

EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF FINE AGGREGATE WITH REED PLANT ASH

Submitted in partial fulfillment of the requirements for the award of Bachelor of
engineering degree in civil engineering

By

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DEPARTMENT OF CIVIL ENGINEERING

SCHOOL OF BUILDING AND ENVIRONMENTAL

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **PREETHI SALOMI J (Reg.No.37200056)** and **SAKTHIMARI S (Reg.No.37200064)**. Who carried out the project entitled "**EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF FINE AGGREGATE WITH REED PLANT ASH.**" under our supervision from December 2020 to April 2021.

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DECLARATION

We **PREETHI SALOMI.J (37200056)** and **SAKTHIMARI.S (37200064)** hereby declare that the project report entitled “**EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF FINE AGGREGATE WITH REED PLANT ASH.**” done by us under the guidance of **Ms. P. Eshanthini M.E.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Civil Engineering

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ABSTRACT

Reed plant (biological name: *Desmostachya bipinnata*) is an aggressive plant species with remarkable reproduction ability that allows it to grow more in less duration. High demand for natural resources, because of fast urbanization and therefore the disposal drawback developed opportunities to be used of this reed plant ash for construction. This study is about finding the new natural material to replace fine aggregate as it is a chief material used for getting ready mortar, concrete and plays a significant role within the combine style. The application of reed plant ash to partially replace the fine aggregate by 0%,5%,10%, and 15% in concrete mix for curing ages of 7,14, and 28 days was investigated and also the mechanical properties (compression test, split tensile test) were analyzed

From this study, it is clear that utilization of reed plant ash in concrete mix offers a solution to the problem that arises from the accumulation of the excessive aggressive species in the site.

Keywords: reed plant ash, fine aggregate, concrete, compression test, and split tensile test.

TABLE OF CONTENT

CHAPTER. No.	TITLE	PAGE. No.
	ABSTRACT	V
	LIST OF FIGURES	VIII
	LIST OF TABLES	IX
	LIST OF SYMBOLS AND ABBREVIATION	X
1	INTRODUCTION	1
	1.1 General	1
2	LITERATURE STUDY AND METHODOLOGY	2
	2.1 Literature Review	2
	2.2 Methodology	5
3	AIM AND SCOPE	6
	3.1 Aim	6
	3.2 Objective	6
	3.3 Scope	6
4	EXPERIMENTAL TESTING	7
	4.1 Materials Used	7
	4.1.1 cement	7
	4.1.2 Fine Aggregate	8
	4.1.3 Coarse Aggregate	8
	4.1.4 Reed plant Ash	9
	4.2 Test on properties of material	10
	4.2.1 Properties of Cement	10
	4.2.1.1 Specific gravity of Cement	10
	4.2.1.2 Consistency of Cement	11
	4.2.1.3 Setting Time of Cement	12
	4.2.2 Properties of Fine Aggregate	13

4.2.2.1	Specific gravity Fine Aggregate	13
4.2.2.2	Fineness modulus of Fine Aggregate	14
4.2.3	Properties of Coarse Aggregate	15
4.2.3.1	Specific gravity of Coarse Aggregate	16
4.2.3.2	Fineness modulus of Coarse Aggregate	17
4.2.4	Properties of Reed Plant Ash	18
4.2.4.1	Specific gravity of Reed Plant Ash	19
4.2.4.2	Fineness modulus of Reed Plant Ash	20
4.3	Mixed Design	21
4.4	Test on Fresh Concrete	22
4.4.1	Slump Test	22
4.5	Preparation of specimens	23
4.6	Curing for 7, 14 and 28 days	25
5	RESULTS AND DISCUSSION	26
5.1	Test on Hardened concrete	26
5.1.1	Compression test	26
5.1.2	Split Tensile Strength test	28
6	CONCLUSION	30
	REFERENCE	31
	APPENDIX A	33
	APPENDIX B	34

LIST OF FIGURES

FIG. No.	TITLE	PAGE. No.
2.1	Methodology	5
4.1	Cement	7
4.2	M – sand	8
4.3	Coarse Aggregate	8
4.4	Fresh Reed Plant	9
4.5	Air Dried Reed Plant	9
4.6	Reed Plant Ash	9
4.7	Specific Gravity Test For Cement	10
4.8	Consistency Test Of Cement	11
4.9	Initial And Final Setting Time Of Cement	12
4.10	Specific Gravity Test For Fine Aggregate	13
4.11	Finding Fineness Modulus Of Fine Aggregate	14
4.12	Specific Gravity Of Coarse Aggregate	16
4.13	Fineness Modulus Test For Coarse Aggregate	17
4.14	Specific Gravity Of Reed Plant Ash	19
4.15	Fineness Modulus Of Reed Plant Ash	20
4.16	Slump Test For Concrete Mix	22
4.17	Slump Value Plotted In Graph	22
4.18	Concrete Mixes	23
4.19	Casting Of Concrete Mixes	24
4.20	Curing	25
5.1	Compression Test on Cube	27
5.2	Bar Chart Showing Compression Strength Value	27
5.3	Split Tensile Strength on Cylinder	28
5.4	Bar Chart Showing Split Tensile Strength value	29

LIST OF TABLES

TABLE. No.	TITLE	PAGE. No.
4.1	Physical Properties of Cement	10
4.2	Specific gravity of cement observation	11
4.3	Cement consistency	12
4.4	Physical properties of fine Aggregate	13
4.5	Specific gravity of fine aggregate observation	14
4.6	Fineness modulus of fine aggregate	15
4.7	Physical properties of coarse aggregate	15
4.8	Specific Gravity of coarse aggregate	16
4.9	Fineness modulus of coarse aggregate	17
4.10	Physical properties of Reed plant ash	18
4.11	Chemical properties of Reed plant ash	18
4.12	Specific gravity of Reed plant ash	19
4.13	Fineness Modulus Test For Reed plant ash	20
4.14	Mixed proportion	21
5.1	Compression strength test results	27
5.2	Split tensile strength test results	29

