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Transparent Concrete Concept By Replacing Fine Aggregate Of Waste Glass By Using Admixture In Optical Fibre

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Abstract: ***Concrete is a homogeneous mixture making a single product. Transparent concrete is a concrete based building material with light-Transmitting properties due to embedded light optical elements usually Optical fibres. This concrete can also be used for aesthetic application by applying the optical fibres in concrete. There are different types of fibres used in concrete for increasing the strength aspect and durability. Optical fibres are one which helps for transmission of light through fibre. In our project, the end-lite type of fibre is used to increase the aesthetic appearance of the concrete. The concept of transparent concrete can also be used for light transmission in the wall panel which is exposed to direct sun light which transmit the image but not completely transparent. This type of concrete can be installed at a very low cost and increasing the visual appeal. The application can be used in decorating the interior of a hall or lobby and the ceiling to glow in dark by external lighting source and during day time the concrete glows by the light transmission from natural resource. The prototype study is made and the concrete is made decorative and durable also. In the present study, the mix design of M40 concrete is adopted. Optical fibres are reinforced in to the concrete by 5% and 10% based on surface area. Different tests like Compressive strength test, split tensile strength, Flexural strength test were carried on the specimen. The results evidently show that as the percentage of optical fibre increases the strength also increases.***

Keywords: Transparent Concrete, Waste Glass, Admixture, Optical Fibre

1. INTRODUCTION

Concrete has been used since Roman times for the development of infrastructure and housing, but its basic components have remained the same. Coarse aggregate, like stones or gravel; fine aggregate, such as sand; and cement, a fine powder material are the three ingredients that make up the dry mix that unite together when water is added.In 1960s, due to rapid urbanization concrete was often misinterpreted and disapproved by its image. But since that time, concrete has made worthwhile progress, in both technical terms and aesthetic terms. Concrete is a chief material in construction and gives strength considerably, beside strength concrete can also be used for aesthetical view. Concrete has become attractive and dynamic and is no longer the cold, grey and heavy material. By advanced study and innovation, newly developed concrete has been created as lightweight concrete, concrete with high resistant and white or coloured concrete, etc.

The main aim of transparent concrete is to produce transparency and its objective of application connect it to green technology and artistic finish. It is the "combination of optical fibres and fine concrete". Currently, green structures focus largely on energy saving with indoor thermal systems. Therefore, it is important to produce a new functional material to satisfy the structure in terms of safety monitoring (such as damage detection, fire warning), protection from environment, energy saving and artistic modelling. The use of non- renewable energy sources is increased as the space between the buildings are reduced due to the construction of high-rise buildings, thus smart construction technique like green building and indoor thermal system becomes essential.
Transparent concrete blocks are adapted in furniture for decorative purpose even for staircase, partition wall where natural light does not reach with required quantity, dark subway to increase the range of vision, lighting sidewalks at night time, etc. Transparent concrete is new technique not same as normal concrete. Transparent concrete is a lightweight concrete compared to conventional concrete. The main objective of transparent concrete is to use sunlight as the light source instead of electrical energy in order to reduce the load on non- renewable sources and to develop energy saving material. Due to the addition of optical glass fibres in the concrete, light can be transmitted from inside out or outside in. Transparent concrete has the same strength as regular concrete and continues light to travel through walls up to twenty meters (twenty-two feet) thick.

Modern construction industry calls for a more innovative comprehensive materials in line with the past developing hands of construction. The thought of all these creative

ideas come up to challenge the spirit of young engineers to achieve a study that would possibly change the history. A wide variety of materials come from municipal and household garbage or waste glass from collapsed building caused by an earthquake.

Waste materials must not react adversely with other constituents of the mix. Most waste glass will readily take part in the alkali-aggregate reaction and possess a potential durability problem.

The effect of waste materials such as waste glass, on concrete properties must be considered. For example, the lower modulus of elasticity glass compared to that of good-quality rock will lower the elastic modulus of concrete. The use of concrete is being generally replaced by the use of polyester or epoxy resins mixed with fillers to make thinner and lighter than concrete.

