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To Study the Behavior of Concrete by Replacement of Fine Aggregate with Granite Powder and Cement with Tobacco Waste Ash

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***Abstract:** Environmental concerns caused by the extraction of raw materials and CO2 emissions in the production of Portland cement led to pressures to reduce the consumption of this constituent of concrete, combined with the need to increase its durability. The cement is the most costly and energy intensive component of concrete. The unit cost of concrete can be reduced as much as possible by partial replacement of cement with other waste pozzolanic materials. Certain materials of mineral origin are also added to concrete to enhance their strength and durability properties of concrete materials such as Granite Powder and other by TWA.*

The partial replacement of aggregates is need for the future generation of concrete structures for the environment supportable. The depletion of the natural resources gets exhausted. We have think over the alternate replacement of the materials. In present work the partial replacement of the TWA with the Cement and the fine aggregates is partially replaced by the Granite Powder. Optimum value of strength in compression, split tensile and flexure came at TWA12%GP24% replacement of the TWA with the Cement and the fine aggregates is partially replaced by the Granite Powder. The workability of mixture increases and after that there is decrease in the workability of the concrete when we increase the percentage of TWA and Granite Powder. A series of experiment were carried out to measure the compressive strength, split tensile strength and flexural strength of the concrete. The results showed that the compressive strength, split tensile strength and flexural strength increases with the adding of the Granite Powder and TWA.

***Keywords:** TWA (TOBACCO WASTE ASH), GP (GRANITE POWDER), workability, compressive strength, Split Tensile strength, Flexural strength.*

I. INTRODUCTION

The strength of concrete, durability of concrete and other characteristics of a concrete depend upon the properties of its ingredients, on the proportion of mix, the method of compaction and other controls during batching, casting and curing. A producing strong, durable and uniform concrete i.e. high performance concrete lies in careful control of its basic and process components i.e. cement, aggregate, water, chemical admixtures and other supplementary cementing materials.

A. Tobacco Waste ASH

One of the residues from a cigarette factory is the Tobacco stem, and it is easy to collect as its production is concentrated in cigarette factories. This has led to a serious waste of resources and environmental problems as more than 95 % of the tobacco stems end up in landfills or incineration.

Thus there is a need to dispose this residue in a way which is environmental friendly. Tobacco waste ash is produced by burning these unwanted tobacco stems. Tobacco waste ash displays properties such as fineness, amorphous form and high silica content and thus needs to be investigated with its potential to show high pozzolanic activity. The ashes are not pozzolanic material, they have pozzolanic activity, but this activity is less than that in pozzolanic material. The ashes exhibit the “filler effect”, which is composed of two phenomena, the nucleation and packing effects that primarily depend on the fineness of the materials. The nucleation effect occurs when the small particles are spread in blended cement paste, leading to an enhanced hydration reaction, while the packing effect occurs when the voids in pastes are filled with fine particles. Tobacco waste ash is not a pozzolanic material but it has been known to display some pozzolanic activities.

B. Granite Powder

Granite powder is formed by igneous rock composed mostly of quartz, alkali feldspar. It forms magma with a high content of silica and alkali metal oxide that slowly solidifies underground. It is common in Earth's continental crust, where it is found in various kinds of igneous intrusions.Granites powder can be gray, pink, or white in color, depending on their mineralogy.

True granite (according to modern petrologic convention) contains between 20% and 60% quartz by volume, with 35% to 90% of the total feldspar consisting of alkali feldspar.Granitic rocks poorer in quartz are classified as syenites or monzonites, while granitic rocks dominated by plagioclase are classified as granodiorites or tonalites. Granitic rocks with over 90% alkali feldspar are classified as alkali feldspar granites. Granitic rock with more than 60% quartz, which is uncommon, is classified simply as quartz-rich granitoid or, if composed almost entirely of quartz, as quartzolite. True granites are further classified by the percentage of their total feldspar that is alkali feldspar. Granites whose feldspar is 65% to 90% alkali feldspar are syenogranites, while the feldspar in monzogranite is 35% to 65% alkali feldspar. A granite containing both muscovite and biotite micas is called a binary or two-mica granite.

II. LITERATURE REVIEW

Naveen Kumar A, Vivekananthan, Chithra 2019) In a paper entitled "Study the Effects of Tobacco Waste Ash and Waste Glass Powder as a partial replacement of cement on Strength Characteristics of Concrete" partial replacement of cement with tobacco waste ash and waste glass powder was done. The replacement with tobacco waste ash was done in the percentage of 5, 7.5, 10 and 12.5 while the replacement with waste glass powder was done in the percentage of 5, 10, 15 and 20. The tests which were done on the specimen included compressive strength, flexural strength and split tensile. The results of these test showed that he compressive and split tensile tests values of the specimens increases by adding at 10% of Waste glass powder and 10% of tobacco waste ash , whereas flexural strength test values increases at the 12.5% of waste glass powder and 12.5 % of tobacco waste ash. The author finally concluded that the presence of silica from the glass waste powder increased the strength of concrete it further made the concrete more durable and also increased its toughness. The use of tobacco waste ash made the concrete more workable thus reducing the amount of water required.