LIST OF SYMBOLS AND ABBREVIATIONS

ACRONYMS

Kg

%

°C

N

Mm

>

<

W

μm

m²

m³

W/C

RPA

EXPANSIONS

Kilograms

Percentage

Degree Celsius

Newton

Millimeter

Greater than

Lesser than

Weight Micrometer

Meter square

Meter cube

Water cement

ratio Reed plant

ash

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Reed plant is a cane-like tall grass that forms large clumps in wetland such as marshes, swamps, also along the sides of streams, lakes, and ponds. It is a species from the family of Poaceae. It is very fast growing with a vigorous root stack that can be 10 meters long. The plant has an extensive uses in medicine, food, biomass, thatch, etc.

Reed plant is native to India; it becomes naturalised and tend to spread in many warm-temperature regions of the World, and it thrives in temperature between 30-35°C. Reed plant can pose an extreme threat to riparian areas by displacing it native species and creating a large stand that poses a conflagration threat and it conjointly disturbs the flow of the stream.

Concrete consist of cement, coarse aggregate, fine aggregate and requisite quantity of water. The demand for M sand is increasing due to rapid growth of construction. In this study, reed plant ash used as a partial replacement for fine aggregate to examine the basic strength properties of reed ash concrete mix for the protection of natural resources in construction work.

CHAPTER 2

LITERATURE STUDY AND METHODOLOGY

2.1 LITERATURE REVIEW

Jatin Srivastava, Ram Naraian, and Swinder J.S. Kalra

They have concluded that common reed plant is most prolific perennial plant species, with well-established arrangement and no clearly defined confines. Many harsh weather conditions, such as extreme cool or extreme hot, as well as dryness or dankness, have been adapted by the grass despite a few environmental drawbacks, such as invasiveness scientist are have demonstrated its potential to restore the consistency of environmental matrices. Apart from commercial uses. it is also environmental species.

Marwa dabaieh and Mamdouh sakr (November 2015)

This research work is to study the properties of a common reed plant and to construct a traditional low carbon building. It offers a cheap and low technology building that can be constructed as both temporary and permanent shelter

Ibrahim, A. S. AL-Jumaily, Nahla Naji, and Qays Kareem (March 2015)

This experiment is to investigate the reaction of concrete when pozzolanic material added to it. This concludes that pozzolanic properties form cementitious compounds, calcium hydroxide in the presences of water, which fills pores existing between the cement grains forms a dense structure. As a result, the strength and durability of the concrete improves

Velu saraswathy, Han Seung Lee, Subbiah karthick, Hyun- Min Yang, and Seung-Jun Kwon (October 2017)

The report is about the comparison between the type of cement. The use of blended cements has no effects on mechanical properties, but it significantly improves corrosion resistance. The values of good porosity and coefficient of water absorption were in the following decreasing order OPC> PPC> PSC. concrete had the fewest pores and the lowest coefficient of water absorption by giving lowest free chloride, minimum current flow and lower corrosion rate, PSC concrete were found to have better corrosion resistance properties, and thus the time took for crack initiations was increase in the stimulate impressed voltage approach.

Abdul Aziz, and Rama krishnaiah.A,

The M25 grade mix design of concrete is studied in this report. It is important to the concrete strength which is determined by number of factors, including the amount of water used in the mix, and the grade of concrete chosen. Practically each and every materials property is studied and its workability is checked. Addition of admixture as well as increasing aggregate content and reducing the water results in improve in compression strength value while selection of mix design it is important to see it meets requirement od Indian standard code book

Zainab Z Ismail and Ali J. Jacel,

Here, they have worked with GRF and GRA the effect of giant reed plant on the basic mechanical properties of concrete mixes was found. In this analysis curing time of 7,14, and 28 days were used the compression strength and flextural strength also increased as result of this study. When 7.5 percent of sand by replaced by giant reed, the percentage increased 7.96 and 7.28 respectively. In terms of the climate, the findings indicated that using GRA is a long term solution to the contamination issues that emerges from the accumulation of this species , in meantime changed properties were applied to concrete

Komal Rawarkar, and Dr. Swati Ambedkar,

This report is to show that the workability continues to deteriorate as more time passes between the placement and compaction more the workability of the concrete, the higher the cement- aggregate ratio. This is due to the increased availability of paste, which makes it easier to deal with unagitated concrete; the loss of workability was more noticeable or accurate for agitated concrete. Mixing for 1 hour the unagitated concrete loses its workability faster than the agitated concrete.

Yash Nahata, , T.G. Tank, and Nirav Kholia.

New curing techniques have been developed because of advancements in the building and chemical industries. This paper summarizes results from a literature review and an experimental investigation conducted in accordance with Indian standards to determine the compressive strength of cubes. after 28 days, the impact of different mode of curing compounds on strength, and the compound grade mixes with 1:2.75 here, an attempt has been made to explain the efficiency of curing method used and how they related to traditional water curing. As compared to conventional curing, the results shows that using membrane-curing method will achieve efficiency of 80 to 90 percent.

Ulo Kask, Livia Kask and Link.S,

The ignition properties of reed vary to some put out relying each on the location it grows (coastal area, watercourse delta, lake or soil treatment plant) and climatical. This report presents the outcome of tests on reed properties together with the chemical composition reed and its ash, ash temperature, physical properties like energy, wetness condition, water absorption percentage, color, bulk density, and hot worth.

