Impact of Partial Replacement of Cement with Rice husk ash and Proportionate Addition of Coconut Fibre on Concrete

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by

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DECLARATION

I, Sahil Sharma (Regd. No. 11511095), hereby declare that this thesis report entitled **"Impact of Partial Replacement of Cement with Rice husk ash and Proportionate Addition of Coconut fibre on Concrete"** submitted in the partial fulfilment of the requirements for the award of degree of Master of Civil Engineering, in the School of Civil Engineering, Lovely Professional University, Phagwara, is my own work. This matter embodied in this report has not been submitted in part or full to any other university or institute for the award of any degree.

Date: **Sahil Sharma**

Place:

CERTIFICATE

Certified that this project report entitled " Impact of Partial Replacement of Cement with Rice husk ash and Proportionate Addition of Coconut fiber on concrete" submitted individually by student of School of Civil Engineering, Lovely Professional University, Phagwara carried out the work under my supervision for the Award of Degree. This report has not been submitted to any other university or institution for the award of any degree.

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ABSTRACT

This study summarizes the impact of partial replacement of cement with rice husk ash and proportionate addition of coir fibre with aggregates for Ordinary Portland cement concrete. Concrete is the most vital construction engineering material and to change the properties of concrete some addition or replacement in the cement has to be done to make the concrete more durable. Due to many research paper it is found that concrete is good in compression but weak in tension and flexural. Rha contain high amount of silica which is harmful for environment. The main purpose of uses coir fibre is resistance to hold cracks and strengthening of concrete. Usage of the waste materials will reduce the effect of waste material on environment. The main objective of the study is to determine the optimum mix level of replacement of Rha in cement and addition of coir fibre with aggregates and to investigate the effect on strength of the concrete by changing of cement with rice husk ash and proportionate addition of coconut fibre.

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LIST OF ABBREVIATIONS

%	Percentage
Mm	Millimetre
Cm	Centimetre
M	Metre
L	Length
Sec	Second
D	Diameter
KN	Kilo newton
Kg	Kilograms
RHA	Rice husk ash
Rha	Rice husk ash

CHAPTER 1

INTRODUCTION

1.1 General

In the construction industry the concrete is most commonly used material for the construction of Building, Roads and Bridges etc. From last many years the many materials are used as replacement or addition in cement to produce the concrete more durable and increased the strength of concrete research find new material to increases the strength of concrete continuous even today. From the studied research paper it is observed that the concrete is good in compression strength and weak in tensile and flexural strength so reinforced bars are used as reinforcement material the use of reinforced steel bars is very costly to make the concrete more durable and strong so we introduced the fiber reinforced concrete material. Fiber reinforced concrete is defined as a complex material made up of Portland cement, aggregates, water and discrete fibers.

Fiber reinforced concrete is resisting the crack that develops in concrete due to loads. It is seen that the fiber reinforced concrete having more strength than the ordinary concrete. Various types of fibers are widely used is steel fiber ,coconut fiber ,synthetic fiber .

1.2 Rice Husk Ash (Rha)

Rha stands for rice husk ash stands, which is a large amount of silicon dioxide (SiO2), importance. Rice husk ash has been around 70 million tons per year. Where rice husk ash surrounded the area to put big risk. Rice is the waste product of rice hush industry. Rice to the burning of rice husk has been developed husk ash. Later, as a substitute for cement with or rice husk that is complementary content and cementanious burning material is used to know. Means using rice husk ash content of rice during construction filtrate. The present time is increased to strengthen the solid waste materials to access updated with new material. To create low-cost new products are in different places with rice husk ash. Husk ash is used to make high performance concrete. Every 1000 kg of rice grain produced 220 kg of Rice husk. Means using rice husk ash content of rice during construction filtrate. To create low-cost new products are in different places with rice husk ash. Husk ash is used to make high performance concrete.

1.2.1 Rice Husk Ash Physical Properties

Table 1.1: Physical Properties

Particulars	Properties
Colour	Grey
Particle Size	<45 microns
Shape texture	Irregular
Odour	Odourless
Appearance	Very Fine
Specific Gravity	2.3

1.2.2 Applications of Rice husk ash

Rice husk ash is produced from rice grain production, but now it is used in a number of excellent products. Due to high amount of silica but cost is less it can used for low cost construction material and mainly used for high performance and high strength concrete. The product is used as a various applications are:

1. Rice husk ash as filler material in the green concrete is used.
2. It is also used in clay finishing.
3. Rice husk ash is used in special oil paints due to high silica content.
4. It is used as high-performance concrete supplementary materials.

