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Experimental Check on Physical and Mechanical Properties of Saw Blocks

Dona Renjith, Balamurali.K, Padmanaban.I

Abstract: ***Blocks plays a major role in framed and non-framed structure, in framed structures blocks are employed as a filler and in non-framed structures it is employed to transfer the load. These are often used as an alternative for different stones with large weight and are generally used in the construction of buildings. The process of manufacturing of blocks from clay involves preparation of clay by natural weathering process, molding and then drying and burning of blocks. Due to high demand on fine aggregate, an attempt has been made to study saw waste as a partial and total replacement for fine aggregate and binder. A detailed investigation is carried out for Ordinary Portland cement and Portland pozzolana cement with various proportion of saw waste. Saw waste is utilized in the form of dust and ash. Saw waste is a by – product or waste product of wood working operation such as sawing, routing, drilling and sanding. It is sundried and kept in water proof bags. Mostly, the period of drying may be three to ten days. It also depends upon the weather conditions. This work aims to show the comparative studies of saw brick with fly ash brick and conventional brick. Test results of compressive, split tensile and crushing test are investigated.***

Keywords: **Saw Dust, Saw Ash, Pozzolana cement, Strength.**

I. INTRODUCTION

Concrete usage in modern world increases day by day and creates environmental pollution by releasing carbon dioxide, to reduce the amount of greenhouse gas concrete can be made with composite materials, composite materials enhances the structural stability and reduces the overall weight of the structures, zziwa, (2006) [11]. Usage of agricultural waste in construction decreases the construction cost and finds solution for green house effects viktor banhidi (2008) [4]. Recycled saw waste can be employed as a new filler material, which will reduce the environmental problems, and reduces the demand of construction materials praveena (2018) [12]. Hardik (2017) [10] studied the elements present in the sawdust ash, and he found that silicon dioxide, aluminum oxide, and iron oxide in the ash matches 72% by cement. Concrete made with sawdust with the replacement for fine aggregates cured at elevated temperature of 950 degree Celsius showed better results bachir (2012) [9]. Dalbergia sissoo species waste combined with starch and cow dung waste shows effective results in the proportions of 100:30 and 100:40 sanjay (2016) [8]. Concrete with saw dust, ball clay and kaolin can be used as light weight heat insulation blocks bwayo (2014) [6]. Paki turgut (2006) [5] studied the use of saw dust and limestone dust in non-loaded masonry units to check the energy absorption capacity, the mix proportions can be used in the production of bricks forms light weight, and economical product. Saw dust ash mixed with ordinary Portland cement and Portland pozzolana cement shows that ash with opc has higher strength than the ash with ppc, marthong (2012) [2].

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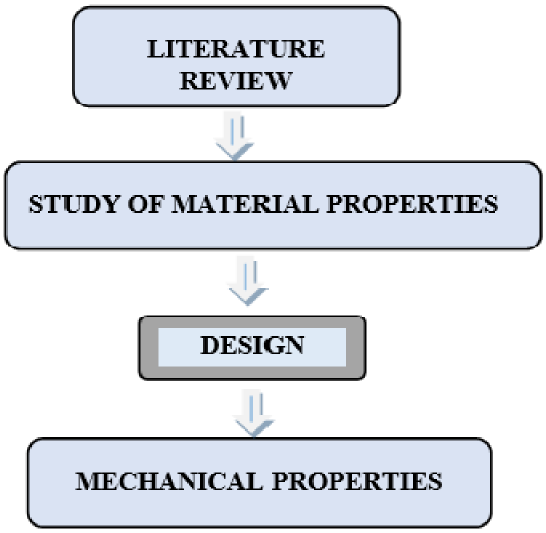
* Correspondence Author
Dona Renjith, Department of Civil Engineering, Sri Krishna College of Technology, Coimbatore, India. Email: 18tpcv008@skct.edu.in
Balamurali.K*, Department of Civil Engineering, Sri Krishna College of Technology, Coimbatore, India. Email: 18tpcv006@skct.edu.in
Padmanaban.I, Department of Civil Engineering, Sri Krishna College of Technology, Coimbatore, India. Email: padmanaban.i@skct.edu.in