2.2 methodology

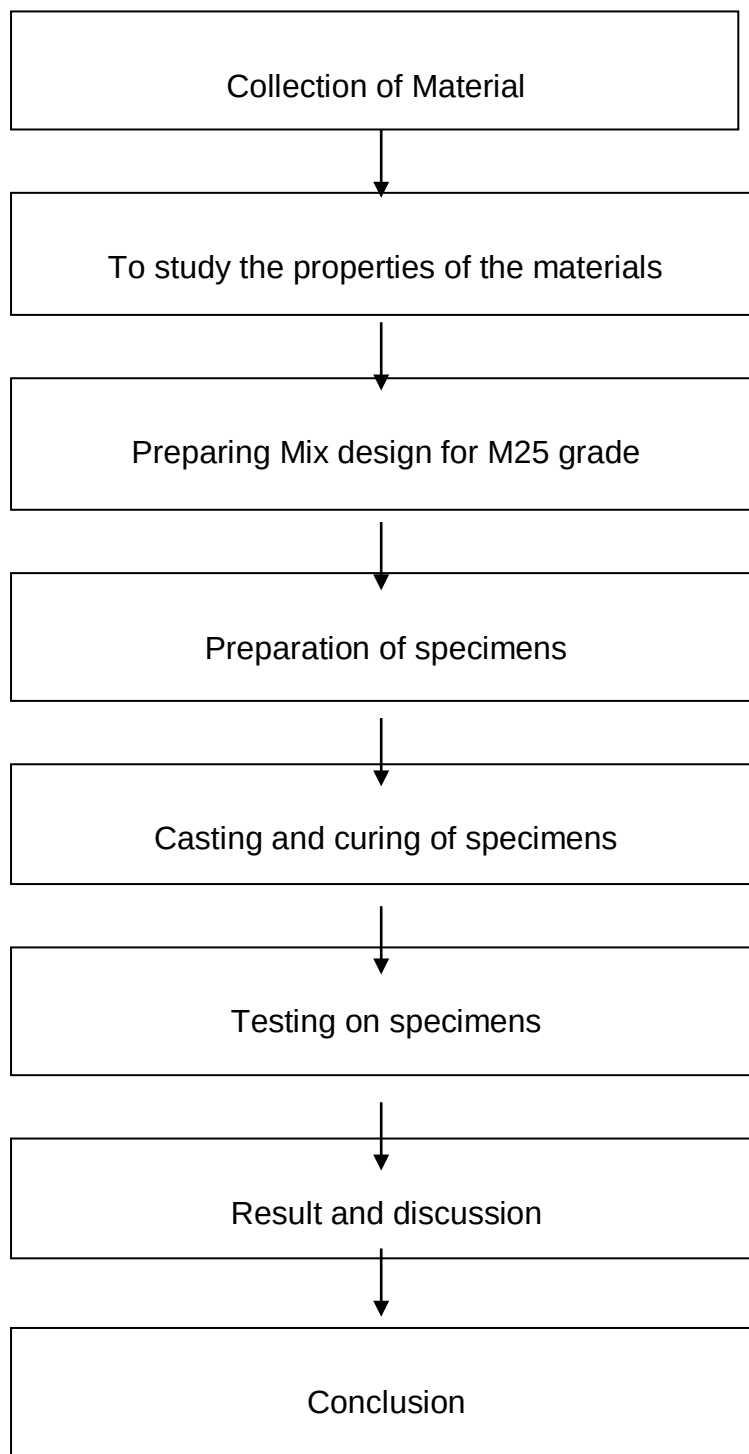


Fig 2.1: Methodology

CHAPTER 3

AIM AND SCOPE

3.1 AIM

The main aim of this project is to create a concrete mixture containing Reed plant ash, which partially replaces fine aggregate, and to find the optimum percentage that gives maximum strength by analyzing its compression and split tensile strength at 28 days.

3.2 OBJECTIVE

1. To study and compare the basic strength properties of the reed ash-concrete mix and standard mix M25.
2. To analyze the utilization of the reed plant ash in concrete mix
3. To cast specified number of cube and cylinder by replacing fine aggregate with reed plant ash by 0%,5%,10%,15%
4. To conduct mechanical strength testing on casted sample at 7th ,14th and 28th days of curing
5. To explore the test result and identify the optimum percentage of reed plant ash to be used.

3.3 SCOPE

1. To provide an alternate light weight material
2. To minimize the maximum demand for M sand
3. To prepare economical concrete
4. Good disposal of waste (reed plant)

CHAPTER 4

EXPERIMENTAL TESTING

4.1 MATERIAL USED

The material used in this experiment is cement, fine aggregate, coarse aggregate, reed plant ash, and a required quantity of water.

4.1.1 CEMENT

Cement is a binding material, combined with sand, gravel, and water to form concrete or mixed with water to form mortar. In this experiment we have used OPC (ordinary Portland cement) 53 grade manufactured by calcareous or other silica, aluminum, or iron oxide, confirming to IS 12269: 2013 was used and its properties were determined.



Fig 4.1: Cement

4.1.2 FINE AGGREGATE

We have used M-sand which is a crushed aggregate from hard granite stone. It has balanced properties can withstand any climatic condition. It has optimum initial and final setting time, excellent fineness which helps the concrete to fill voids, segregation, honeycomb effect, etc

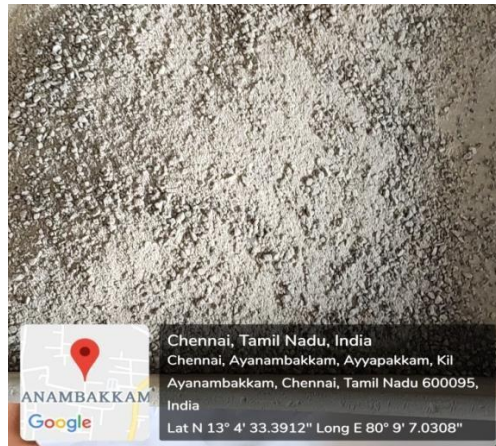


Fig 4.2: M-sand

4.1.3 COARSE AGGREGATE

Coarse aggregate is nothing but gravel or irregular crushed stone obtained naturally from the ground deposit. In this experiment coarse aggregate with a size of 20 mm is used, was angular in shape and its properties were determined.