1.3 FIBRE

A natural or synthetic fiber material is quite wide. Other ingredients often used in the manufacture of fiber. Strong engineering materials often steel fiber, coconut coir fiber and synthetic fiber for 30 to 40-year-past feature to improve the characteristics strength of concrete. Resist cracks due to loading, and fiber increases the flexibility of materials.

1.3.1 Coconut Fibre Reinforced Concrete

Coconut Fibres and used in the work of the branch of engineering as fiber material was used in one of the construction material in civil engineering. The coconut fibres are also one of the best fibres among all natural fibres which gives high strength. Coconut fibre gives good flexibility, durability so we can have used this as a fibre reinforcement material in the concrete. Coconut fibre is removed from the outer shell of coconut and it's a scientific name and plant family name of the coconut natural fibre is "coir". Two types of coconut fibres are produced one is the brown fibre take out from the matured coconut and another is the white fibre are take out from the immature of coconut. fibre have a many mechanical and physical characteristics they can be used effectively in the reinforced concrete material development .in many cases to coconut fibre is damped as a waste of agricultural .the coconut fibre in large quantity are easily available to make it cheap. Coconut fibre already being low in density so reduces the weight of the fibre reinforced concrete therefore it can be used as a structural light weight concrete and by reinforcing the concrete with coconut fibres which are freely available, we can reduce the environmental waste. Flexural strength increases in when added 3% of fibre in concrete mix. Thus, economy can be achieved in construction.

Fig 1.1: Coconut Fibre

1.3.2. Application of the Coconut Coir Fibre

1. White coir yarn, for the manufacture of rope, and due to the strong Resistance to salt water Fishing nets.
2. Brown Coir is in bags, brushes, mats, rugs, mattresses, insulation and packaging. In Europe the car industry with brown cushions .Coconut connected to the rubber latex.
3. Geotextiles made from coconut mesh (left) are durable; absorb water, resistant to sunlight, Facilitate seed germination and are biodegradable 100%.
4. Used in plaster, roof tiles, slabs, coating system and home construction.

1.4 Scope of the Study

The rice husk ash and coconut fiber, are the industrial and agricultural waste products -industry as a product of Agricultural waste to reduce environmental impact, The concrete grade M 20 is used for research work i.e cement is to be changed (by weight) by rice husk ash and addition of coconut fibre to concrete by 5%, 10%, 15%, 20% and 25% and1% and 2% and 3% respectively, to get optimal results. The various concrete properties like compressive strength, split tensile strength and flexural strength for various mixes is to be examined at a changed proportion of Rice Husk Ash and coconut fibre . And the standard concrete specimens i.e., concrete specimens with no replacement and no addition in cement also would cast out. The results carried out after replacement and addition of cement compared with the standard concrete mix and then best result is taken into considered for practical applications.

1.5 Objective of the Study

In my investigation work is study the characteristics strength of concrete M20 grade for different percentage replacement of cement with rice husk ash with addition of coconut fibre.

The main objective for project is: -

1. To investigate the effect on compressive strength of concrete by changing of cement with rice husk ash and addition of coconut fibre for different percentages and to find the optimal quantity.
2. To investigate the effect on tensile strength of concrete by changing of cement with Rice husk ash and addition of coconut fibre for different percentages and to find the optimal quantity of Rha Concrete
3. The objective of the study was determined and compare the difference in strength of concrete Contain Rha and fibre and normal concrete. This investigation was carried out using several tests, compressive test and Split Tensile test.
4. To produce the economical construction materials.
5. To produce alternative light weight material.
6. To reduce the effect on environment due to industrial and agricultural waste materials.

CHAPTER 2

LITERATURE REVIEW

2.1 Compressive Strength:

Ramakrishnan S et al. (2014) Studying the pavement concrete performance on limited changed percentage mix of M40 grade concrete growth rice hush ash cement control weight. Change the cement with limited rice husk ash at 0%, 5%, 10%, 15%, 20% and 25% with M40 grade concrete mix for concrete pavement.

Table 2.1: Mix percentage (Ramakrishnan S et al., 2014)

Mix	Cement	Sand	C.A	Water
Ratio	1	1.632	2.353	0.40
Quantity	442 Kg/m^3	734.9 Kg/m^3	1048.53 Kg/m^3	176.5 Kg/m^3

The most significant and useful properties of concrete is its compressive strength. In the structure applications concrete is mostly used to hold the compressive stress. The concrete specimen changed with RHA at 0%, 5%, 10%, 15%, 20% and 25% for calculated compressive strength were determined.