However, other materials can still be improved by adding other materials for further modify its property which can be called admixture. An admixture is a material added to the water, sand, cement and gravel with glass, in order to change one or more properties fresh hardened stage admixtures are generally divided into two groups: Chemical admixtures and mineral admixtures. Chemical admixture used in concrete generally serves as water reducers, accelerators, set retarders or a combination.

1.1 Experimental Investigation

This experimental research focuses on the effect of using recycled bottles as concrete material for mass housing projects. This research aims to determine the effect of using recycled bottles on the properties of hardened concrete namely: compressive strength and modulus of elasticity. Also included, are the effect of recycled bottles on water-cement ratio, quality and size of aggregates and consistency of the mix. Experiments shall be conducted to acquire the necessary data needed in the analysis. The researcher used manually crushed and clean bottles and chosen bottles with the same property for uniformity. The crushed samples were passed through sieve analysis to ensure that the size of the cullet will be less than 4.0 mm but greater than 2.0 mm with accordance to ASTM standards.

The research concentrates on the effect of using recycled bottles as coarse aggregate and not on its properties as an aggregate. The researcher used only Portland Pozzolanic Cement, which are commonly used in the field at present, for the specimens. This type of cement has low hardening characteristics. It will also cover the difference between the common concrete cement and concrete recycled glass bottles in terms of its properties as a coarse aggregate. The specimens are tested for compressive strength using UTM on its 7^{th}, and 28^{th} day of curing. This will be the basis for the data. Figure 1 shows waste glass bottles as collected before crushing and sieving

Figure 1: Waste glass bottles as collected before crushing and sieving

Figure 2 shows the Crushing of glass bottles to coarse sizes

Figure 2: Crushing of glass bottles to coarse sizes

The study focuses on compressive strength of broken glass and plain concrete. This study also gives emphasis on the environmental concerns and not on its economic aspect. In addition, study is also delimited to durability, creep, shrinkage and water tightness. These four properties of hardened concrete are time-dependent properties which will entail so much time to determine.

1.2 Light Transmitting Concrete

I selected Transparent Concrete as my term paper writing because it is interesting to me being a mechanical engineer as well as Transparent Concrete has become most favourable progressive technology for the 21st Century and has the potential to develop both industrial and consumer products by combining optical fibres with normal concrete material. Its uses can change our lives and the way of living passionately.

Concrete has a vital role in development of infrastructure and housing. Due to globalization, population growth and space utilization worldwide, there is drastic change in construction technology. Small buildings are replaced by high-rise buildings and skyscrapers. This arises one of the problem in deriving natural light in building, due to obstruction of nearby structures. Due to this problem use of artificial sources for illumination of building is increased by great amount. Complete dependence on artificial sources has adverse impacts on our environment and health of people living in these buildings. Production of these artificial sources of energy pollutes our environment. So, it

is very essential to reduce the artificial light consumption in structure.

Light transmitting concrete allows natural sunlight or any light to pass through it, thus increasing the natural light content in the building to enhance optical activity. It reduces electricity consumption in the buildings and makes it easier for buildings to achieve higher LEED (Leadership in energy and environmental design) rating. Thus reduces the dependence on artificial sources.

Transparent concrete is a concrete-based building material with light-Transmissive properties due to embedded light optical elements i.e. plastic optical fibres. Light is conducted through the concrete from one end to the other. Therefore the fibres have to go through the whole object. Transparent concrete is also known as the translucent concrete and light transmitting concrete because of its properties. It is used in fine architecture as a facade material and for cladding of interior walls.

Light transmitting concrete is made up of cement, fine aggregates, coarse aggregates and optical fibres, placed in alternate layers. It is based on the principle of total internal reflection of light in the core of the plastic optical fibre. When light falls on one end of the optical fibre, it gets totally internally reflected in the fibre and gets transmitted on other end of the fibre.

This concrete is very important from sustainable development and green building point of view as it allows use of natural light more efficiently without compromising much on strength parameter. For green buildings, according to IGBC (Indian Green Building Council), 50% of daylight is mandatory which accounts for 3 credits in the green buildings. Light transmitting concrete allow sufficient light inside the building, thereby making it easier to achieve higher ratings for buildings.