Fig 4.3: Coarse aggregate

4.1.4 REED PLANT ASH

Reed plant ash was prepared by collecting the fresh plant and allowing it to air-dry for 2 to 3 days and then burn the air-dried reed plant in a furnace at 750°C in order to obtain reed plant ash.



Fig 4.4: Fresh Reed plant ash



Fig 4.5: Air-dried Reed plant ash



Fig 4.6: Reed plant ash

4.2 TEST ON PROPERTIES OF MATERIAL

4.2.1 PROPERTIES OF CEMENT

Table 4.1: Physical properties Of Cement

PHYSICAL PROPERTIES		OPC 53 GRADE RESULT	REQUIREMENTS AS PER CODE BOOK IS 12269 (2013)
Fineness (m ² /Kg)		290	>225
Consistency (%)		29	30
Specific gravity		3.15	3.15
Setting Time (min)	Initial	90	>30
	Final	262	<600
Compression strength test at 28 days		58.2	>53

4.2.1.1 SPECIFIC GRAVITY OF CEMENT



Fig 4.7: Specific gravity test for cement

Table 4.2: Specific gravity of cement observation

OBSERVATION	TRIAL 1	TRIAL 2	MEAN VALUE
Empty weight of flask (w1)	0.122	0.122	0.122
Weight of flask+ Cement (w2)	0.172	0.173	0.173
Weight of kerosene +Cement (w4)	0.374	0.376	0.375
Weight of kerosene +Flask (w4)	0.330	0.332	0.331

Table 4.2 shows that the specific gravity of the cement is 3.15

4.2.1.2 CONSISTENCY OF CEMENT



Fig 4.8: Consistency of cement test

Table 4.3: Cement consistency of cement observation

PERCENTAGE OF WATER	HEIGHT OF THE PLUNGER IN mm
26%	30
27%	23
28%	15
29%	5
30%	2

From Table 4.3: The consistency of given cement paste is 29%

4.2.1.3 SETTING TIME OF CEMENT



Fig 4.9: Initial and final setting time of cement

The initial setting time of given cement is 90 min

The final setting time of given cement is 262 min

4.2.2 PROPERTIES OF FINE AGGREGATE

Table 4.4: physical properties of fine aggregate

PHYSICAL PROPERTIES		RESULTS
Specific gravity		2.62
Water absorption (%)		2.65
Bulk density (Kg/m ³)	Loose	1637
	Rodded	1920
Fineness modulus (%)		2.66

4.2.2.1 SPECIFIC GRAVITY OF FINE AGGREGATE



Fig 4.10: Specific gravity test for fine aggregate

Table 4.5: Specific gravity of fine aggregate observation

OBSERVATION	TRIAL 1 (Kg)	TRIAL 2 (Kg)	MEAN VALUE
Empty weight of pycnometer (A)	0.670	0.670	0.670
Weight of pycnometer + Sand(B)	1.323	1.325	1.324
Weight of pycnometer +Sand+ Water (C)	1.852	1.856	1.854
Weight of pycnometer +Water (D)	1.448	1.449	1.449

Table 4.5 Shows specific gravity of fine aggregate we have used in this experiment is 2.62

4.2.2.2 FINENESS MODULUS OF FINE AGGREGATE



Fig 4.11: Finding Fineness modulus of fine aggregate

Table 4.6: Fineness modulus of fine aggregate

SIEVE SIZE	WEIGHT RETAINED	CUMMULATIVE WEIGHT RETAINED	CUMMULATIVE %OF WEIGHT RETAINED	CUMMULATIVE WEIGHT % PASSING
4.75 mm	0	0	0	100
2.36 mm	24	24	4.8	95.2
1.18 mm	176	152	35.2	64.8
600 µm	287	111	57.4	42.6
300 µm	383	96	76.6	23.4
150 µm	463	80	92.6	7.4
Pan	500	37	100	0

From table 4.6, using the obtained value fineness modulus of fine aggregate is 2.66%

FORMULA

$$\text{Fineness modulus of Fine Aggregate} = \frac{\text{cumulative \% of Wt retained}}{100}$$

4.2.3 PROPERTIES OF COARSE AGGREGATE

Table 4.7: Physical properties of coarse aggregate

PHYSICAL PROPERTIES		RESULTS
Specific gravity		2.76
Water absorption (%)		0.33
Bulk density (Kg/m ³)	Loose	1429.3
	Rodded	1652
Fineness modulus (%)		6.003

4.2.3.1 SPECIFIC GRAVITY OF COARSE AGGREGATE

Table 4.8: Specific gravity of coarse aggregate observation

OBSERVATION	TRIAL 1 (Kg)	TRIAL 2 (Kg)	MEAN VALUE
Empty weight of pycnometer (A)	0.670	0.670	0.670
Weight of pycnometer+ coarse aggregate(B)	1.326	1.325	1.325
Weight of pycnometer+ coarse aggregate+ Water (C)	1.837	1.836	1.866
Weight of pycnometer + Water (D)	1.448	1.449	1.448

Table 4.8 Shows specific gravity of coarse aggregate we have used in this experiment is 2.76



