# Experimental Study On Strength Properties Of Diaphanous Concrete With Vermiculite

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## ABSTRACT

***This study is aimed at investigating the shear strength and work ability characteristics of Fiber Reinforced High Strength Concrete (FRHSC) which use recycled coarse aggregates that have originated from demolished construction wastes. Different mixes were taken with 20%, 40% replacement of natural coarse aggregate with recycled coarse aggregate. To improve the ductility and performance, 1% steel fiber is also added to the concrete. The concrete has main advantage that it has a better compressive strength. The compressive strength of concrete can be represented as cube or cylinder compressive strength. The compressive strength of concrete is depending on size and shape of the test specimens. In this study, the conventional concrete was reinforced by the plastic fibers obtained from waste plastic bottles. The cube and cylinder compressive strength of conventional concrete and plastic fibers reinforced concrete were determined in the laboratory. The M30 grades of concrete and two fiber geometry at volume fractions 0.0 % to 3.0 % were used in the experimentations. All specimens were tested after curing age 28 days. In this paper the relationship between cube and cylinder compressive strength for conventional and plastic fibers reinforced concrete were established and compared with standards.***

**Keywords:** Experimental Study, Strength, Properties, Diaphanous Concrete, Vermiculite

## 1.INTRODUCTION

Concrete is widely used in domestic, commercial, recreational, rural and educational construction. Communities around the world rely on concrete as a safe, strong and simple building material. It is used in all types of construction; from domestic work to multi-storey office blocks and shopping complexes. Despite the common usage of concrete, few people are aware of the considerations involved in designing strong, durable, high quality concrete. As the constituents of concrete come from stone, people have always thought that concrete has the same quality and will last forever. However, concrete must be thought of as a distinct material to stone. It has its own characteristics in terms of durability, weathering and repair. Lightweight concretes can either be lightweight aggregate concrete, foamed concrete or autoclaved aerated concrete. Structural lightweight aggregate concrete is an important and versatile material in modern construction. It has many and varied applications including multistory building frames and floors, bridges, offshore oil platforms, and prestressed or precast elements of all types. Many architects, engineers, and contractors recognize the inherent economies and advantages offered by this material, as evidenced by the many impressive lightweight concrete structures found today throughout the world. Structural lightweight aggregate concrete solves weight and durability problems in buildings and exposed structures. Lightweight concrete has strengths comparable to normal weight concrete, yet is typically 25% to 35% lighter. Structural lightweight concrete offers design flexibility and substantial cost savings by providing: less dead load, improved seismic structural response, longer spans, better fire ratings, and thinner sections, decreased story height, smaller size structural members, less reinforcing steel, and lower foundation costs. There are many types of aggregates available that are classed as lightweight, and their properties cover wide ranges. In this study, Vermiculite was used. Heat in building through roof is the major cause of unconditioned building or the major load for the air conditioned building. So we carried out the specific studies by comparing the two design methodologies in the same format in assigning the factors that would accept all the properties and statement. The designed mix and their following characteristics at different mix proportions are studied. Vermiculite is a inert material so to resist the heat penetration. In many places of the world the temperature is raising day by day. Many investigations are carried out throughout the world to decrease the environmental temperature. The aim of our project is to decrease the room temperature of the building lower than the surrounding environmental temperature and providing thermal insulation to the building. It is done by replacement of the fine aggregate with the material called vermiculite. It belongs to the family of light weight aggregates. The exfoliated vermiculite is used as a replacement of fine aggregate. This project is mainly applicable in places where the environmental temperature is very high. This material is widely used in many places in the world to control the room temperature. The vermiculite added concrete is used for plastering purposes to resist the entry of heat from the surroundings into the room. For structural application of thermo proof concrete, the density is often more important than the strength. A decreased density for the same strength level reduces the self-weight and construction cost. The material seems to be very economical so all class of people mainly poor and middle family are benefited. It also resists the entry of fire inside the building as the materials are light weight. Vermiculite exists in a wide range of colors from black through various shades of brown to yellow. Its chemical composition varies widely consisting of a complex hydrated aluminum, magnesium silicate and hence the analysis of the mineral is of little use in determining the vermiculite for commercial utility; a technical trial of the material provides the only satisfactory test. Vermiculite owes its commercial utility to its property of exfoliation when heated.