S.celikten, M. Canbaz (2017) In a paper entitled "A Study on the Usage of Tobacco Waste Ash as a Mineral Admixture in Concrete Technology" studied the effects of partial replacement of cement with tobacco waste ash. The tobacco waste ash was taken from two sources and the tests were carried out on each of the specimen of the two tobacco waste ash. The partial replacement was done in the percentage of 10, 15 and 20 by weight. The mortar samples were then tested. The tests that were done included compressive strength and flexural strength test. From the results of these tests unit weight, ultrasound pulse velocity, dynamic modulus of elastic values of the mortar specimen was calculated. There was seen a decrease in the values of these results as the percentage of tobacco waste ash was increased. On comparing the values of the specimen with the control specimen there was a decrease in both compressive and flexural strength, though in the case of compressive strength the decrease was more. Thus the author came to the conclusion that with the partial replacement of 10 percent cement with tobacco waste ash there are ecological and economic benefits.

(Rafael Fragozo, Sergio Vesga 2018) In a paper entitled "Tobacco waste ash: a promising supplementary cementitious material" studied the use of tobacco waste ash as a cementitious material. The experiment were done at various percentage of replacement and at the end of which the author came to the conclusion that the compressive strength of the specimen increased when there was a partial replacement of cement at 10 percent. The experiments achieved a compressive strength more than 51 percent of the control specimen. The author states that this improvement in compressive strength is due to the "filler effect" and the pozzolanic activity occasioned by 10 percent replacement of cement.

Y. Yaswanth Kumar et al. examined the usage of granite powder as a partial replacement of cement in concrete. Cement was replaced with granite powder in steps of 0%, 5%, 10%, 15% and 20%. The compressive strength and of the samples was recorded at the activity age of seven and twenty eight days. The results indicated that the compressive strength of concrete inflated with extra of granite powder up to 10% replaced by weight of cement further addition of granite powder was found that the compressive strength are going to be decreasing from 10% replacement of cement.

A. C. Ubani , P. N. Atanmo Graphite crucibles were successfully produced by the partial replacement of graphite with granite, borosilicate glass, silicon carbide and kaolin at a molding pressure of 300KN and firing temperature of 1100oC for 3hours 34mins.The densities, refractoriness, hardness and compressive strength of the crucibles were in conformation with that of graphite crucibles. However, sample F with composition of 30% graphite, 12% silicon carbide, 48% kaolin, 8% granite, and 7.5% borosilicate glass, had the highest hardness value of 116.4 HB, refractoriness of 1400oC, density of 2.48g/cm3 and compressive strength of 4.04N/mm2.

III. MATERIALS

A. Cement

Although all materials including concrete are important, cement is often very important because it is usually a weak link of the chain. Cement is a compact material and the cement function is the first of all to glue sand and stones together and secondly to fill in the gaps between sand and stone particles to form a pile. It covers only about 20 percent of the total concrete mix; it is an active component of binding materials and is the only scientifically controlled concrete ingredient. Any variation in their quantity affects the compressive strength of the concrete mix. Portland Cement (Ordinary Portland Cement) is a very important type of cement and a fine powder produced to grind Portland Cement clinker. The OPC is divided into three phases, namely Grade 33, Grade 43 and Grade 53 depending on the strength of 28 days. OPC of grade 53 conforming to IS 12269 from a single lot was used throughout the course of the investigation. It was fresh and without any lumps.

B. Coarse Aggregates

The aggregate which is retained over IS Sieve 4.75 mm is termed as coarse aggregate. They can be of the following types:-

1) Crushed gravel obtained by crushing of gravel or hard stone.
2) Uncrushed gravel resulting from the natural disintegration of rocks.
3) Partially crushed gravel obtained as product of blending of above two types.
4) Machine crushed stone angular in shape were used as coarse aggregate conforming to IS 383 1987

C. Fine Aggregates

According to size, the fine aggregate may be described as coarse, medium and fine sands. IS: 383-1970 has divided fine aggregate into 4 grading's which become gradually finer from grading zone I to IV. The fine aggregate used in this research was clean river sand collected from wahid-pora Ganderbal whose maximum size was 4.75 mm, conforming to IS 383 1987 grading zone II.

D. Granite Powder

Granite power if formed by igneous rock composed mostly of quartz, alkali feldspar and plagioclase. It forms magma with a high content of silica and alkali metal oxide that slowly solidifies underground. It is common in Earth's continental crust, where it is found in various kinds of igneous intrusions. Granites powder can be predominantly white, pink, or gray in color, depending on their mineralogy.

S. No.	Compound	Wt%
1	Silica	70-77
2	Alumina	11-13
3	Potassium Oxide	3-5
4	Soda	3-5
5	Lime	1
6	Iron	2-3
7	Magnesia & Titania	Less than 1

E. Tobacoo Waste ASH

The Tobacco wash ash that was used in the experiments was made by purchasing tobacco stems and then burning them and the ash that was obtained was sieved through a 425 µm sieve to remove any undesirable particles. The ashes were further rounded in the Los Angeles machine to reduce the size of particles to 60 µm. The amount of silica in the tobacco waste ash depends on the burning temperature and the amount of time for which the burning is done. Thus from different sources of tobacco stems, we get different composition. The total amount of silicon dioxide, aluminum oxide and ferric oxide is less than 70 percent, which is the minimum value required for a material to be considered as pozzalonic.