Fig 4.12: specific gravity of coarse aggregate

4.2.3.2 FINENESS MODULUS OF COARSE AGGREGATE



Fig 4.13: Fineness modulus test for coarse aggregate

Table 4.9: Fineness modulus of coarse aggregate observation

SIEVE SIZE	WEIGHT RETAINED	CUMMULATIVE WEIGHT RETAINED	CUMMULATIVE %OF WEIGHT RETAINED	CUMMULATIVE WEIGHT % PASSING
80 mm	0	0	0	100
40 mm	2.002	2.002	40.04	59.96
20 mm	1.913	3.915	78.30	21.7
10 mm	0.852	4.767	95.53	4.47
4.75 mm	0.100	4.831	96.62	3.38
2.36 mm	0	4.831	96.62	3.38
1.18 mm	0	4.831	96.62	3.38
600 μm	0	4.831	96.62	3.38
Pan	0.133	5.00	100	0

FROM TABLE 4.9, using the obtained value fineness modulus of coarse aggregate is 6.003%

FORMULA

$$\text{Fineness modulus of coarse aggregate} = \frac{\text{cumulative \% of Wt retained}}{100}$$

4.2.4 PROPERTIES OF REED PLANT ASH

Table 4.10: Physical properties of Reed Plant Ash

PHYSICAL PROPERTIES	RESULTS
Specific gravity	1.98
Water absorption (%)	4.85
Fineness (%)	2.66
Maximum gradation (mm)	2.36
Density (Kg/m ³)	1275

Table 4.11 Chemical properties of Reed plant ash

CHEMICAL COMPONENTS	RESULTS
SiO ₂	37.1
Al ₂ O ₃	0.6
Fe ₂ O ₃	0.7
CaO	6.8
MgO	3.3
Na ₂ O	3.6

4.2.4.1 SPECIFIC GRAVITY OF REED PLANT ASH

Table 4.12 specific gravity of reed plant ash observation.

OBSERVATION	TRIAL 1 (Kg)	TRIAL 2 (Kg)	MEAN VALUE
Empty weight of pycnometer (A)	0.670	0.671	0.670
Weight of pycnometer +RPA(B)	0.775	0.776	0.775
Weight of pycnometer+ RPA +Water (C)	1.462	1.464	1.462
Weight of pycnometer +Water (D)	1.408	1.412	1.410

Table 4.12 Shows specific gravity of coarse aggregate we have used in this experiment is 1.98



Fig 4.14: Specific gravity of Reed plant ash

4.1.1.1 FINENESS MODULUS OF REED PLANT ASH



Fig 4.15: Fineness modulus of Reed plant ash

Table 4.13: Fineness modulus of Reed plant ash

SIEVE SIZE	WEIGHT RETAINED	CUMMULATIVE WEIGHT RETAINED	CUMMULATIVE %OF WEIGHT RETAINED	CUMMULATIVE WEIGHT PASSING %
4.75 mm	0	0	0	100
2.36 mm	23	23	4.6	95.4
1.18 mm	149.9	126.9	25.38	74.62
600 μmm	79.8	70.1	14.02	85.98
300 μmm	307.3	227.5	45.5	54.5
150 μmm	100	207.3	41.46	58.54
Pan	660	560	52	48

From table 4.13, using the obtained value fineness modulus of reed plant ash is 1.31%

FORMULA

$$\text{Fineness modulus of Reed plant ash} = \frac{\text{cumulative \% of Wt retained}}{100}$$

4.3 MIXED DESIGN

In this experiment, the mix proportion is designed for M25 grade for W/C ratio 0.50 respectively by using IS 10262:2009 method of mix design maintaining a constant w/c ratio for control mix and by replacing 0%, 5%, 10%, and 15% of reed plant ash in concrete.

Table 4.14: mixed proportion

MIX DESIGN	CEMENT (Kg)	FINE AGGREGATE (Kg)		COARSE AGGREGATE (Kg)	WATER (L)
		SAND (Kg)	REED PLANT ASH (Kg)		
CC	12.30	26.51	0	32.43	6.12
MIX1	12.30	23.60	2.05	32.43	6.12
MIX2	12.30	21.09	4.11	32.43	6.12
MIX3	12.30	18.23	6.167	32.43	6.12

4.4 TEST ON FRESH CONCRETE

4.4.1 SLUMP TEST



Fig 4.16: Slump test for concrete mix

Slump cone test method is used to determine the workability or consistency of the concrete mix prepared. It is a cone having a top diameter of 10 cm, bottom diameter of 20 cm, and height of 30 cm. For conventional mix the slump value arrived is 125mm. The reed ash concrete mix has less workability compared to the standard mix M25 grade. The increase in RPA decreases the water content in the concrete mixture causes lower slump value. It is due to poor geometry of RPA and the reduction in fineness modulus.

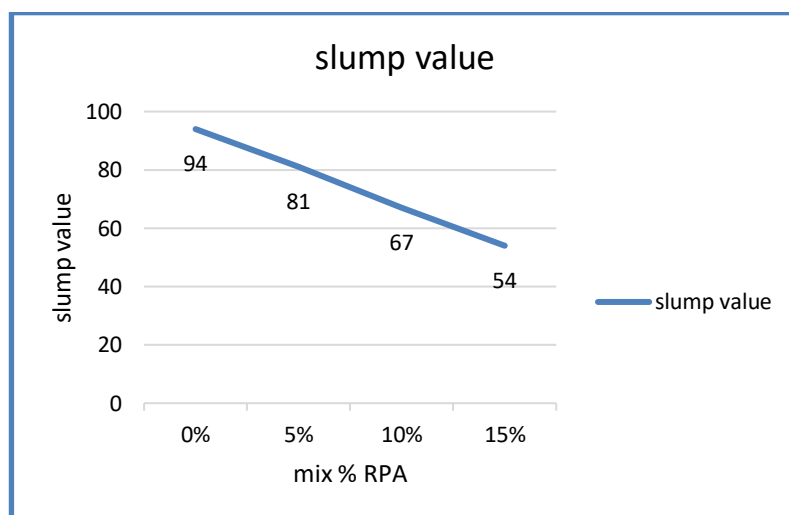


Fig 4.17: Slump value plotted in graph

4.5 PREPARATION OF THE SPECIMENS

The concrete mix is prepared using mixer with respective proportion of replacement then the concrete mix is taken for slump value test after fresh concrete test done the prepared specimen is taken for casting as cube and cylinder for conducting mechanical strength test