Vermiculite is a phyllosilicate mineral group and is micaceous in nature. It is found in so many parts of the world but only a limited number of sources are worked as commercial deposits. The vermiculite is mined and refined using a variety of techniques and supplied commercially in a range of particle size grades of vermiculite concentrate (unexpanded). Vermiculite is the name used in commerce for a group of micaceous minerals that expand or exfoliate many times (commercial varieties exfoliate 8 to 20 times or more) the original thickness when heated. They show the characteristic micaceous structure of basal cleavage and occur as soft, pliable inelastic lamina. Their basal cleavages are not so perfect as those of mica. Vermiculite exists in so many colors from black through various shades of brown to yellow. Its chemical composition varies widely consisting of a complex hydrated aluminum, magnesium silicate and hence the analysis of the mineral is of little use in determining the vermiculite for commercial utility a technical trial of the material provides the only satisfactory test. Vermiculite owes its commercial utility to its property of exfoliation when heated. It exfoliates into a yellow to bronze colored mass giving an appearance of a cluster of worms - vermicular, an Italian word for worm from which it has derived its name as vermiculite. Some authorities quote the Latin word vermicular from which the name vermiculite might have been derived.

### 1.1 Objectives

The objective of present investigation is to development of normal strength in lightweight concrete using natural sand as fine aggregate and also trial mixes by replacing various percent of the weight of natural sand by vermiculite minerals. The investigation is also aimed at finding out the optimum percentages of natural sand replacement using vermiculite minerals for superior strength, density and fire resistant characteristics. To study and compare the performance conventional and vermiculite minerals in lightweight concrete. To understand the effectiveness of vermiculite minerals in strength enhancement. To study the physical and chemical properties of vermiculite minerals and the ingredients in lightweight concrete. The scope of this project is to know the effect on workability, strength properties of lightweight concrete mix with varying percentage replacement of natural sand by vermiculite minerals. To find out the optimum percentage of natural sand replacement by vermiculite minerals for which the lightweight concrete yields the superior mechanical properties. To compare the variation of compressive strength at 7 days ,14 days and 28 days curing strength with conventional cube. The effect of vermiculite minerals on compressive strength of lightweight concrete as partially replacement of fine aggregates can be analyzed. The tensile strength of lightweight concrete also can be studied by using vermiculite minerals in a lightweight concrete.

Vermiculite is the name used in commerce for a group of micaceous minerals that expand or exfoliate many times the original thickness when heated. Its chemical composition varies widely consisting of a complex hydrated aluminium, magnesium silicate and hence the analysis of the mineral is of little use in determining the vermiculite for commercial utility. Providing thermal insulation for the building is one of the developing areas in the field of Civil Engineering. Due to the increase of global warming the room temperature is increased. Vermiculite, a mineral of natural occurrence of the group of hydromicas, when heated to above 300°C, expands to become a highly efficient heat-insulating material. In order to reduce the temperature, we are using vermiplast in plastering. For structural application of thermo proof concrete, the density is often more important than the strength. A decreased density for the same strength level reduces the self-weight and construction cost. Structural lightweight aggregate concrete generally used to reduce deadweight of structure as well as to reduce the risk of damage due to high temperature to a structure because the blast load.

### 1.2 Vermiculite Used In Industry

#### 1.2.1Boards, Panels and Pre-Mixed Coatings
Vermiculite-based products range from factory made boards and panels to premixed coatings suitable for application by mechanical spray or by hand plastering techniques on a range of structures. These coatings have been used in the petrochemical industry and tunnel construction.

#### 1.2.2 Special Coatings
Special coatings are produced with vermiculite milled before or after exfoliation according to a range of particle sizes required. Such milled or ground material may be used for the production of anti-drumming coatings, condensation control paints, high performance gaskets and seals and for upgrading fire resistance of organic foams and other polymer based systems. Exfoliated vermiculite can be colored to suit its end use.

#### 1.2.3 Refractory and High Temperature Insulation
Vermiculite for refractory and high temperature insulation is normally bonded with alumina cements, fire clays and silicates to produce a wide range of vermiculite products which, depending on the type and application can withstand temperatures of up to 1100ºC. The type of refractory products made using vermiculite are:
- Pre-fired clay bonded insulation firebricks.
- Castable high alumina concretes for backup insulation.
- High alumina bonded bricks, slabs and special shapes.
- Silicate bonded insulating shapes and moulded products.