Particular	Percentage
Silicon Dioxide (SiO_2)	25.67
Aluminum Oxide (Al_2O_3)	0.16
Ferric Oxide (Fe_2O_3)	0.31
Sodium Oxide (Na_2O)	0.49
Calcium Oxide (CaO)	25.54
Magnesium Oxide (MgO)	4.6
Sulphur Trioxide (SO_3)	7.04
Potassium Oxide (K_2O)	17.84

IV. METHODOLOGY

A. *Mixing Concrete*

All the ingredients of concrete are mixed together however this mix should be homogenous and uniform in color and consistency. The mixing can either be done by hand or with the use of mixer.

B. *Mixing Concrete*

Thorough mixing of the materials is essential to produce uniform concrete. The mixing should make sure that the mass become homogeneous, uniform in consistency and colour. There are two methods adopting for mixing concrete one is hand mixing and other is machine mixing.

C. *Curing*

Before removing the mould, it is dried for 24 hours, and then specimens are placed in a water tank made to cure specimens. The specimens must be marked for identification so that there must not be any error. The specimens are removed from the tank and dried before putting in the testing machine. The specimens are kept in the tank for 3,7,28 days.

D. *Workability Test*

It can be used in site as well as in lab. This test is not applicable for very low and very high workability concrete. It consists of a mould that is in the form of frustum having top diameter of 10cm, bottom diameter of 20cm and height of 30cm. The concrete to be tested if fitted in the mould in four layers. The each is compacted 25 times with the help of tamping rod. After the mould is completely filled it is lifted immediately in the vertically upward direction which causes the concrete to subside.

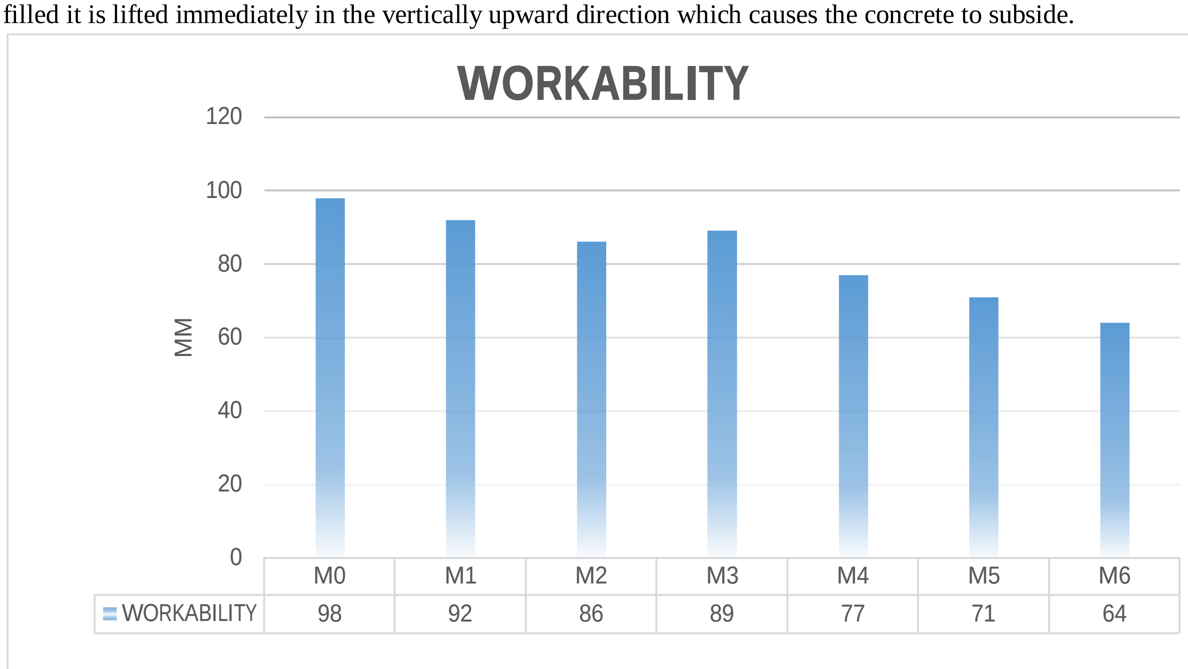

Fig -3: Slump Cone Test

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E. Compressive Strength Test

Then fresh concrete is filled in mould in 4 layers and after filling each layer tamping should be done 35 times in case of cube and 25 times in case of cylinder by using standard tamping rod. Once the mould is filled then leveled top surface of concrete with trowel. After the day the mould will removed and specimen are dropped in the curing tank under standard temperature of 27±2° c. After 7,14 days and 28 days in this research.