Fig 4.18: Concrete mixes

The mould of size 150 X 150 X 150 mm (cube) and 150 X 300 mm (cylinder) are taken initially the mould is cleaned properly and greased. The concrete sample is filled into the mould and compacted with vibrator



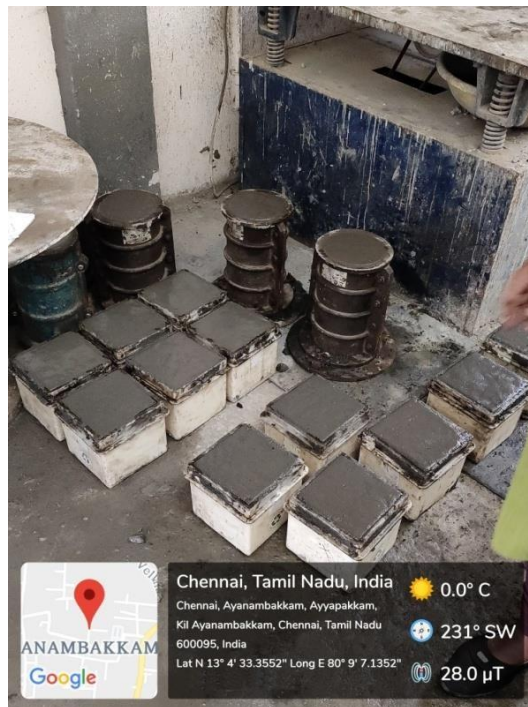


Fig 4.19: Casting of concrete mixes

4.6 CURING FOR 7, 14. AND 28 DAYS

It is process of providing adequate wetness, temperature, and period to enable the concrete to attain the required properties for its intended use.