1.3 Functional Principle of Light Transmitting Concrete

Diffuse natural light and sunlight provide the full spectrum of colours shining through the concrete panels. Sunlight is the most inexpensive light source. If the panel is mounted free standing or in front of a window, one will not need any artificial light source. Transparent concrete or translucent concrete is work Based on “Nano-Optics”. Optical fibres passes as much light when tiny slits are placed directly on top of each other as when they are staggered. Principle can carry because optical fibres in the concrete act like the slits and carry the light across throughout the concrete.

1.4 Usage of Light Transmitting Concrete Blocks

- Translucent blocks can be installed as front wall of restaurant and shops to let people from outside know about inside condition, which can catch customers.
- Ceilings can be made up of this concrete, thus saving electricity cost and providing scattered light.
- It can be used to make speed breakers and road marking by providing light source beneath it and Light transmitting block over it.
- Sidewalks can also be constructed with light source beneath it which will provide scenic view as well light during night.
- In subways and airports it can be added as guiding mark as well as safety mark during time of darkness.
- It can be used for making different decorative shapes such as book shelves, outer home boundary, statues etc.
- Translucent walls should be installed in museum, prison cell, and schools thus providing way to vigilance along with safety.

1.5 Compressive Strength of Light Transmitting Concrete

Compressive strength is most important property for any material that is intended to be used for construction. Any material cannot be used for construction until it satisfies the requirements about sufficient strength to withstand all the loads that will be acting on it after construction during its useful life. Various studies have been carried out to investigate the compressive strength of light transmitting concrete.

1.6 Recent Development

The community has great challenges and it needs useful solution for the challenges as like the global climate change, using energy in a sustainable way and protecting the environment. We should find a good solution, for instance: using of solar energy, transparent heat insulation, passive buildings etc. The development of the building technology in the field of building industry is a good way to eliminate the emission of greenhouse gases, because we shall use less loam and the industry will not need to transfer those materials.

The former Research and Development results will be combined with the technologies of the frozen sand concrete and the non-tectonic constructions theories and practices. The results of the last decades in the field of concrete technology and material science could be combined with the new Research and Development results. New Research and Developments are developing of a simple, cheap and productive optical fibre, especially according to the production of the transparent concrete. The use of this material in the solar architecture in a cheap way. The other aim is that the people could use it more. By the results, the transparent concrete will be available for everybody, because the technology is cheap and productive due to the fibre pulling and brick technology methods.

1.7 Aim and Objectives

At present scenario construction field all around the world is facing a serious problem with price hike of raw materials. It is also important for engineers to develop Eco-friendly material, as environment is getting affected day by day by the increasing construction activities It is much of importance for developing a new kind of building material, which can integrate green energy saving with self-sensing properties of functional material such that the excellent properties of light guiding and light weight, a smart transparent light weight concrete is researched by arranging he glass crystals & resin-hardener into the concrete. The way to control the density of lightweight transparent concrete become difficult. By using different quantities of foaming agent will affect the strength and quality of foam concrete.

1.8 Objectives

- To make concrete partly transparent by using optical fibres in it to impart good appearance to structure.
- To study improvement in performance of concrete in light transmission by using optical fibre and improve performance of structure to derive natural light.
- To study Energy saving for illumination by using transparent block for building.
- To study cost effectiveness of this high performance concrete