II. METHODOLOGY



III. PHYSICAL PROPERTIES

Physical properties of Saw Ash and Saw Dust is Examined in the laboratory as similar to that of test conducted for cement. First, physical examination is color of the material, it is found by seeing the color of the samples. Second, specific Gravity of the samples are found as similar to the test conducted for cement, as shown below:

Table-I. Specific gravity of Mix Ingredients

Material	Cement	Fine Aggregate	Saw Ash	water
specific Gravity	3.25	2.74	2.62	1

Table-II. Chemical composition of Saw Ash

Parameters (%)	Saw Ash
AL_2O_3	2.57
CaO	6.2
MnO	5.4
K_2O	0
SO_3	0.65
P_2O_5	0.5
Na_2O	0
MgO	0
Fe_2O_3	12.25
SiO_2	45.5
LOI (g/cm^3)	2.5
Moisture	3.6

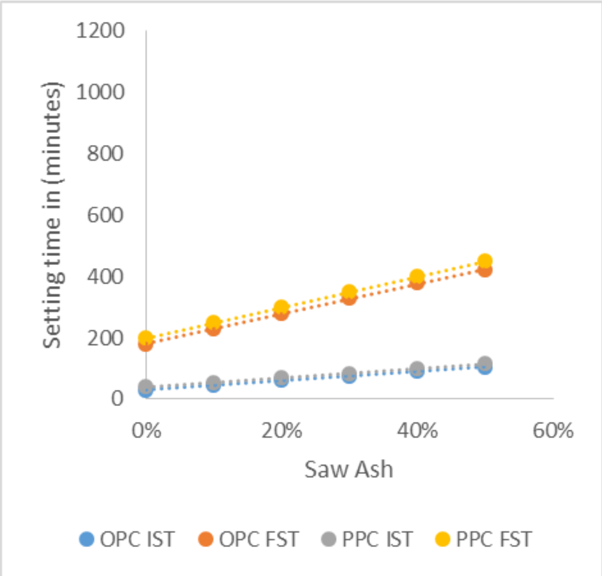


Figure 1. Setting time of block with different Ash proportions

IV. MECHANICAL PROPERTIES

Saw ash is used in different proportions in ordinary Portland cement (OPC) and Portland Pozalona cement (PPC), to study the behavior of mix ingredients in different curing period.

A. Compressive strength

Cubes with 150x150 mm were used to find the compressive strength. Blocks with different curing period was tested to examine the properties of mix ingredients. Blocks with two types of mix ingredients were studied. Figure 3, shows the compressive strength results of OPC grade cement with saw ash. Similarly, Figure 4 shows the test results of 3, 7, 14, 28 days compressive strength for PPC with different proportions of Saw ash.

