a detailed review of the body of literature related to Filler slab and Activated carbon would be too immersing to address in this thesis.

The materials chosen is based on the corresponding references.

Chaocan Zheng in their study of Activated carbon with fly ash cement composites stated that, the weight of Carbon for about 2% and 4% were added initially in a fly ash cement mixer to obtain the exact Activated carbon–fly ash in the form of mixture pastes and mortars. Compressive rate of the composites was then investigated compared to the before obtained rate. After the 28 days of testing done, the obtained compressive strength is the highest quality acquired for 20% fly ash concrete mortars was found to be 4% Activated carbon. Aiswarya proposed about the prospective Benefits of Using Activated Carbon in Cement Composites Experimental research work did on concrete composites containing activated carbon uncovered its potential capacity to improve physical, mechanical and toughness properties of concrete composites. Carbon dark or activated carbon is a black colored at long last isolated petals or powder. Analysts had revealed that 1 to 4 % level of actuated carbon in concrete cement/concrete composite essentially improve its properties [2]. Narayanan Neithalath, K. Ramamurthy, R. Ambalavanan. in they are cost decrease in rooftops/floors has been accomplished through the reception of exchange procedures like filler slab, which works away at the standard of filling a portion of cement in the tension zone with less expensive substitutes. Despite the fact that there are sound hypothetical bases and demonstrated techniques for development, there has been no precise examination of cost-adequacy such a framework can offer for a scope of ranges, forced stacking and bolster condition. This paper examines the subtleties of a cost-viability investigation led on two-way filler slabs with Mangalore design tiles as filler units. The expense and weight decrease that can be offered by such a framework in contrast with the conventional slabs for various parameters as recorded above are brought out [9]. Sukumar.S in his study on SCC is a creative solid that doesn't need any vibration for putting and condensation. It can stream under its weight, totally filling the space and accomplishing full condensation, even within the sight of clogged fortification. The cement that is in the solid state is thick and has same designing characteristics and toughness as conventional reinforced concrete. The fixings utilized in self-compacting cement are equivalent to those utilized in ordinary cement. A significant part of the prepared substance would possess receptive substances like fly debris.

self-compacting cement is totally varying from normal cement in that the previous has enormous powdery substance content and minimum coarse sum total.
SCC additionally joins HRWR in enormous sums' and a thickness altering operator (VMA) in little portions. HRWR helps in accomplishing fantastic stream at low water substance. VMA lessens draining and improves the solid blend. The functionality of SCC is "extremely high" when contrasted with the regular cement. Filler sections are one practical material framework supplanting solid segments in pressure zone with filler material. The filler piece depends on the rule that for rooftops which are essentially upheld, the upper piece of the chunk is exposed to compressive powers and the lower some portion of the section experience pliable powers.In this manner, the lower malleable locale of the section needn't bother with any solid aside from holding the steel fortifications together. In this way, in a traditional RCC chunk parcel of cement is squandered and it needs additional support due to included heap of the solid which can in any case be supplanted by ease and light weight filler materials, which will diminish the dead weight just as the expense of the section. The first cracking load of filler slabs is validated with theoretical loads. The load vs. deflection curves exhibits the stiffness of the slabs [10]. Akhil P.A has stated that the entire load of the structure is especially impacted by oneself load of the reinforced cement. So as to diminish the measure of cement and weight of each single slabs, typically favoured sections are voided slabs or empty slabs. This kind of slabs is proved to have inherent advantages by adding diminished loads, efficient longer ranges, decreased floor-to-floor statures and so on. Cost decreases in rooftops/floors are accomplished through the appropriation of filling a piece of cement in pressure zone with less expensive substitutes. Rooftop tiles is said to be good here and the solid utilization just as support could be essentially controlled. The most extreme burden conveying limit found on the control specimen is 94.3kn and the central deflection corresponding to that load is 16.46mm. By reducing the self-weight of slab SB – 1 of about 33.52 %, compared to that of normal slab SB – C, the maximum load carrying capacity is 42.6kn and the central deflection corresponding to the maximum load is 10.55mm. By reducing the self- weight of slab SB – 2 of about 27.93 %, compared to that of normal slab SB – C, the maximum load carrying capacity is 47.3kn and the central deflection corresponding to the maximum load is 8.43mm.

M. P. Jaisingh in their study stated that Fly ash is a significant mechanical waste and enormous scope utilization of this material in building development will go far in taking care of the removal issue of this contamination material. This method of construction can be effectively received for the development of a wide range of buildings, when the cell concrete structures are accessible in the market. This is conceivable if business people set up creation units close to Thermal Power Plants, where they are given fly ash liberated from cost and space and offices like force and water provided at no-benefit, no misfortune premise. The huge scope creation of the squares will help in the issue of removal of fly debris all things considered. Moreover, it will bring about sparing of concrete and steel and will prompt moderate housing [7].