2. METHODOLOGY

Figure 3 shows the methodology of the study

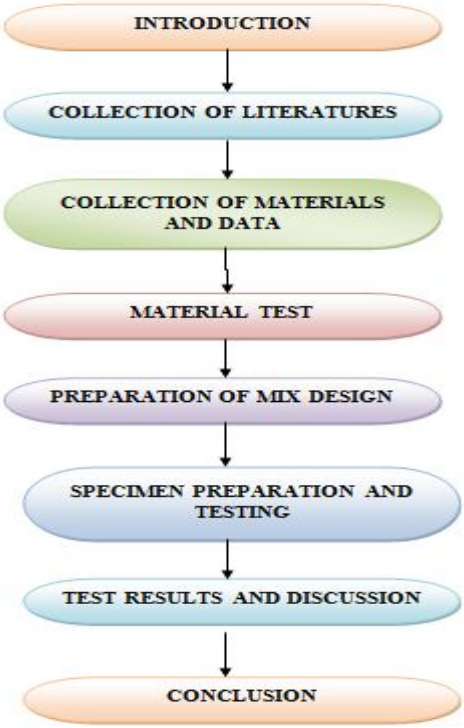

Figure 3 Methodology

3. MATERIAL COLLECTION AND PROPERTIES

3.1 Materials Used

In This Investigation, The Following Materials Were Used:

- Ordinary Portland Cement Of 53 Grade Cement Conforming To Is:169-1989
- Fine Aggregate and Coarse Aggregate Conforming To IS: 2386-1963.
- Water.
- Waste Glass
- Optical Fibre

3.2 Cement

Ordinary Portland cement is the most common type of cement in general use around the world as a basic ingredient of concrete, mortar, stucco, and most non specialty grout. It developed from other types of hydraulic lime in England in mid-19th century and usually originates from limestone. It is a fine powder produced by heating materials to form clinker. After grinding the clinker we will add small amounts of remaining ingredients. Many types of cements are available in market. When it comes to different grades of cement, the 53 Grade OPC Cement provides consistently higher strength compared to others. As per the Bureau of Indian Standards (BIS), the grade number of a cement highlights the minimum compressive strength that the cement is expected to attain within 28 days. For 53 Grade OPC Cement, the minimum compressive strength achieved by the cement at the end of the 28th day shouldn't be less than 53MPa or 530 kg/cm2. The colour of OPC is grey colour and by eliminating ferrous oxide during manufacturing process of cement we will get white cement also. Ordinary Portland Cement of 53 Grade of brand name Ultra Tech Company, available in the local market was used for the investigation. Care has been taken to see that the procurement was made from single batching in air tight containers to prevent it from being effected by atmospheric conditions. The cement thus procured was tested for physical requirements in accordance with IS: 169-1989 and for chemical requirement in accordance IS: 4032-1988.

3.3 Fine Aggregates

Sand is a natural granular material which is mainly composed of finely divided rocky material and mineral particles. The most common constituent of sand is silica (silicon dioxide, or SiO2), usually in the form of quartz, because of its chemical inertness and considerable hardness, is the most common weathering resistant mineral. Hence, it is used as fine aggregate in concrete. River sand locally available in the market was used in the investigation. The aggregate was tested for its physical requirements such as gradation, fineness modulus, specific gravity in accordance with IS: 2386-1963.The sand was surface dried before use.

3.4 Coarse Aggregates

Crushed aggregates of less than 12.5mm size produced from local crushing plants were used. The aggregate exclusively passing through 12.5mm sieve size and retained on 10mm sieve is selected. The aggregates were tested for their physical requirements such as gradation, fineness modulus, specific gravity and bulk density in accordance with IS: 2386-1963. The individual aggregates were mixed to induce the required combined grading. The particular specific gravity and water absorption of the mixture are given in table.

3.5 Water

Potable water conforming to IS 456-2000 was used for casting and curing.The role of water is important because the water to cement ratio is the most critical factor in the concrete. It should be of drinking water quality. It should be free from all impurities.

3.6 Optical Fibres

Optical fibres are flexible, transparent fibres made up of glass as well as plastic and are thin as human hairs. It transmits light between two ends of the fibres by process of total internal reflection. In this experiment, the holes of 5mm diameter were drilled and glass optical fibres of 0.5mm diameter were used.

3.7 Waste Glass

The waste toughen glasses are collected from industrial waste. Industrial waste glass was hammered and crushed in to smaller pieces with the help of Impact test machine.