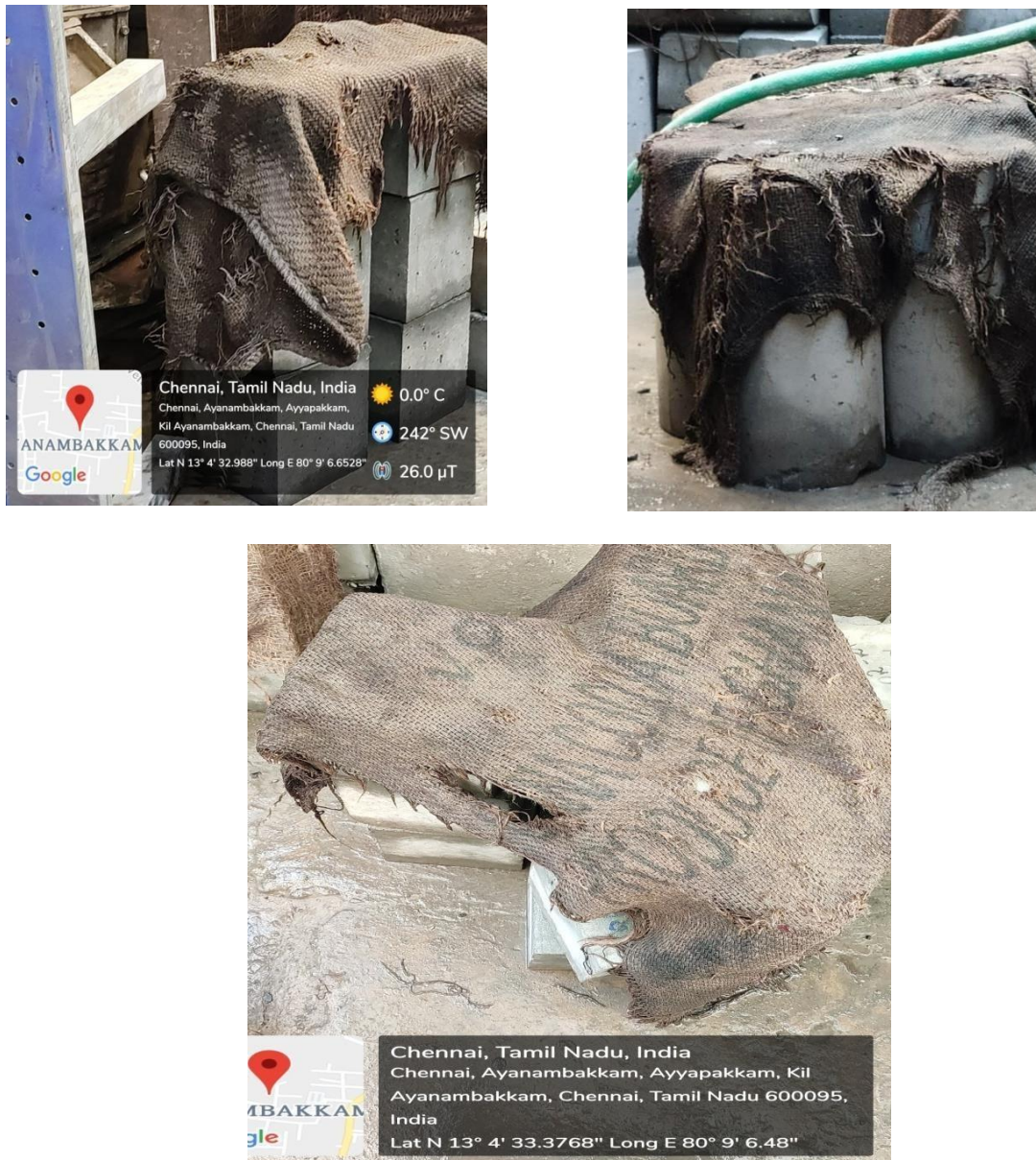


Fig 4.20: Curing

CHAPTER 5

RESULTS AND DISCUSSION

5.1 TEST ON HARDENED CONCRETE

5.1.1 COMPRESSION TEST

The outcome of the compressive strength tests for the reed plant ash concrete mixes are given in Table 4.15. As per the test results, the optimum 28-day compressive strength value of 33.38 N/mm² was acquired for the concrete mix made of 10% reed plant ash, which represents an rise in the compressive strength of up to 13.89% compared to the conventional mixture. The compressive strength increases with the increasing of the RPA content (5% and 10%), and then after that the compressive strength decreased with the increasing of RPA (15%). By increasing the percentage RPA up to 10%, the value show a tendency for compressive strength values of RPA concrete mixes to increase below the simple mixes at each curing. This tendency could result from the pozzolanic action of reed plant ash, and the increasing in cohesive strength between the surface of the RPA and the cement glue. moreover, at early time reed plant ash reacts slowly with calcium hydroxide free through hydration of cement. By addition of the RPA from 10% up to 15%, the result reveals a propensity for compressive strength values of RPA-concrete mixes to improve. However, by adding the proportion of RPA up to 15% only, the compressive strength values falls. This could be due to the fact that raising the material of RPA in the concrete may interfere with the water needed for cement hydration from penetrating through the construction of the cement specimens during the curing period



Fig 5.1: Compression test on cube

Table 5.1: Compression strength test result

MIX % OF REED PLANT ASH	AVERAGE COMPRESSION STRENGTH VALUE (N/mm ²)		
	7 DAYS	14 DAYS	28 DAYS
0%	22.34	24.11	28.74
5%	25.09	27.63	31.78
10%	26.93	29.43	33.03
15%	23.66	25.14	29.18

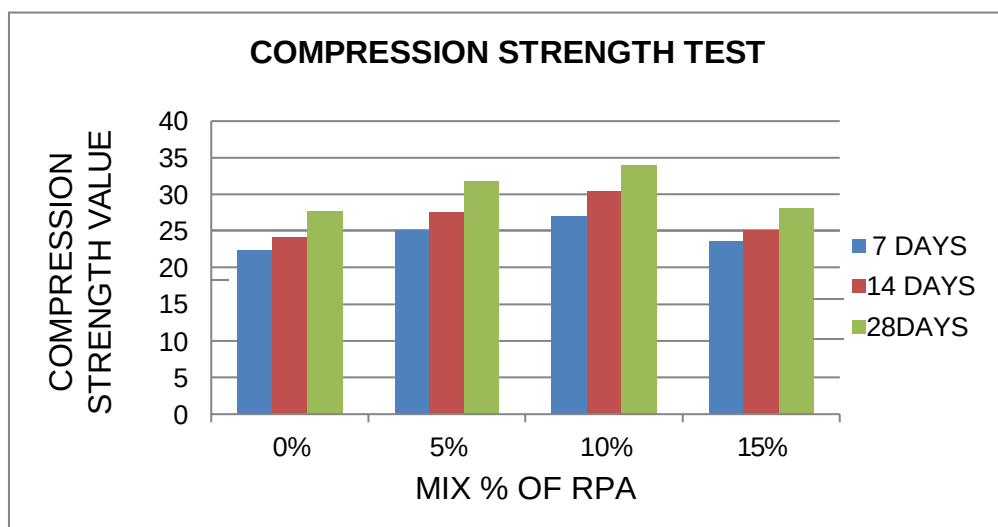


Fig 5.2: Bar chart showing compression strength value

5.1.2 SPLIT TENSILE STRENGTH

The outcome of the split tensile strength tests for the RPA- concrete mixes 0%, 5%, 10%, and 15% are tabulated in table 5.2. As per the test results, the optimum 28- day split tensile strength test value of 4.10 N/mm² was obtained for the concrete mixture made with RPA, which replaced M-sand by 10%, which represents an increase in the split tensile strength of up to 11.8% compared to the conventional mix. The value reveals that the split tensile strength of RPA- concrete mixture at each curing period is prone to fall with the rise of the RPA proportion in these mixes up to 10% ratio, and then the split tensile strength decreased with increasing the proportion of RPA up to 15%. This tendency might be associated with a decrease in adhesive stability between the reed plant ash surfaces and cement glue. Also, the repellent nature of reed plant ash may restrict the hydration of cement.