#### 1.2.4 Steelworks And Foundries
Due to its refractory properties, good thermal insulation and low density, vermiculite is used in steelworks and foundries, for hot topping molten steel to reduce heat loss from ingots and ladles and generally as a loose fill insulator.

#### 1.2.5 Loose Fill Insulation
Loose fill vermiculite can be used between joists in attics for house insulation. The free flowing properties of exfoliated vermiculite makes installation very simple. The insulating properties of vermiculite significantly reduce the loss of heat in cold weather and keep the house cool in hot weather. It also functions as a sound absorbing material.

## 2.METHODOLOGY

Figure.1. shows methodology adopted in this study.

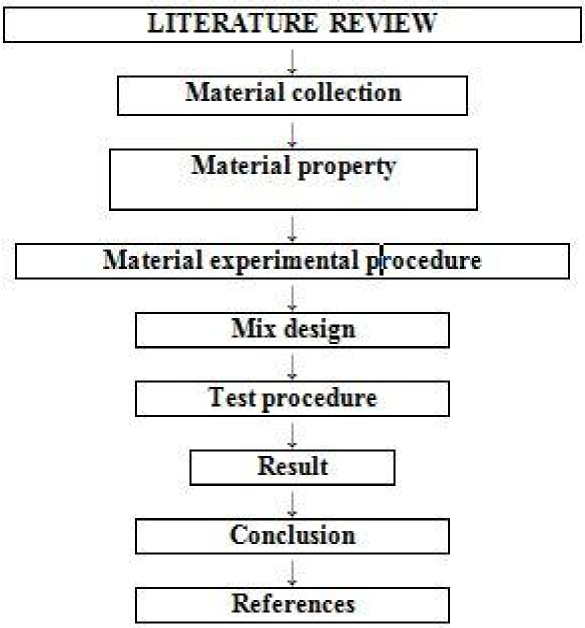


**Figure.1**.Methodology

Materials required are procured as per the codal provision and tested for physical properties of the materials. Mix proportioning is prepared for M25 grade concrete. The Cubes of 150x150x150 mm, Cylinders of 150mm diameter x 300mm height and Prisms of 100x100x500 mm are prepared and cast for testing of specimens. Curing of specimens is done for periods of 3,7 and 28 days and the specimens are tested for Compressive strength and Split tensile strength.

## 3.VERMICULITE

### 3.1 Vermiculite

Vermiculite is a type of aggregate that is created when volcanic rock is heated to extreme temperatures. The heating process causes the rock to expand. When this is combined with concrete it expands the concrete and creates a lighter structure. This is especially useful in lawn ornaments, walkways, and even walls.

**Figure.2** Vermiculite

### 3.2 Industrial Applications

Vermiculite is always used in exfoliated form. When exfoliated it possesses nearly 10 to 11 times less bulk density than the original volume. In commerce, vermiculite which expands more than 10 times the original volume. In commerce, vermiculite which expands more than 10 times the original volume is regarded of good quality. With an expansion below 10 times the original volume, vermiculite is considered of low grade. The low bulk density, comparative high refractoriness, low thermal conductivity and chemical inertness make vermiculite satisfactory for many types of thermal and acoustic insulations. One of its large commercial uses is as an aggregate in light weight concrete and hard wall-plaster because of its acoustic and thermal insulating and fire-resisting qualities. The density of raw vermiculite is 50 to 90 lbs. per cu. ft. While that of the exfoliated one is 5-10 lbs. per cu. ft. It is therefore extensively used in concrete work to save weight.

Vermiculite concrete weighs 20-25 per cu. ft. as against and concrete which weighs about 100 lbs. per cu. ft. Vermiculite concrete has the same advantages as concrete made with pumice and perlite. Refractory insulations both in the form of loose vermiculite fill and vermiculite bricks are used in furnaces and kilns up to 1100ºC. About 60% of the present world consumptions is in the form of loose fill when the expanded material is merely pured like dry sand into wall spaces or applied over ceiling constructions or attics of residential buildings with a view to insulating homes against cold in winter and heat in summer. One inch of Unifil, a trade name of a particular expanded vermiculite, holds back as much of 2½ ft. brick wall or wall of concrete 3¾ ft. thick. As a light-weight aggregate it is extensively used in prefabricated houses.