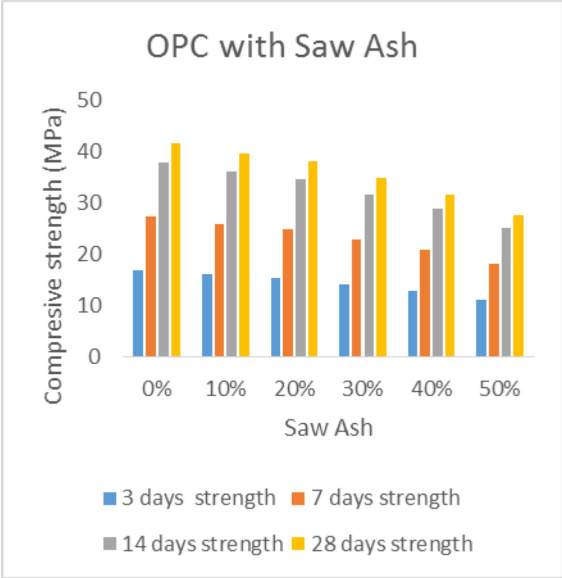


Figure 2. Compressive strength of OPC with Saw Ash for different curing days

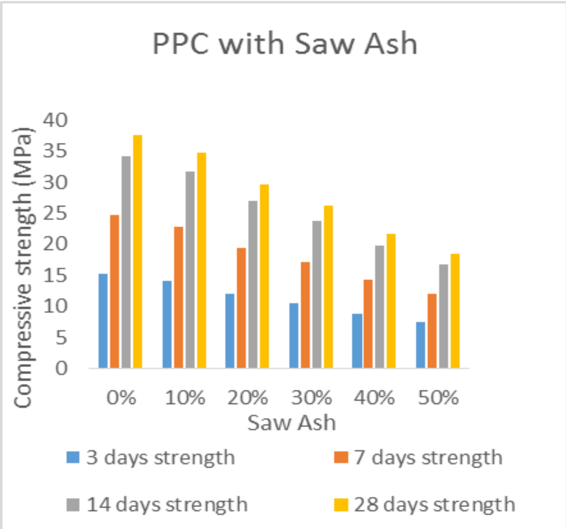


Figure 3. Compressive strength of PPC with Saw Ash for different curing days

B. Flexural strength

As per Indian standard the specimen size is fixed as 150mm width, 150mm depth and 700 mm length to determine flexural strength of mix proportion. The test specimen is placed in loading frame and a constant load of 400 kg/min is applied as per Indian standard. Loading rate can be calculated as per ASTM standard are given below,

$$r = \frac{Sbd^2}{L}$$

Where, r= loading rate, S= rate of increase of extreme fiber, b=average specimen width, d= average specimen depth, L= span length.

Figure 5 & 6, shows the test results of 3, 7, 14, 28 days compressive strength for OPC & PPC with different proportions of Saw ash.

Where, r= loading rate, S= rate of increase of extreme fiber, b=average specimen width, d= average specimen depth, L= span length.

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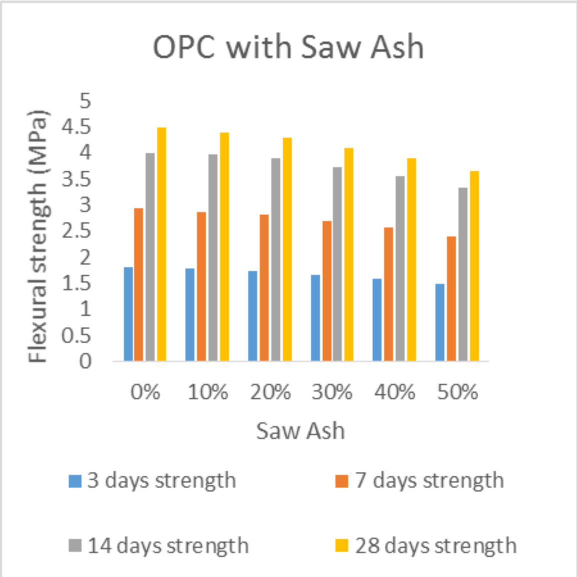

Figure 4. Flexural strength of OPC with Saw Ash for different curing days

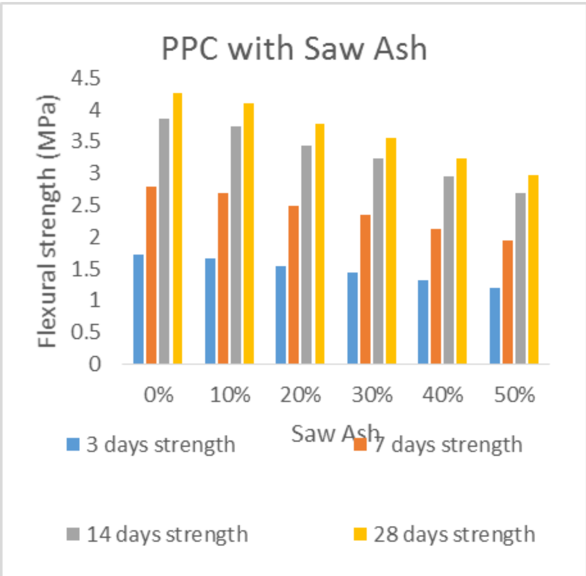

Figure 5. Flexural strength of PPC with Saw Ash for different curing days.

C. Split Tensile Strength

As per Indian standard 5816 1999, splitting tensile strength is determined. The test specimen is casted and tested at different ages, after curing the specimen is placed in the compression testing machine and a constant load of 0.7 to 1.4 MPa/min is applied to determine the splitting tensile strength of the specimen. Figure 7 & 8, shows the test results of 3, 7, 14, 28 days compressive strength for OPC & PPC with different proportions of Saw ash.