## III. PHYSICAL PROPERTIES

The material used for making concrete pavement and investigation of their material properties are being specified here.

### A. Cement

Cement is a sort of Blended Cement which is delivered by either intergrading of OPC clinker along with gypsum and pozzolanic materials in specific ratios or grinding the OPC clinker, Pozzolanic materials, and gypsum separately and thoroughly blending them in certain ratios. Portland Pozzolana Cement (PPC) of grade 43 contains up to 25% fly ash. Tests were conducted to find the consistency, setting time, and the results are tabulated in Table1.

**Table- I: Properties of 43 Grade PPC values**

| Test Particulars | Result | Requirements of Is: 1489-1991 |
|---|---|---|
| Specific Gravity | 3.15 | 3.10 – 3.15 |
| Normal Consistency (%) | 33 | 30 - 35 |
| Initial Setting Time (Minutes) | 45 | 30 minimum |
| | 480 | 600 maximum |

### B. Fine aggregate (M - SAND)

M-Sand is an alternate of river sand for construction of concrete. It is prepared by squashing of hard rock stone. Squashed sand is shaped like cube structure with grounded edges, rinsed thoroughly and evaluated to as a development material. The size of M-Sand is under 4.75mm. The processed M-sand found to have great degree and perfect completion which is deficient in normal sand and this has been resulted in good cohesive concrete mortar. Also, specific gravity and Fineness Modulus values of M-Sand obtained results are tabulated in Table II.

**Table- II: Test on Fine Aggregate**

| Test | Results |
|---|---|
| Specific gravity | 2.37 |
| Fineness modulus | 2.96 |

### C. Coarse aggregate

Coarse aggregate can have elliptical, angular, or unpredictable shape. By appropriate evaluating of coarse aggregate, the chance of isolation is limited, particularly for higher functionality. Appropriate evaluating of coarse aggregate likewise improves the similarity of cement. The coarse aggregate reviewing limits are given in IS 383 – 1970.

**Table- III: Test on Coarse Aggregate**

| Test | Results |
|---|---|
| Specific gravity | 2.74 |
| Fineness modulus | 6.94 |

### D. Activated Carbon (AC)

Activated carbon have an enormous adsorption limit, ideally for little atoms, and are utilized for filtration of fluids and gases. By controlling the procedure of Carbonization and actuation, an assortment of dynamic carbons having distinctive porosity can be acquired. Activated carbons are utilized predominantly in granular and powdered structures, yet can likewise be delivered in material structure by controlled carbonization and initiation of material filaments. Different terms utilized in the literature: active carbons, active charcoals [3].

**Table- IV: Test on Activated Carbon**

| Test | Results |
|---|---|
| Specific gravity | 1.32 |

## IV. EXPERIMENTAL INVESTIGATION

### A. Mix Design

The mix is picked to satisfy all exhibition criteria for the cement in both the fresh and cemented states. Proportioning of cement blends can be viewed as a methodology set to extent the most conservative solid blend for indicated strength and grade for required site conditions. The fundamental guideline of the solid blend configuration is to choose the extent of the considerable number of materials as the premise of the indecisive volume and taking complete outright volume of cement 1m3. Mix design process is mainly followed to minimize the trial tests count in the laboratory.

**Table- V: Mix proportion for IS code control mix**

| MIX PROPORTIONS | | | | |
|---|---|---|---|---|
| Water | Cement | Fine Aggregate | Coarse Aggregate | Activated Carbon |
| 191.58 | 478.95 | 576.2 | 1,119.74 | 0 |
| 0.40 | 1.00 | 2.37 | 2.74 | 0 |

Through the replacement of Activated carbon in Cement with various proportions (2%,3%,4%) in the tension Zone of the filer slab, it increases the compressive and the flexural strength, also it filters air pollutants. The obtained values for the various proportions are tabulated in Table VI

**Table- VI: Replacement of Activated carbon (AC) in Cement with various proportion**

| **Constituents** (Kg/m3) | **Normal mix** | **2% AC** | **3% AC** | **4% AC** |
|---|---|---|---|---|
| Water | 191.58 | 191.58 | 191.58 | 191.58 |
| Cement | 478.95 | 469.38 | 464.59 | 459.81 |
| Fine aggregate | 576.2 | 576.2 | 576.2 | 576.2 |
| Coarse aggregate | 1119.74 | 1119.74 | 1119.74 | 1119.74 |
| Activated Carbon | 0.00 | 9.57 | 14.36 | 19.14 |

## V. TEST RESULTS AND DISCUSSION

### A. Compression Test

Compressive quality is the restriction of material or structure to withstand loads having a tendency to lessen the size. Compressive strength test is done to cubes of 150mm x 150mmx 150mm in a CTM machine of capacity 200 tone. The cube specimen is brought under the CTM machine and load is applied to the specimen, at maximum load point the specimen tends to break. That maximum point of load where the specimen breaking down is noted as load value. The calculated compressive strength of the specimen is estimated by dividing the maximum applied load to the specimen during the test by the cross-sectional area.