Vermiculite, being a granular expanded aggregate with numerous air voids, when mixed with a suitable binder develops sound insulating properties. Vermiculite plaster is widely used for better acoustics and reduction of noise in auditoriums, wireless studios, theatres, hospitals etc. Vermiculite mixed with three parts of gypsum is used as plaster for sound-absorbing purposes. A new building material called Pyrok, consisting of vermiculite bonded with lime and cement is marketed in England. A canadian steel company ships red hot steel ingots for a distance of 288 km from open hearth to mill plant, embedded in loose vermiculite. A temperature loss of less than 9 per cent is reported. The vermiculite is reused. Unexfoliated vermiculate has a few minor uses, such as for circulation in drilling mud and in the annealing of steel. When unexfoliated vermiculate is reacted with concentrated $H_2SO_4$, it produces a pure form of silica in flake form. This product is known as 'samisilite'. It is used as adehydrating medium in air conditioning plants since it can absorb about 20 per cent its weight of water. The potency of this product may be revived by heating.

### 3.3 Properties
Vermiculite is a hydrated magnesium aluminum silicate mineral. The formation of vermiculite has been variously ascribed to natural weathering, hydrothermal action, percolating ground waters or combinations of all these three actions. Research over recent years, however, tends to exclude an exclusively hydrothermal origin for vermiculite, and the main agents for vermiculite formation are believed to be due to natural weathering and percolating ground waters. Commercial vermiculite deposits are normally derived from either iron bearing phlogopite or biotite micas, by the natural alteration of the mineral structure to reduce the alkali metal levels and to incorporate crystalline water into the structure.

## 4. MATERIALS PROPERTIES

### 4.1 Fresh Concrete Properties

### 4.1.1 Workability
The property of fresh concrete which is indicated by the amount of useful internal work required to fully compact the concrete without bleeding or segregation in the finished product.

### 4.2 Cement
The cement used was ordinary Portland cement 53 (OPC 53).All properties of cement were determined by referring IS 12269 - 1987. The specific gravity of cement is 3.15. The initial and final setting times were found as 55 minutes and 258 minutes respectively. Standard consistency of cement was 30%. Cement is one of the binding materials in this project. Cement is the important building material in today's construction world. 53 grade Ordinary Portland Cement (OPC) conforming to IS: 8112-1989. Table 1 gives the properties of cement used.

**Table 1** Physical Properties Of 53 Grade Ordinaryportland Cement

| Physical Properties | Test Values | Requirements as per IS 12269-1987 |
|---|---|---|
| Standard Consistency | 29.20% | - |
| Initial Setting Time | 45 Minutes | Minimum of 30 minutes |
| Final Setting Time | 265 Minutes | Maximum of 600 minutes |
| Specific gravity | 3.15 | - |
| Compressive strength in $N/mm^2$ at 3 days | 29.00 | Not less than 27.00 |
| Compressive strength in $N/mm^2$ at 7 days | 38.50 | Not less than 37.00 |
| Compressive strength in $N/mm^2$ at 28 days | 48.00 | Not less than 53.00 |

### 4.2.1 Specific Gravity
The density bottle was used to determine the specific gravity of cement. The bottle was cleaned and dried. The weight of empty bottle with brass cap and washer W1 was taken. Then bottle was filled by 200 to 400g of dry cement and weighed as W2 .The bottle was filled with kerosene and stirred thoroughly for removing the entrapped air which was weighed as W3. It was emptied, cleaned well, filled with kerosene and weighed as W4.

Specific gravity of Cement (G) = (W2-W1)/ ((W2-W1)-(W3-W4))

Where

$W_1$ = Weight of empty density bottle with brass cap and washer in gm.
$W_2$= Mass of the density bottle & cement in gm.
$W_3$= Mass of the density bottle, cement & kerosene in gm.
$W_4$= Mass of the density bottle filled with kerosene in gm.