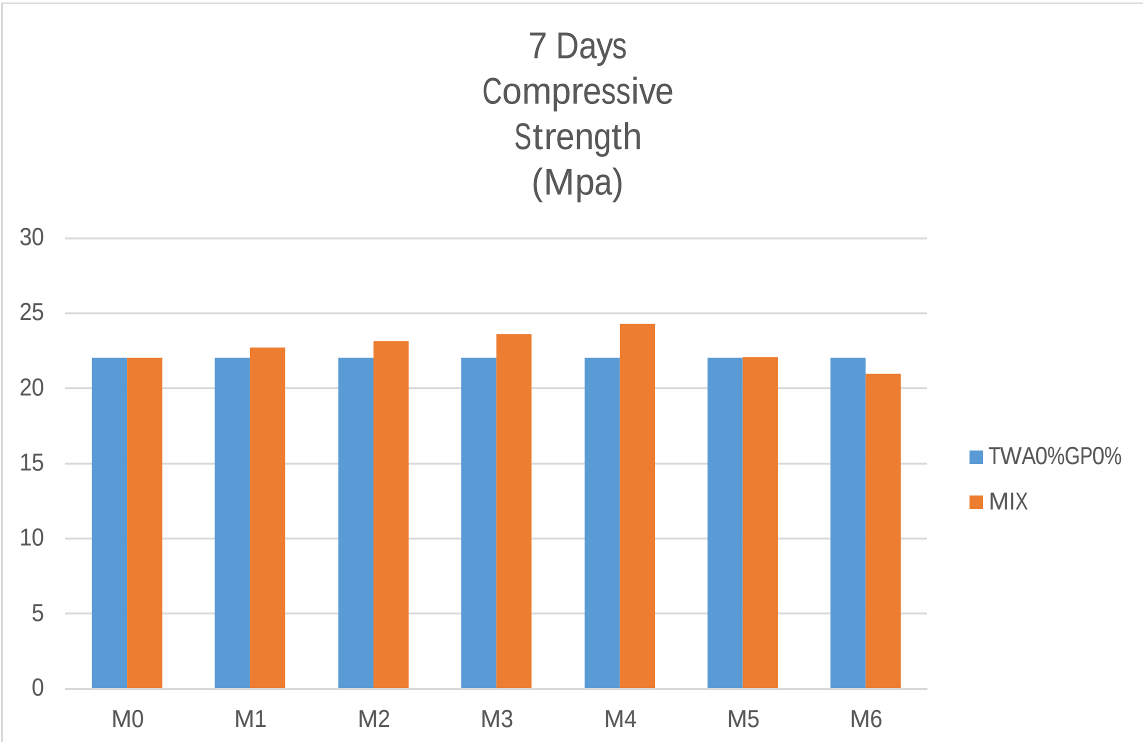

Fig -4: Compressive Strength Test 7

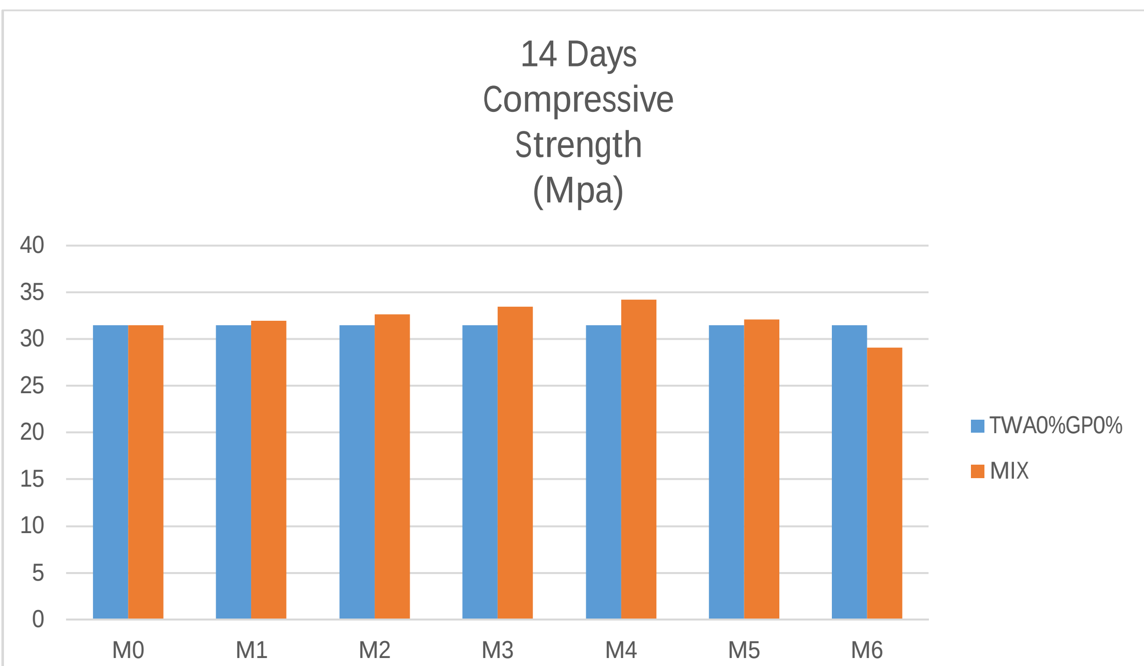

Fig -5: Compressive Strength Test 14

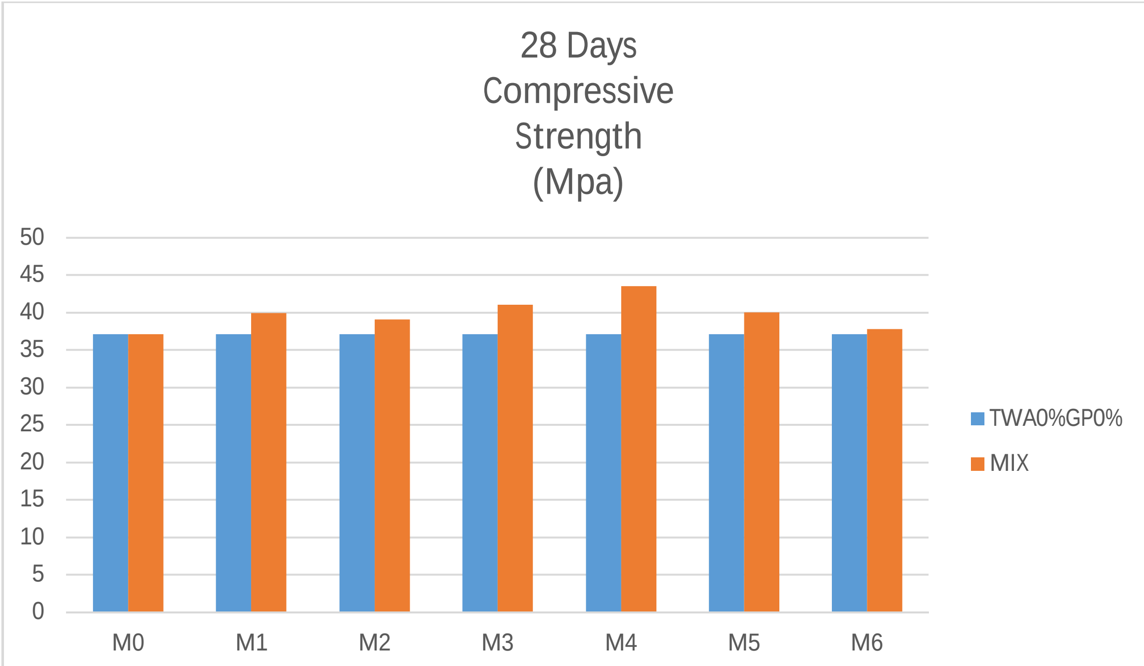

Fig -6: Compressive Strength Test 28

F. Split Tensile Strength Test

The specimen used for this test is cylindrical and its dimension is 150 mm in diameter and 300mm in length. The instrument used for this testing is universal testing machine. The fresh concrete is prepared in according to the required grades and respective mix proportion. The fresh concrete is filled in mould in layers and each layer is tamping with standard tamping rod with 25 blows for each layer. After the day the mould is removed and specimen is placed in the curing tank for 7,14 days and 28 days in this research at the temperature 27+ 2°c. Then draw the line on the specimen.