Compressive strength fck = P/A

fck = Compressive strength in $N/mm^2$

P = Maximum load in N

A = Cross sectional area of cube in mm

Size of the cube = (150 X 150 X 150) mm

**Fig. 1. Compression testing**

In the below fig 1, it shows the replacement of Activated carbon in cement with various proportions is tested and the values obtained are depicted in a bar chart that is shown in a fig 2.

**Table- VII: Compression test results**

| S.No | Composition of materials | $7^{th}$ day | $28^{th}$ day |
|---|---|---|---|
| 1. | Conventional | 21.16 $N/mm^2$ | 30.23 $N/mm^2$ |
| 2. | 2%(AC) Replacement | 22.07 $N/mm^2$ | 31.54 $N/mm^2$ |
| 3. | 3%(AC) Replacement | 22.55 $N/mm^2$ | 32.22 $N/mm^2$ |
| 4. | 4%(AC) Replacement | 21.07 $N/mm^2$ | 30.10 $N/mm^2$ |

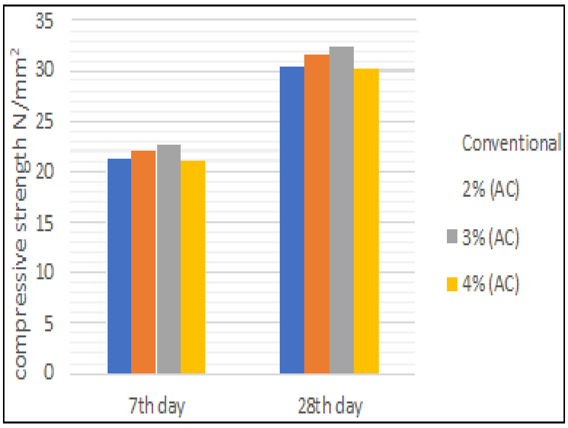


**Fig. 2. Bar Chart of Compressive strength**

### B. Flexural Testing:

Flexural testing is performed based on ASTM D790 and ISO 178. Flexural properties for plastics are inferred by setting an example on two backings and applying the weight at the Center at a predefined rate and the stacking at disappointment is the flexural quality. In bowing, the shaft is dependent upon both ductile and compressive burdens [4]. Since most thermoplastics don't break right now, flexural quality can't be determined. Rather, flexural worry at 5% strain is determined the stacking expected to extend the external surface 5%. Fig 3 portrays the flexural testing and the qualities got are delineated in a bar outline that is appeared in a fig 4.

**Fig. 3. Flexural testing**

**Table-VIII: Flexural test results**

| S No | Composition of materials | $7^{th}$ day | $28^{th}$ day |
|---|---|---|---|
| 1. | Conventional | 2.66 $N/mm^2$ | 3.80 $N/mm^2$ |
| 2. | 2%(AC) Replacement | 8.40 $N/mm^2$ | 12.00 $N/mm^2$ |
| 3. | 3%(AC) Replacement | 8.82 $N/mm^2$ | 12.60 $N/mm^2$ |
| 4. | 4%(AC) Replacement | 7.42 $N/mm^2$ | 10.60 $N/mm^2$ |

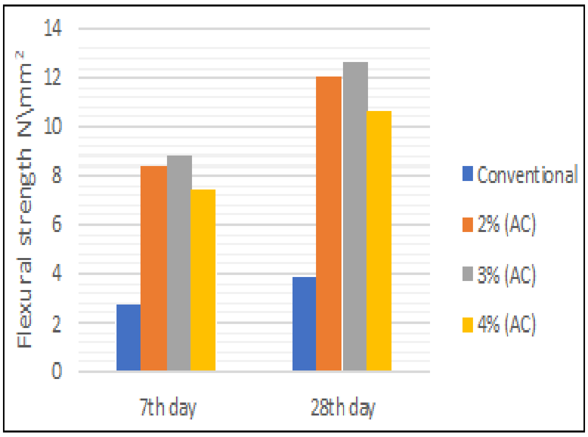


**Fig. 4. Bar Chart of Flexural Strength**

## VI. CONCLUSION

Thus, the following results were obtained from the Compression test Flexural load test of cube and prism. From the above test results, it ensured that 3% of activated carbon is the exact proportion that is to be replaced from cement. Cement is replaced with Activated carbon from 3% is the proportion. Also, from the above investigation the result proves that the Compressive strength and Flexural strength of the filer slab in tension zone is increased. This gives scope for further investigation of testing this project by casting the filler slab.

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