#### 4.2.2 Bulk Density
Bulk density is the weight of a material in a given volume. It is expressed in Kg/m3. A cylindrical measure of nominal diameter 250mm and height 300mm was used. The cylinder has the capacity of 1.5 liters with the thickness of 4mm. The cylindrical measure was filled about 1/3 each time with thoroughly mixed aggregate and tampered with 25 strokes. The measure was carefully struck off level using tamping rod as straight edge. The net weight of aggregate in the measure was determined. Bulk density was calculated as follows.

Bulk density = (Net weight of coarse aggregate in Kg)/ (Volume)

#### 4.2.3 Surface Moisture
100g of coarse aggregate was taken and their weight was determined, say W1. The sample was then kept in the oven for 24 hours. It was then taken out and the dry weight is determined, says W2. The difference between W1 and W2 gives the surface moisture of the sample.

#### 4.2.4 Water Absorption
100g of coarse aggregate was taken and their weight was determined, say W1. The sample was then kept in the oven for 24 hours. It was then taken out and the dry weight is determined, says W2. The difference between W1 and W2 gives the surface moisture of the sample.

#### 4.2.5 Fineness Modulus
The sample was brought to an air-dry condition by drying at room temperature. The required quantity of the sample was taken (3Kg). Sieving was done for 10 minutes. The material retained on each sieve after shaking, represents the fraction of the aggregate coarser then the sieve considered and finer than the sieve above. The weight of aggregate retained in each sieve was measured and converted to a total sample. Fineness modulus was determined as the ratio of summation of cumulative percentage weight retained (F) to 100.

### 4.3 Properties Of Water
Water used for mixing and curing shall be clean and free from injurious amounts of Oils, Acids, Alkalis, Salts, Sugar, Organic materials Potable water is generally considered satisfactory for mixing concrete Mixing and curing with sea water shall not be permitted. The pH value shall not be less than 6.

### 4.4 Fine Aggregate
The sand which was locally available and passing through 4.75mm IS sieve is used. The specific gravity of fine aggregate was 2.60. Locally available river sand conforming to Grading zone I of IS: 383 –1970.Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm Sieve will be used for casting all the specimens. Fine aggregate" is defined as material that will pass a No. 4 sieve and will, for the most part, be retained on a No. 200 sieve. For increased workability and for economy as reflected by use of less cement, the fine aggregate should have a rounded shape. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent

### 4.5 Coarse Aggregate
20mm size aggregates-The coarse aggregates with size of 20mm were tested and the specific gravity value of 2.78 and fineness modulus of 7 was found out. Aggregates were available from local sources. Locally available crushed blue granite stones conforming to graded aggregate of nominal size 20 mm as per IS: 383 – 1970.Crushed granite aggregate with specific gravity of 2.77 and passing through 4.75 mm sieve and will be used for casting all specimens. Several investigations concluded that maximum size of coarse aggregate should be restricted in strength of the composite. In addition to cement paste – aggregate ratio, aggregate type has a great influence on concrete dimensional stability.

## 5.TESTING PROCEDURE

### 5.1 Compressive Strength Test

At the time of testing, each specimen must keep in compressive testing machine. The maximum load at the breakage of concrete block will be noted. From the noted values, the compressive strength may calculated by using below formula.

Compressive Strength = Load / Area

Size of the test specimen=150mm x 150mm x 150mm

#### 5.1.2 Compressive Strength Test Results

**Table 2** Compression Test Result

| % of replacement | Avg compressive strength ($N/mm^2$) | | |
|---|---|---|---|
| | 7days | 14days | 28days |
| 0 | 21.9 | 28.2 | 33.3 |
| 5 | 17.2 | 24.8 | 31.4 |
| 10 | 14.6 | 21.6 | 29.6 |