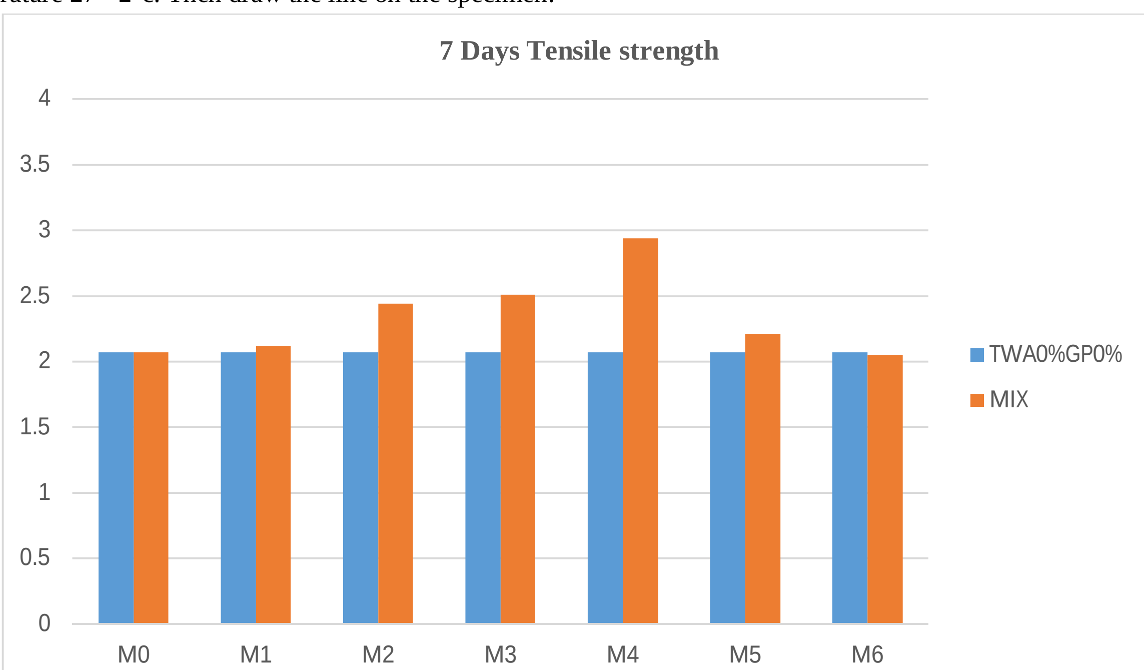

Fig -7: Split Tensile Strength Test 7

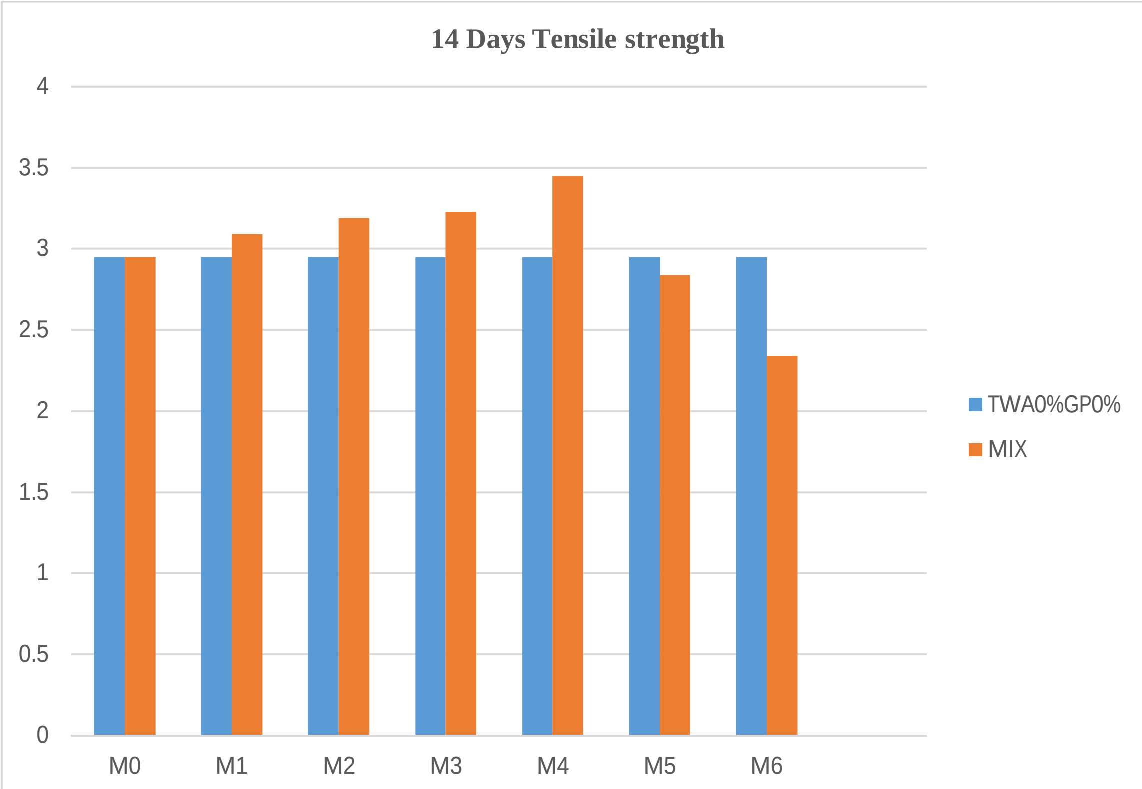

Fig -8: Split Tensile Strength Test 14

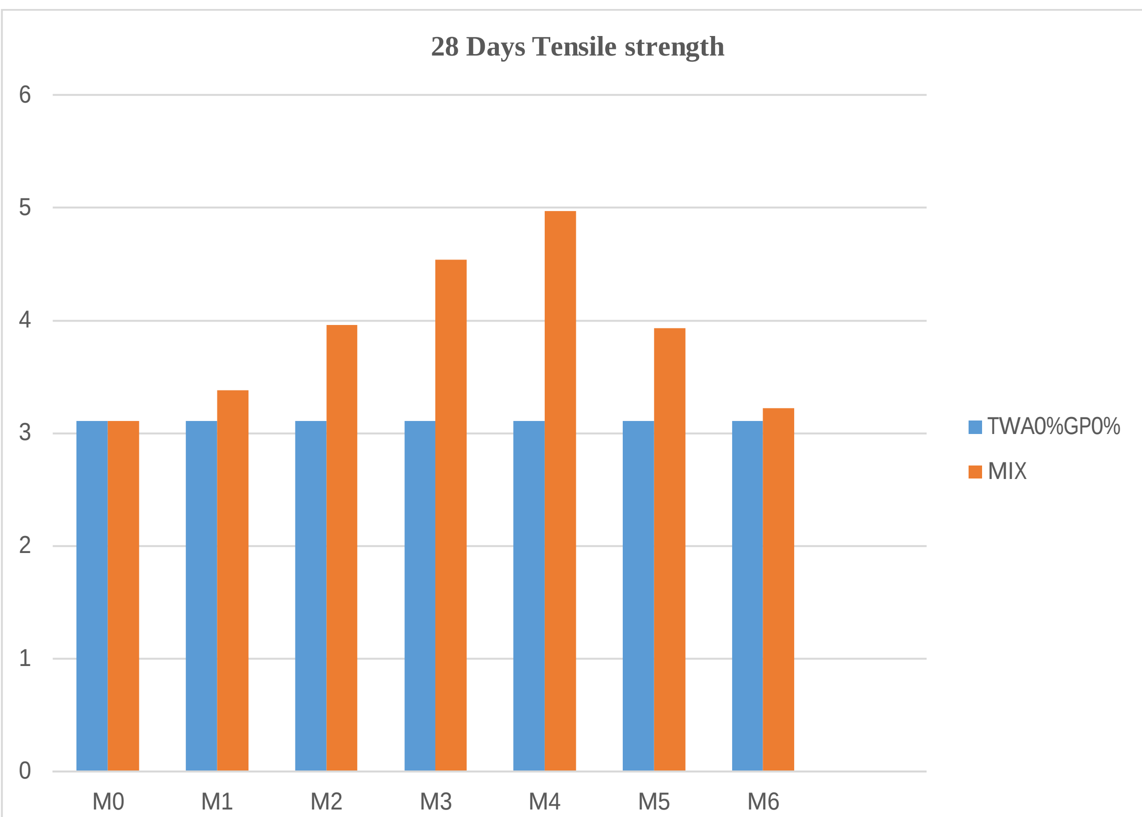

Fig -9: Split Tensile Strength Test 28

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G. Flexural Strength Test

The concrete is prepared at required rate of mass element the mould is filled with concrete in layers and blows 25 times with standard tamping rod. After the day or we can say 24 hours the mould is removed and specimen placed in the water tank for curing at a temperature of 27 + 2 C. Depending upon the requirement the test specimen is removed from the water tank and wipe it properly for 7,14 and 28 days for testing.