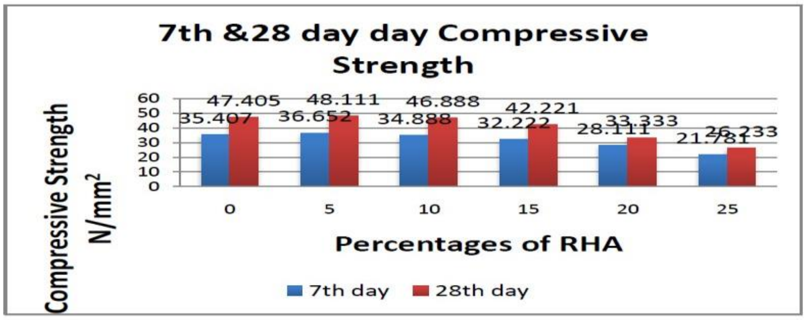

Fig 2.1: Compressive strength after 7 & 28 days in N/mm^2 (Ramakrishnan S et al., 2014)

As the increase in the rice husk ash (RHA) in concrete its compressive strength is reduces. At 20% and 30% replacement the strength reduction is very high as we compared with 10% RHA replacement.

S. I. Khassaf et al. (2014) investigate the strength of concrete which is limited changed by RHA the seepage in the canal lining used to decrease and control the workability, compression strength. Concrete specimens were molded with replacement of cement with

(RHA) at changed percentages 10%, 20%, and 30%. The results were compared with the standard concrete mix having 0% RHA. The mix percentage used for concrete specimens as shown in table:

Table 2.2: Mix Percentage (S. I. Khassaf et al.)

MIX	Cement (Kg/m^3)	F.A. (Kg/m^3)	C.A. (Kg/m^3)	RHA (Kg/m^3)	Water (Kg/m^3)	Slump(mm)
MR	350	660	1185	0	205	70
M10	315	660	1185	35	205	55
M20	280	660	1185	70	205	45
M30	245	660	1185	105	205	15

The standard compressive strength of concrete specimen are discussed at 7, 28, 56, 90 days with the replacement of RHA to the cement at 10%, 20% and 30%. The results are discussed in following table:

Table 2.3: Compressive Strength in N/mm^2 (S. I. Khassaf et al., 2014)

Mix Designation	7 days	28 days	56 days	90 days
MR	21.29	28.71	32.75	34.27
M10%	19.86	26.16	34.32	35.81
M20%	17.65	25.85	35.95	37.86
M30%	15.8	20.92	24.29	28.5

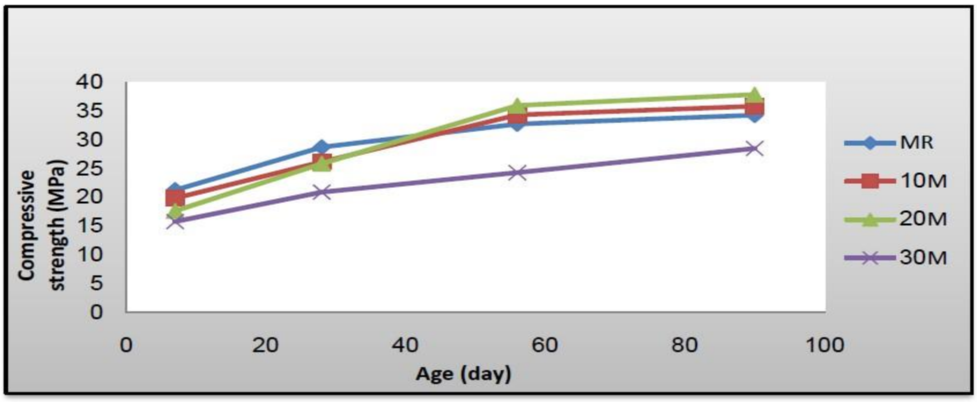

Fig 2.2: Compressive strength in various aged of curing (S. I. Khassaf et al., 2014)

Improved compressive strength up to the age of 90 days, when the main improvement is reached for concrete consumption increased to combine the materials. However, 7 and 28 days the Between maximum Growth seen. The compressive strength at 28 days of age was changed in range 21 to 29 MPa for concrete mixes. It shows that the compressive strength of the concrete Rha in the early years of life are lower than the reference standard as the percentage of RHA replacement growths. This occurs due to the fact that in the early years, the addition of RHA reduces the amount of cement by 10 to 30%.