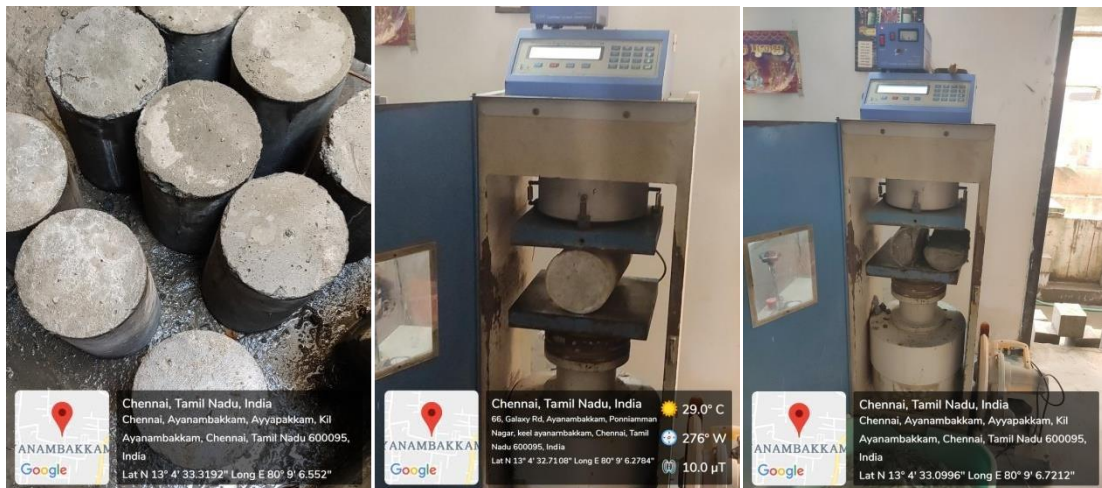


Fig 5.3: Split tensile strength test on cylinder

Table 5.2: Split Tensile Strength test result

MIX % OF REED PLANT ASH	AVERAGE SPLIT TENSILE STRENGTH VALUE (N/mm ²)		
	7 DAYS	14 DAYS	28 DAYS
0%	2.43	2.76	3.64
5%	2.65	3.08	3.82
10%	2.97	3.26	4.10
15%	2.32	2.73	3.58

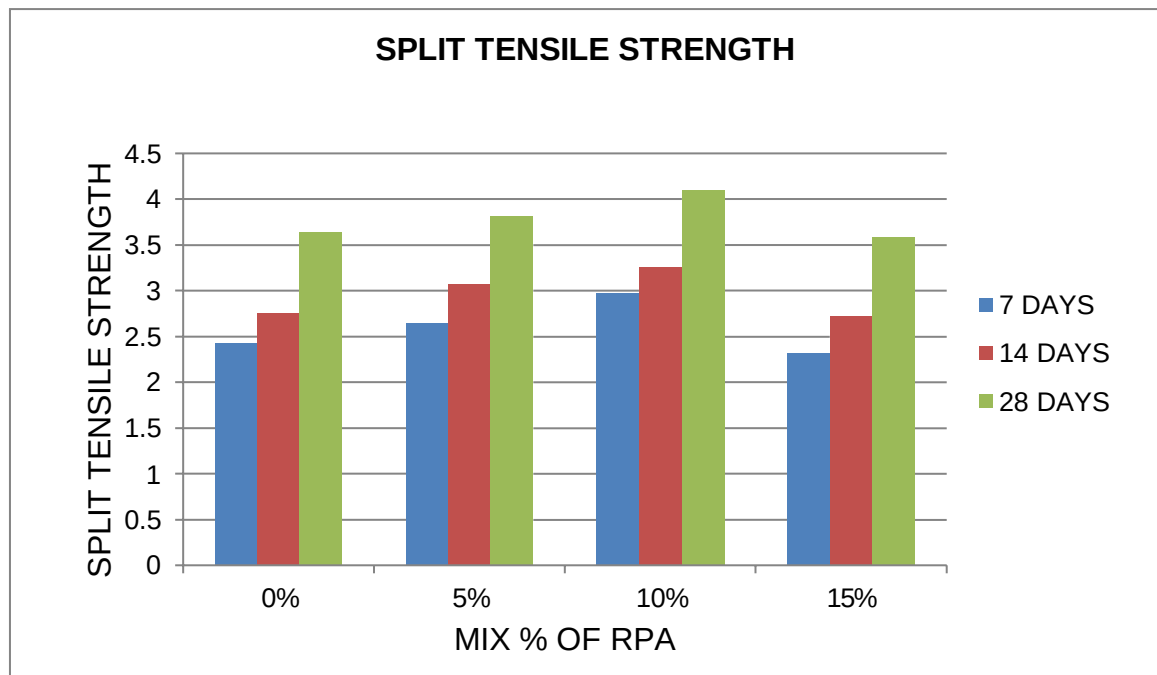


Fig 5.4: Bar chart showing split tensile strength value

CHAPTER 6

CONCLUSION

6.1 CONCLUSION

In this experimental study, the main work is to find an efficient and promising method for use of the unwanted reed plants in concrete. The reed plant ash (RPA) as a partial replacement for fine aggregate had no discernible impact on the color of the concrete. The slump cone test values of RPA concrete decreased as the reed plant ash (RPA) ratio was increased up to 15% this is because as RPA increases the water content in the concrete mixture decreases, resulting in lower slump value. Compressive strength test after 28 days increased 13.89% compared to conventional mix and Split tensile strength after 28 days increased 11.8% as compared to conventional mix. Since increasing, the content of RPA in the concrete may prevent the water needed for cement hydration process from entering the layout of cement, 10 % reed plant ash (RPA) was found to be the optimal ratio that produces the highest values of compressive and split tensile strengths above which the effect falls with increases in reed plant ash. This is because adding the content of RPA in the concrete may impede the water required for cement hydration from entering through the structure of the concrete.

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13-03-2021

Dr. K. Balasubramanian
Managing Director

Project Certificate

This is to certify that Ms. J. Preethi Salomi, Department of Civil Engineering, M/s Sathyabama Institute of Science & Technology, Chennai has undergone her project work in our laboratory in the name of “**Partial Replacement of Fine Aggregate with Reed Plant Ash in Concrete**” under the guidance of our engineers at Hitech Concrete Solutions Chennai Pvt. Ltd., Chennai during the period between February 2021 and March 2021.

For Hitech Concrete Solutions Chennai Pvt. Ltd.,



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