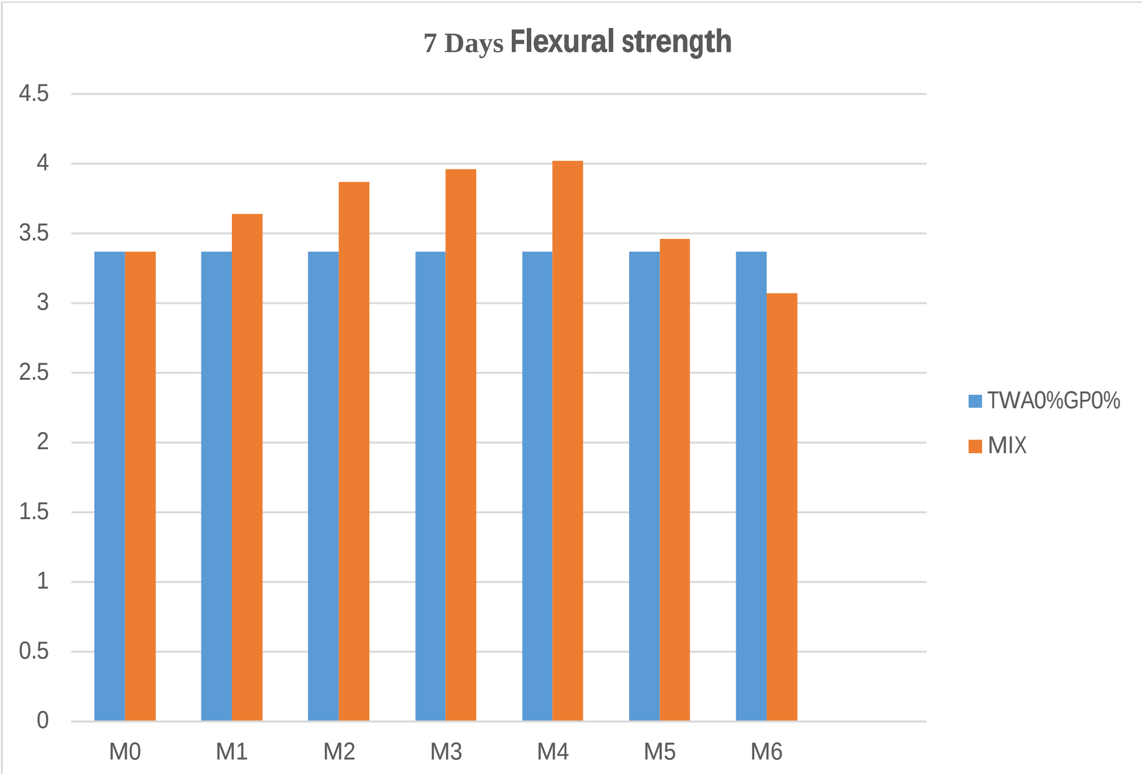

Fig -10: Flexural Strength Test 7

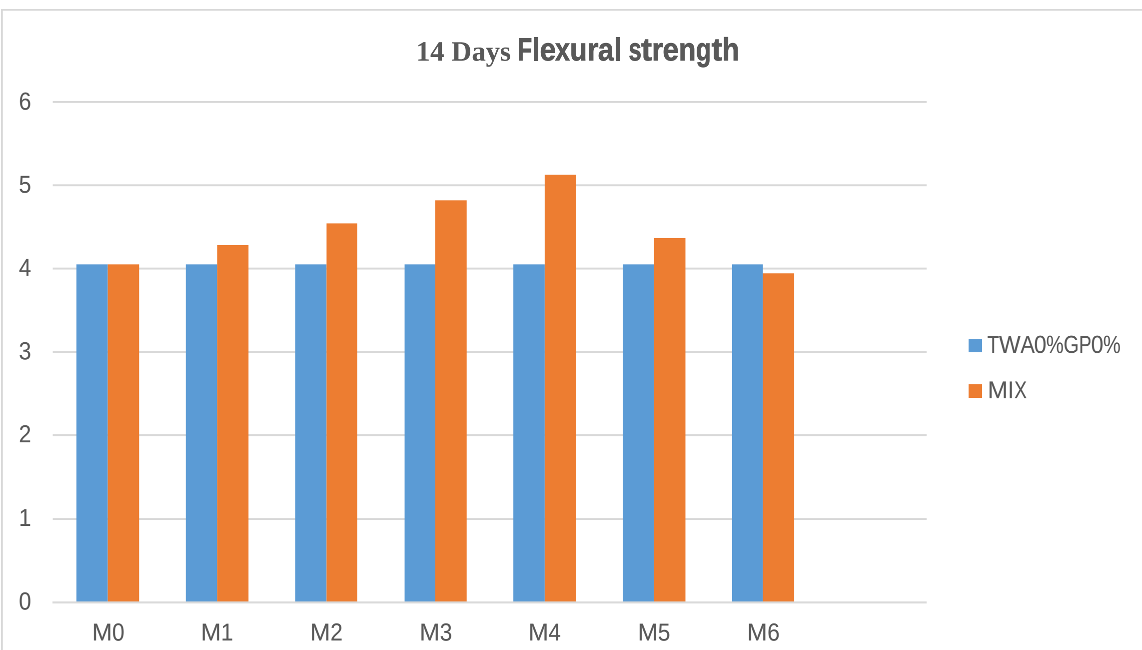

Fig -11: Flexural Strength Test 14

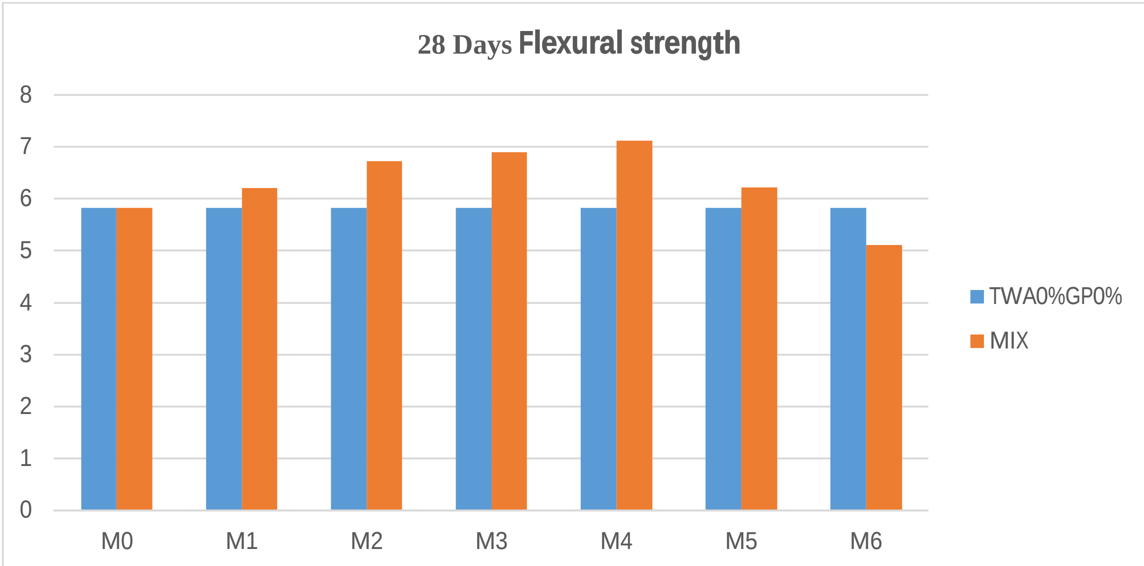

Fig -12: Flexural Strength Test 28

V. CONCLUSION

1) The use of TWA and Granite powder as partial replacement of cement and Fine Aggregate respectively should be taken up for acceptable and environmentally friendly construction.
2) By using these easily available left overs and agricultural waste materials in construction, we can greatly decrease the cost of construction up to a certain level and also not compromising much on the quality while also overcoming the environmental hazards.
3) In general, it was also observed in the experiment that the workability of concrete decreases with the increase in the percentage of TWA and Granite Powder the concrete was less workable.
4) This investigation has also established that the use of TWA and Granite Powder by a certain percentage can produce positive results when cement and fine aggregate. Thus can be used in construction purpose.
5) It is observed that by replacement of cement with TWA up to 32% by weight of cement, there is an increase in compressive strength, Flexural strength and Split tensile strength of concrete after which there is a drastic decline in the strength of concrete.
6) The max compressive strength is achieved by replacement of fine aggregate with Granite powder and replacement of Cement with TWA in combination on 28th day as 43.54Mpa.
7) In the case of replacement of fine aggregate with Granite powder and replacement of Cement with TWA in combination, it is found out that there is an increase in all the three strengths compressive, split tensile and flexural. The increase is up to a percentage replacement of 12% of TWA and 24% of Granite Powder in combination by weight of cement and fine aggregate respectively.
8) The max split tensile strength is achieved by replacement of fine aggregate with Granite powder and replacement of Cement with TWA in combination on 28th day as 4.97 Mpa.
9) As it was observed that TWA overall gains strength in the later days due to its pozzolanic activity and hence is a good enough material as the replacement material of cement.
10) The max flexural strength is achieved by replacement of fine aggregate with Granite powder and replacement of Cement with Groundnut shell ash in combination on 28th day as 7.12 Mpa.

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