Makarand Suresh Kulkarni et al. (2014) studies the mechanical properties of concrete by limited changed of rice husk ash with cement of 0%, 10%, 20 %, 30 %. In this study the optimal amount of replacement of RHA with cement is determined. At M30 grade of concrete the compressive strength are determined and their mix percentage shown as:

Table 2.4: Mix Percentage for M30 grade of concrete (Makarand Suresh Kulkarni et al.)

Material	Proportion by weight	Weight in kg
Cement	1	476
F.A.	1.25	595
CA (20mm)	2.73	1299.48
W/C ratio	0.45	186

Table 2.5: Test results of compressive strength after 7 days and 28 days in N/mm^2 (Makarand Suresh Kulkarni et al.)

S. no.	Mix Design	%RHA	Compressive Strength (N/mm^2)		% increase or decrease in strength over control mix	
1	M0	0	27.2	37	0	0
2	M1	10	27.8	42.8	2	15.67
3.	M2	20	28.3	39.8	4	7.56
4	M3	30	27.4	37	0.73	0

As the amount of RHA in concrete is rises the workability will reduced. With the rise of 10%, 20% and 30% RHA in normal concrete at 7 days the strength is slightly increased but after 28 days the addition of 20% RHA gives the similar strength to the normal concrete. The optimal replacement amount of RHA for M30 grade of concrete is found to be 20%.

Godwin A. Akeke et al. (2012) studied the improvement on Structural Properties of concrete by the partially changed of RHA with ordinary Portland cement (OPC). Rice husk ash has been used great scale and found to concrete tensile strength changed percentages of 10-25% in a mix of 1:1.5:3. The effects of compressive strength shown in following table

Table 2.6: Compressive Strength of Mix 1:1.5:3 (Godwin A. Akeke et al., 2012)

Description	Age(days)	Percentage of RHA		
		10%	20%	25%
Average Compressive Strength (N/mm^2)	7	12	11	10
	14	14	13	12
	21	18	18	14
	28	22	22	19

Compressive strength test shows the RHA and the OPC process without loss of workability and strength of concrete can replace up to 25% in the construction.

Abhilash Shukla et al. (2011) studied the mechanical properties of concrete with partial change of RHA. The aim of this work is to control the optimal percentage (0, 5, 10, 15 & 20%) of RHA as a partial change for M30 and M60 grade of concrete .The mix percentage shown as:

Table 2.7: Mix percentage for M30 grade mixture (Abhilash Shukla et al., 2011)

Mix	**BC**	**BC1**	**BC2**	**BC 3**	**BC 4**
Rice Husk Ash %	0	5	10	15	20
W/c ratio	0.43	0.43	0.43	0.43	0.43
Cement(kg/m^3)	420	399	378	357	336
RHA (kg/m^3)	0	21	42	63	84
Sand (kg/m^3)	621.6	582.18	542.88	503.5	464.2
Coarse Aggregate (kg/m^3)	1108.8	1108.8	1108.8	1108.8	1108.8
Water (lit/m^3)	180.6	180.6	180.6	180.6	180.6

Table 2.8: % Change in Compressive strength of M30 Grade of Concrete compared with Control Concrete respective ages ((Abhilash Shukla et al., 2011)

Mix	**% change in compressive strength**	
	7 Days	**28 Days**
BC	-	-
BC 1	4.68	3.37
BC 2	10.93	6.74
BC 3	-6.25	13.48
BC 4	-14.06	-17.97

Note: Negative Sign shows decrease in strength

Table 2.9: Mix percentage for M60 grade (Abhilash Shukla et al., 2011)

Mix Designation	CC	CC1	CC2	CC 3	CC 4
Rice Husk Ash %	0	5	10	15	20
W/c ratio	0.35	0.35	0.35	0.35	0.35
Cement(kg/m^3)	474	450.3	426.6	402.9	379.2
Rice husk ash (kg/m^3)	0	23.7	47.4	71.1	94.8
Sand (kg/m^3)	636	585.1	535.6	483.2	433.7
Coarse Aggregate (kg/m^3)	1113	1113	1113	1113	1113
Water (lit/m^3)	166	166	166	166	166

Optimal range of RHA changed out for both mix after 7 and 28 days the compressive strength were carried for M30 and M60 grade of concrete discussed in table

Table 2.10: % Change in Compressive strength of M60 Grade of Concrete compared with Control Concrete respective ages (Abhilash Shukla et al., 2011)

Mix	% change in compressive strength	
	7 Days	28 Days
CC	-	-
CC 1	2.88	4.87
CC 2	4.23	6.50
CC 3	-4.80	0.80
CC 4	-8.65	-5.69

Note: Negative Sign shows decrease in strength.