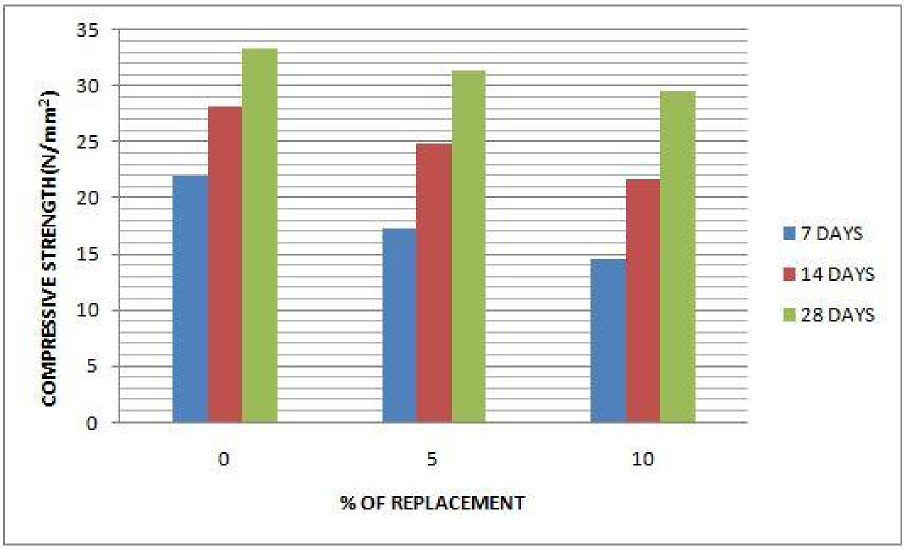


**Figure. 3**. Graph Shown Split Test

### 5.2 Split Tensile Test

- The size of cylinders 300 mm length and 150 mm diameter are placed in the machine such that load is applied on the opposite side of the cubes are casted. Align carefully and load is applied, till the specimen breaks. The formula used for calculation.

Split tensile strength = 2P/ μdl

**5.2.1 Split Tensile Test Results**

**Table .4** Split Tensile Strength Test Result

| % of replacement | Avg Split Tensile strength (N/mm$^2$) | | |
|---|---|---|---|
| | 7days | 14days | 28days |
| 0 | 2.44 | 2.98 | 3.45 |
| 5 | 2.31 | 2.77 | 3.30 |
| 10 | 2.12 | 2.40 | 3.14 |

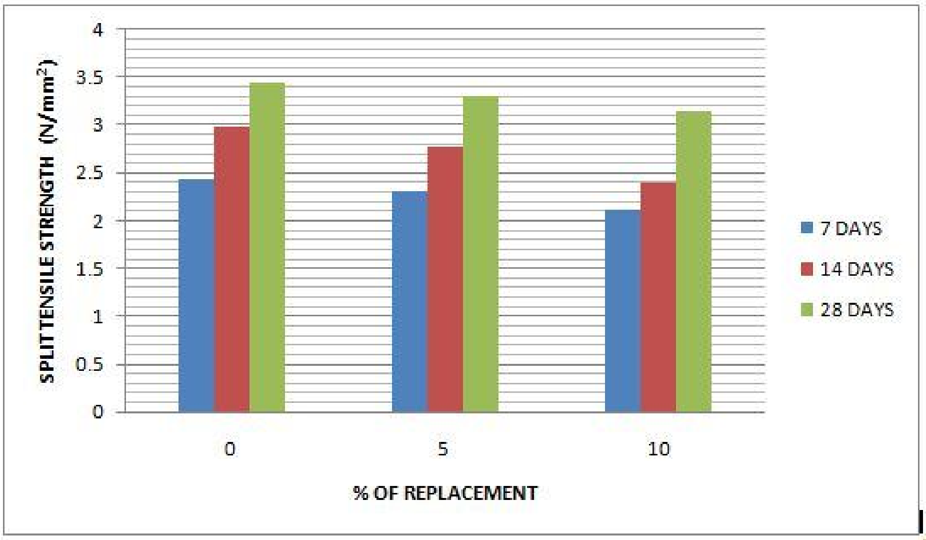


**Figure 4:** Graph Shown Split Test

## 6.CONCLUSION

- The initial test results shown that adding vermiculite in to lightweight concrete decreases the compression strength and by adding super plasticizers the decreased compression strength of the cube can be regained.
- Compare with conventional cube the cube with vermiculite had less density.
- Thus we can come to an conclusion that vermiculite added light weight concrete cannot be useful for load bearing purpose, rather it can be used as non load bearing purpose like heat insulation, weathering course etc.
- From our studies it is concluded that the replacement of vermiculite shows that by designing a building with dynamic loading and with the replacement of vermiculite up to 15% in concrete and in plastering, will lead to light weight thermal insulated concrete.