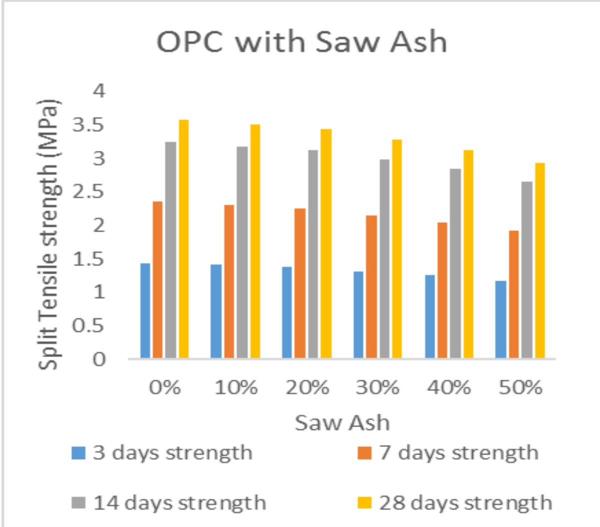

Figure 6. Split Tensile strength of OPC with Saw Ash for different curing days

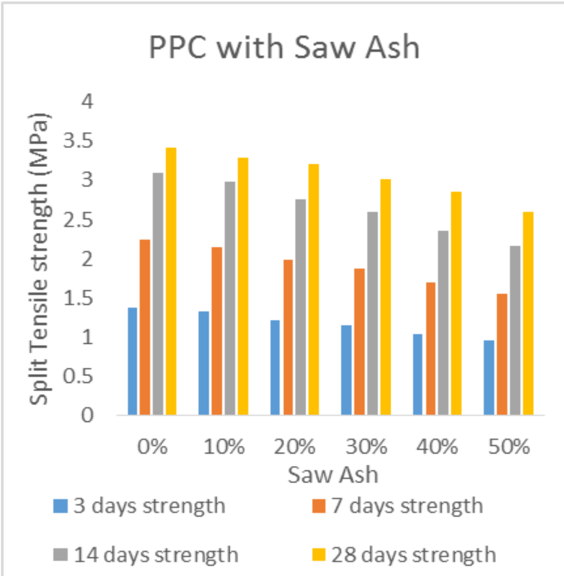

Figure 7. Split Tensile strength of PPC with Saw Ash for different curing days

V. RESULT ANALYSIS

A. Comparison between predicted flexural and splitting tensile strength from experimental compressive strength

Based on several studies splitting tensile strength is an indirect method for finding the Tensile strength of specimens [Akshay]. The relation between the flexural, split tensile and compressive strength are represented in the form of linear equations.

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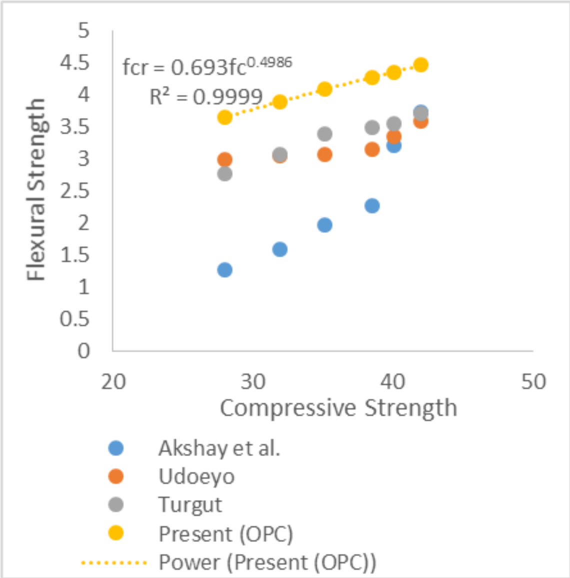