4. MIX DESIGN

4.1 Design Stipulations

Grade Designation M-40
Type of cement O.P.C-53grade
Fine Aggregate Zone-I
Sp. Gravity Cement 3.14
Sp. Gravity Fine Aggregate 2.59
Sp. Gravity Coarse Aggregate 2.9

4.2 Mix Proportion

Table 1 shows the mix proportion

Table1: Mix proportion

Cement (kg)/m^3	FA (kg)/m^3	CA (kg)/m^3	Water (liter)/m^3
547.37	580.53	1130.84	191.58

5. TEST PROCEDURE

5.1 Compressive Strength Procedure

Prepare the concrete in the required proportions and make the specimenby filling the concrete in the desired mould shape of 15cm x 15cm x 15cm cube with proper compaction, after 24 hrs. place the specimen in water for curing.

- Take away the specimen from water when such as natural process time and wipe out excess water from the surface.
- Take the dimension of the specimen to the closest 0.2m
- Clean the bearing surface of the testing machine
- Place the specimen within the machine in such a fashion that the load shall be applied to the other sides of the cube forged.
- Align the specimen centrally on the bottom plate of the machine.
- Rotate the movable portion gently by hand so it touches the highest surface of the specimen.
- Apply the load step by step while not shock and incessantly at the speed of 140kg/cm2/minute until the specimen fails
- Record the utmost load and note any uncommon options within the form of failure.

5.2 Water Absorption

For the water absorption test, the specimens are dried in an oven for a specified time and temperature and then placed in a desiccator to cool. Immediately upon cooling the specimens are weighed. The material is then emerged in water at agreed upon conditions, often 23°C for 24 hours or until equilibrium. Specimens are removed, patted dry with a lint free cloth, and weighed.

5.3 Split Tensile Test

Take the wet specimen from water after 7 days of curing. Wipe out water from the surface of specimen Draw diametrical lines on the two ends of the specimen to ensure that they are on the same axial place. Note the weight and dimension of the specimen. Set the compression testing machine for the required range. Keep are plywood strip on the lower plate and place the specimen. Align the specimen so that the lines marked on the ends are vertical and centered over the bottom plate. Place the other plywood strip above the specimen. Bring down the upper plate to touch the plywood strip. Apply the load continuously without shock at a rate .Note down the breaking load (P)

6. TESTING RESULT

6.1 Compressive Strength of Cube

Table 2 shows the compressive strength of cube and Figure 4 shows the Compressive test graph result

Table 2: Compressive strength of cube

MIX DESIGN	% OF REPLACEMENT	COMPRESSIVE STRENGTH(N/mm²)		
		7DAYS	14 DAYS	28DAYS
M_{40}	0	28.13	33.78	42.38
	5	30.99	35.68	45.38
	10	26.45	30.51	40.83

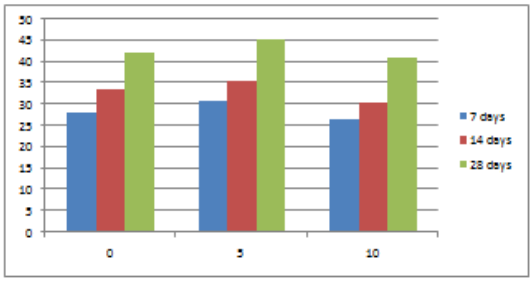

Figure4 Compression Test Graph Result

6.2 Split Tensile Test for Cylinder

Table 3 shows the split tensile test result

Table 3: Split Tensile Test Result

MIX DESIGN	% OF REPLACEMENT	SPLIT TENSILE TEST (N/mm²)		
		7 DAYS	14 DAYS	28 DAYS
M_{40}	0	3.3	5.32	6.42
	5	3.8	5.5	6.75
	10	3.1	4.5	6.88