## References

[1] T.Subramani., S.Krishnan. S.K.Ganesan., G.Nagarajan ”Investigation of Mechanical Properties in Polyester and Phenyl-ester Composites Reinforced With Chicken Feather Fiber” International Journal of Engineering Research and Applications Vol. 4, Issue 12(Version 4), pp.93-104, 2014.

[2] T.Subramani, J.Jayalakshmi , " Analytical Investigation Of Bonded Glass Fibre Reinforced Polymer Sheets With Reinforced Concrete Beam Using Ansys" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 105-112 , 2015

[3] T.Subramani, D.Latha , " Experimental Study On Recycled Industrial Waste Used In Concrete" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 113-122 , 2015
[4] T.Subramani, V.Angappan , " Experimental Investigation Of Papercrete Concrete" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 134-143 , 2015
[5] T.Subramani, V.K.Pugal , " Experimental Study On Plastic Waste As A Coarse Aggregate For Structural Concrete" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp.144-152 2015
[6] T.Subramani, B.Suresh , " Experimental Investigation Of Using Ceramic Waste As A Coarse Aggregate Making A Light Weight Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 153-162 , 2015
[7] T.Subramani, M.Prabhakaran , " Experimental Study On Bagasse Ash In Concrete" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 163-172 , 2015
[8] T.Subramani, A.Mumtaj , " Experimental Investigation Of Partial Replacement Of Sand With Glass Fibre" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 254-263 , 2015
[9] T.Subramani, S.B.Sankar Ram Experimental Study on Concrete Using Cement With Glass Powder, IOSR Journal of Engineering,Volume 5 , Issue 5, Version 3, pp43-53, 2015
[10] T.Subramani, S.Kumaran , " Experimental Investigation Of Using Concrete Waste And Brick Waste As A Coarse Aggregate " , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 294-303 , 2015
[11] T.Subramani, G.Ravi, "Experimental Investigation Of Coarse Aggregate With Steel Slag In Concrete", IOSR Journal of Engineering, Volume 5,Issue 5, Version 3, pp64-73, 2015
[12] T.Subramani, K.S.Ramesh , " Experimental Study On Partial Replacement Of Cement With Fly Ash And Complete Replacement Of Sand With M sand" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5 , pp. 313-322 , 2015
[13] T.Subramani, G.Shanmugam , " Experimental Investigation Of Using Papercrete And Recycled Aggregate As A Coarse Aggregate " , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 323-332 , May 2015
[14] T.Subramani, P.Sakthivel , " Experimental Investigation On Flyash Based Geopolymer Bricks" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 5, Issue 5, pp. 216-227 , 2016 .
[15] T.Subramani, R.Siva, "Experimental Study On Flexural And Impact Behavior Of Ferrocement Slabs" International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 5, Issue 5, pp. 228-238 , 2016
[16] T.Subramani, A.Anbuchezian , " Experimental Study Of Palm Oil Fuel Ash As Cement Replacement Of Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 001-005 , ISSN 2319 - 4847.
[17] T.Subramani, A.Anbuchezian , " Experimental Study Of Mineral Admixture Of Self Compacting Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 006-010 , ISSN 2319 - 4847.
[18] T.Subramani, A.Anbuchezian , " Experimental Test On Bitumen With Addition Of 35% Of Plastic Fibre " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 017-022 , ISSN 2319 - 4847.
[19] T.Subramani, A.Anbuchezian , " Stabilization Of M30 Concrete Pavement By Partially Replacing Cement By 20% Of Flyash And Sodium Silicate " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 023-031 , ISSN 2319 - 4847.
[20] T.Subramani, A.Anbuchezian , " Experimental Investigation On Flexural Behavior Of Folded Ferro Cement Panels " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 045-049 , ISSN 2319 - 4847.
[21] T.Subramani, A.Anbuchezian , " Experimental Study On Replacement Of Concrete Material By Water Treatment Plant Waste Sewage " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 050-057 , ISSN 2319 - 4847.
[22] T.Subramani, A. Fizoor Rahman , " An Experimental Study On The Properties Of Pet Fibre Reinforced Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 058-066 , ISSN 2319 - 4847.

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