Figure 8. Comparison of predicted Flexural strength values for OPC

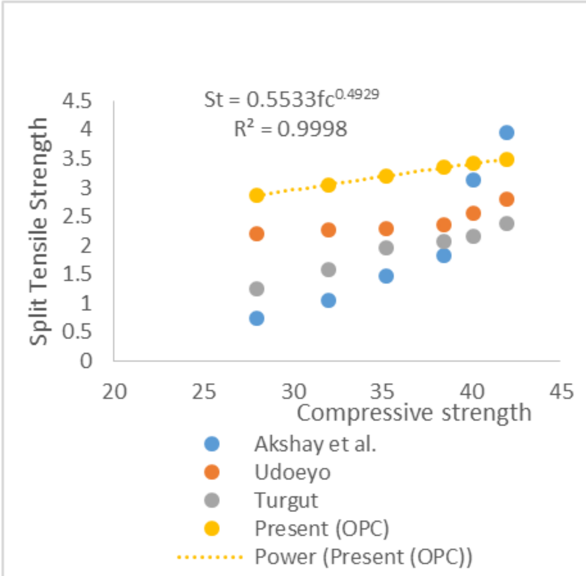

Figure 10. Comparison of predicted Split Tensile strength values for OPC

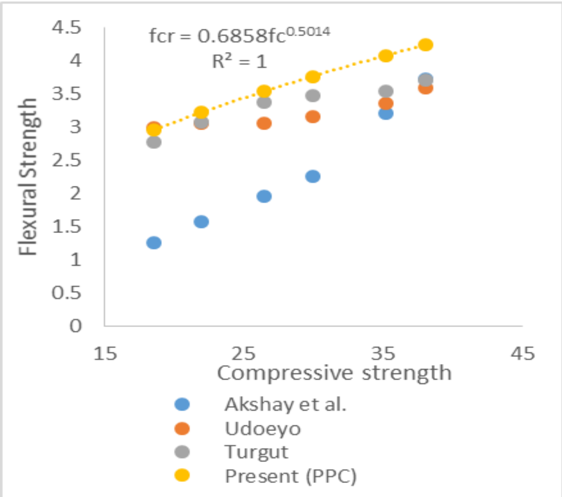

Figure 9. Comparison of predicted Flexural strength values for PPC

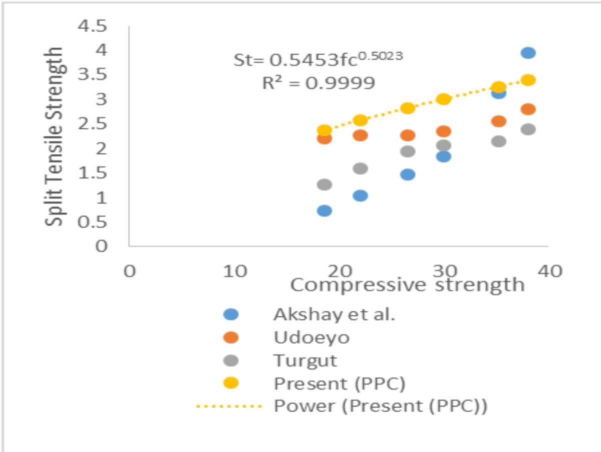

Figure 11. Comparison of predicted Split Tensile strength values for PPC.

Table-III. Predicted Flexural strength for several relationship

Mix	Experimental data				Predicted data				
	Compressive strength (Mpa)		Flexural strength (Mpa)		Akshay et al.	Udoeyo	Turgut	Present (OPC)	Present (PPC)
Saw Ash	OPC	PPC	OPC	PPC	$f_{cr} = 0.43fc^{0.66}$	$f_{cr} = 0.70fc^{0.49}$	$f_{cr} = 1.78fc^{0.23}$	$f_{cr} = 0.69fc^{0.50}$	$f_{cr} = 0.69fc^{0.50}$
0%	42	38	4.53	4.31	3.73	3.6	3.72	4.47	4.25
10%	40.1	35.2	4.43	4.15	3.21	3.36	3.55	4.36	4.09
20%	38.5	30	4.34	3.83	2.27	3.16	3.49	4.28	3.77
30%	35.2	26.5	4.15	3.6	1.97	3.07	3.39	4.09	3.55
40%	32	22	3.95	3.28	1.58	3.06	3.08	3.9	3.23
50%	28	18.6	3.7	3.01	1.26	3	2.78	3.65	2.97

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Table-IV. Predicted Split Tensile strength for several relationship