Figure 5 shows the split tensile graph results

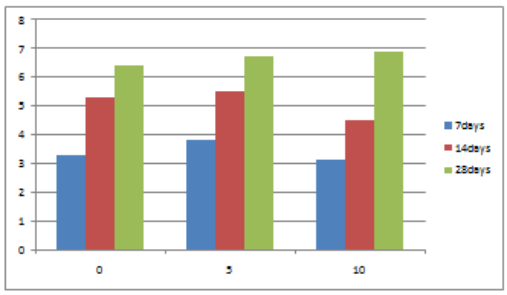

Figure 5 Split tensile graph result

6.3 Water Absorption Test

Table 4 shows the water absorption test results

Table 4: Water absorption test result

% OF ADDING COCOUNT FIBER	% OF WATER ABSORPTION
0	5.12
5	4.5
10	3.6

Figure 6 shows the water absorption graph results

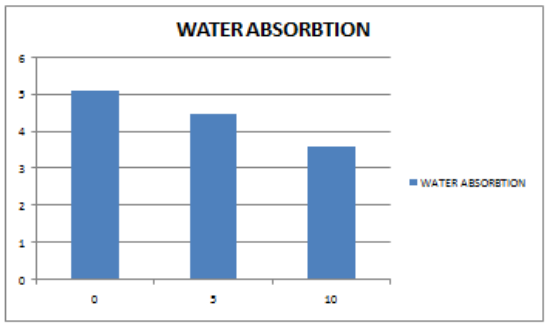

Figure 6 Water Absorption Graph Result

7. CONCLUSION

A novel architectural material called translucent concrete can be developed by adding optical fibre or large diameter glass fibre in the concrete mixture. Optical fibre based transparent concrete could be regarded as an art which could be used in museums and specific exhibitions rather than just a construction material. The translucent concrete has good light guiding property and the ratio of optical fibre volume to concrete is proportion to transmission. The translucent concrete not loses the strength parameter when compared to regular concrete and also it has very vital property for the aesthetical point of view. It can be used for the best architectural appearance of the building.

- Variation in compressive strength, flexural strength and tensile strength is observed in the presence of finely ground waste glass crystals.
- Compressive strength will be increases at 5% replacement of waste glass at 45.38 N/mm2 at 28 days.
- Split tensile value will be maximum at 10% replacement of waste glass at 6.88 N/mm2 at 28 days.
- From observed results both compressive & split tensile tests attain maximum strength at Waste glass replacement compared to conventional concrete.
- Percentage of water absorption will be minimum at 10% replacement of fine aggregate compared other ratios.

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 Fibre" 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.

[23]. T.Subramani, M.Meganathan, S.Priyanka , " Experimental Study On Strength Properties Of Diaphanous Concrete With Vermiculite " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 5, May 2017 , pp. 229-238 , ISSN 2319 - 4847.

[24]. T.Subramani, T.Anandavel, S.Priyanka , " Experimental Investigation Of Waste Plastic Fibre In Reinforced Cement Concrete Using Recycled Coarse Aggregate " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 5, May 2017 , pp. 239-250 , ISSN 2319 - 4847.

[25]. T.Subramani, S.Priyanka , " Experimental Test On Carbon Nano Powder On The Properties Of Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 5, May 2017 , pp. 294-303 , ISSN 2319 - 4847.

[26]. T.Subramani, P.Babu, S.Priyanka , " Strength Study On Fibre Reinforced Concrete Using Palmyra Palm Fibre Using Fem Software " , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 6, Issue 3, May - June 2017 , pp. 198-207 , ISSN 2278-6856.

[27]. T.Subramani, G.Unni Krishnan, R.Arumugam, A.Godwyn Michael Cornelies, H.Gopu , " Experimental Study Of Quarry Sand And Rice Husk Replacing In Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 5, May 2017 , pp. 312-319 , ISSN 2319 - 4847.

[28]. T.Subramani, R.Sengottaiyan, K.Roop Kumar, V.Arun Kumar , S.S.ShanjaySundaraSood , " An Expremental Investigation On Mineral Admixture For High Perfomence Of Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 5, May 2017 , pp. 320-326 , ISSN 2319 - 4847.

[29]. T.Subramani, J.Karthickrajan , " Experimental Study On Absorption Of CO2 By M30 Concrete As A Partial Replacement Of Cement By 25% Of Zeolite" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 5, Issue 5, pp. 085-094 , 2016 .

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