Mix	Experimental data				Predicted data				
	Compressive strength (Mpa)		Split Tensile strength (Mpa)		Akshay et al.	Udoeyo	Turgut	Present (OPC)	Present (PPC)
Saw Ash	OPC	PPC	OPC	PPC	$S_t = 0.14fc^{1.02}$	$S_t = 0.32fc^{0.65}$	$S_t = 0.48fc^{0.50}$	$S_t = 0.56fc^{0.49}$	$S_t = 0.55fc^{0.50}$
0%	42	38	3.62	3.45	3.95	2.81	2.39	3.49	3.39
10%	40.1	35.2	3.54	3.32	3.13	2.56	2.15	3.41	3.26
20%	38.5	30	3.47	3.06	1.83	2.36	2.07	3.35	3.01
30%	35.2	26.5	3.32	2.88	1.47	2.28	1.95	3.2	2.83
40%	32	22	3.16	2.62	1.05	2.26	1.59	3.05	2.57
50%	28	18.6	2.96	2.41	0.74	2.2	1.26	2.86	2.37

VI. CONCLUSION

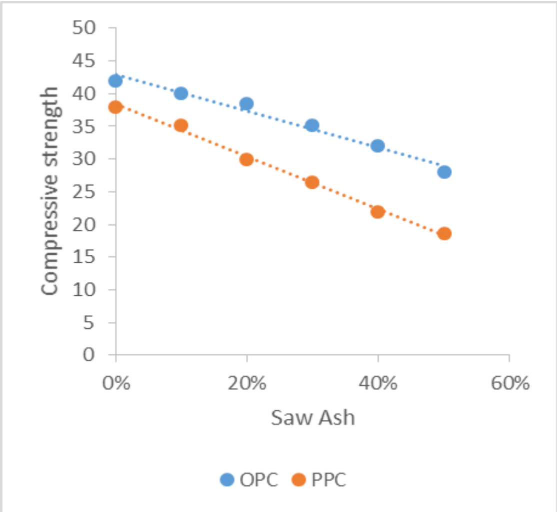

Figure 12. Compressive strength with different ash proportions

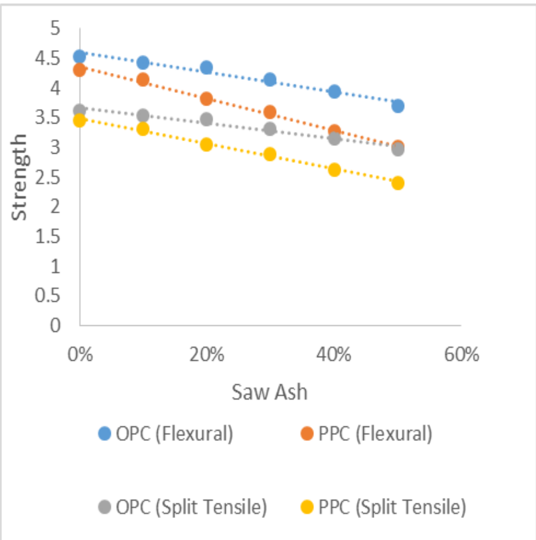

Figure 13. Strength with different proportions of Ash

From the results of chemical analysis it is found that silicon dioxide is major element present in the ash of 45.5% and next major element is Iron oxide of 12.25%, it clearly shows that this ash can be used as replacement of ordinary Portland cement and this cannot be used as substitute for Portland pozalona cement.

Setting time of OPC & PPC with different ash proportions were tested and it shows that 10% of saw ash in both OPC & PPC shows similar results of conventional samples, increase in ash percentage increase in both initial and final setting time of samples.

The compressive strength of both ordinary Portland cement and Portland pozalona cement shows the similar results with different proportions of Saw ash, figure 12 shows that with increase in percentage of saw ash decrease in compressive strength.

Similarly, the flexural and split tensile strength has the same behavior of compressive strength, increase in percentage of ash results in decrease in strength as shown in figure 13.

Both the OPC & PPC shows the similar results with different proportions of Saw ash. Percentage of saw ash should be limited as in the range of 10 to 20% shows optimum results. Saw ash can be replaced for binder as well as the fine aggregate.

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We declare that this current research is not considered or published previously.

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AUTHORS PROFILE

Dona Renjith, currently doing Masters program in the Civil Engineering Department at Sri Krishna College of Technology, Coimbatore, Tamil Nadu, India. Completed Higher Secondary in the year of 2014 and joined as under graduate student in the Department of Civil Engineering at Mar Ephaream college of Engineering and Technology. Completed my under graduate degree in the year of 2018. Also received certificate issued by Robo Species Technology Private Limited an association with Sportech 15, 117 - Delhi and accredited by International Accreditation Organisation, Houston, U.S.A and received certificate issued by Kerala Highway Research Institute for doing project work based on the study on Influence of Additives on the Draindown Characteristics of SMA (Stone Matrix Asphalt). Patents filled and published in IPR Journal during the year of 2019, **first**. Utilization of Arecaceae plant family fibers to increase the strength property, Published in IPR journal. **Second**. Application of engineering fiber wires to increase strength properties, published in IPR journal. **Third**. Use of waste plastics in the production of engineered fiber wires, published in IPR journal. BE project – Study on influence of Additives on the Draindown Characteristics of SMA (stone Matrix Asphalt). ME Project - Phase 1 - Experimental Check on Physical and Mechanical Properties of Saw Blocks

Balamurali.K, Currently studying as a Post Graduate student in the Civil Engineering Department at Sri Krishna College of Technology. Completed higher secondary in the year of 2014, and joined as under graduate student in the Department of civil engineering at Karunya University. Completed my under graduate degree in the year of 2018. And also I have completed Business English certification, Revit and Primavera certified courses, Attended National Level Workshop on “FOUNDATION ENGINEERING” in KARUNYA Institute of Technology, Coimbatore. Student Representative during Pre Final year, Attended Workshop on NON DISTRUCTIVE TESTING in KARUNYA University, Coimbatore. Presented paper in international conference, 8^{th} International conference on Engineering and Advancement in Technology, organized by IEEE, March 2018, Presented paper in international conference, Advances in Renewable Energy and Green Technology, organized by Co_2 Research and Green Technology Centre, VIT, August 2019. Publications: 1. “Usage of Agricultural waste in concrete to improve Mechanical Properties of concrete” in International journal of Trend in Research and Development. 2. “Utilization of waste plastic in Concrete” in International Research Journal of Engineering and Technology. 3. “Trial Examination of eco benevolent, vitality sparing and minimal effort protected material board from reused paper squander” in International Journal of Engineering Applied Sciences and Technology. BE Project - Comparative Analysis and Design of Low Cost Residential Building using Conventional and Light Weight Materials. ME Project- Phase I- Trial Examination of Synthetic polymer as shear reinforcement. Patents: 1. Utilization of Arecaceae plant family fibers to Increase the Strength Property, Published in IPR Journal. 2. Utilization of Igneous rock slag in the Manufacturing of Sintered Structural panel, Published in IPR Journal.

Padmanaban.I, Currently working as Professor and Head of Civil Engineering Department at Sri Krishna College of Technology from October 2015 to till date ¬ Professor and Head of Civil Engineering Department at Jansons Institute of Technology from December 2010 to October 2015(5 years) ¬ Worked as Senior Lecturer in Civil Engineering Department at V.L.B Janakiammal College of Engineering and Technology(from July 2007 to December 2010, (3years) ¬ Worked as Lecturer in Civil Engineering Department at Kumaraguru College of Technology, Coimbatore (from May 2006 to June 2007 for a period of 1 year) ¬ Teaching Research Associate in Govt. Engg. College, Salem from April 2002 to April 2006 (acquired teaching and research experience for a period of 4 years) ¬ Experience in Developing High Volume Fly ash Concrete Mix Design of High Performance Characteristics ¬ Testing and consultancy experience in Soil Engineering and concrete mix design ¬ Introduced First of its kind Experiential Learning in Civil Curriculum starting from first year ¬ MOU collaboration with 12 of established construction Industries ¬ Projects evaluated by Industrial Experts. CONTRIBUTION TO THE DEPARTMENT ¬ Convener for the International conference on Frontline areas of Civil Engineering. 5-6 Jan 2018 at Sri Krishna college of Technology sponsored by AICTE ¬ Convener for the Industrial Aspects of Cold Formed Steel Structures ", April 6, 2017. sponsored by CSIR ¬ Motivated our Civil Engineering faculty to obtain research funding under DST SERB, DRDO,MOES,CSIR, ICMR to a tune of 35 lak ¬ Co-ordinatior for Faculty Development Programme on “CE2302 Structural Analysis –I” from 11th to 17 June 2013 at Jansons Institute of Technology ¬ Convener for the National conference NCONET’14 for Civil Engineering Department at Jansons Institute of Technology ¬ Convener for the National conference NCONET’13 for Civil Engineering Department at Jansons Institute of Technology.

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