For M30 grade of concrete increased in the compressive strength by the replacement of RHA is 10% in all days. For the both (M30 and M60 grade) 10% RHA level presented 3-10% increase in compressive strength. At 15-20% replacement strength is decreased in both the mixes.

Kartini, K. et al. (2006) studied the strength characteristics of concrete by limited replacement of ordinary Portland cement with and without super plasticizers(Sp). The main objective of study to determine the optimal quantity of RHA for attaining high strength .The compressive strength of concrete were carried out on 20% and 30% changed of RHA after 1, 3, 7, 28, 90 and 180 days. Mix percentage for M30 grade as shown in table

Table 2.11: Mix percentage (Kartini, K. et al., 2006)

Mixes	w/b ratio	Sp%	Slump(mm)	Mass per unit volume of material (kg/m³)			Aggregate	
				OPC	RHA	Water	Fine	Coarse
OPC	0.63	-	51	325	-	205	900	940
OPCRHA20	0.68	-	44	260	65	221	894	930
OPCRHA30	0.70	-	42	228	97	228	890	927
OPCSp	0.63	0.40	130	325	-	205	900	940
OPCRHA20Sp	0.63	1.00	120	260	65	205	900	340
OPCRHA30Sp	0.63	1.61	122	228	7	205	900	940

Table 2.12: Compressive Strength (Kartini, K. et al., 2006)

Mixes	w/b ratio	Sp%	Compressive Strength in N/mm²					
			1 day	3 days	7 days	28 days	90 days	180 days
OPC	0.63	-	11.6	17.7	20.8	31.7	33.6	35.9
OPCRHA20	0.68	-	12.2	16.0	18.7	30.3	32.5	34.4
OPCRHA30	0.70	-	9.2	12.2	15.5	30	30.1	30.1
OPCSp	0.63	0.40	10.8	19.1	27.8	37.8	44.7	45.8
OPCRHA20Sp	0.63	1.00	12.8	18.6	22.8	32.0	37.6	37.6
OPCRHA30Sp	0.63	1.61	11.4	15.7	25.1	30.1	33.7	35.0

Pravin V Domke,(2012) has studied Development in concrete strength by using industrial (RHA) and agricultural waste (coir fibre) to reduce the impact on the environment due to the waste materials. Also find its workability and compression strength of concrete specimen was moulded with different percentage of RHA and coir fibre replacement of cement. The result were compared with the normal concrete mix and also check the optimal quantity of RHA replacement.

Table 2.13: Compressive strength,(Pravin V Domke,2012)

MIX	Compressive Strength of Cubes in (N/mm^2)			
	7 DAYS	14DAYS	28DAYS	90DAYS
M20	23.55	24.88	40.0	45.5
M20+2.5%Rha	20.11	20.81	30.18	42.3
M20+5%Rha	20.8	21.2	31.25	42.8
M20+7.5%Rha	21.22	21.28	32.58	43.58
M20+10%Rha	21.33	21.88	35.8	44.98
M20+12.5%Rha	22.5	22.48	38.55	45.2
M20+15%Rha	20.0	20.12	32.3	42.22
M20+17.5%Rha	19.98	19.92	33.3	41.18
M20+20%Rha	19.58	19.98	34.0	34.55
M20+12.5%Rha+1%coir	22.8	23.5	40.8	36.68
M20+12.5%Rha+2%coir	23	23.8	42.4	38.67
M20+12.5%Rha+3%coir	23.8	24.4	42.8	38.07
M20+12.5%Rha+4%coir	22.2	23.2	35.5	32.8
M20+15%Rha+1%coir	21.80	22.22	28.3	41.9
M20+15%Rha+2%coir	23.5	28.3	29.4	35.55
M20+15%Rha+3%coir	24.1	30	32.3	35.55
M20+15%Rha+4%coir	24	29.80	32.3	34.4
M20+17.5%Rha+1%coir	22.22	21.87	30.3	30.3
M20+17.5%Rha+2%coir	22.2	23.8	35.5	35.5
M20+17.5%Rha+3%coir	23.5	28.8	36.8	36.8
M20+17.5%Rha+4%coir	24.5	24.8	36.5	36.5
M20+20%Rha+1%coir	21.1	21.8	28	28
M20+20%Rha+2%coir	22.5	23.2	25.5	25.5
M20+20%Rha+3%coir	23.6	24.2	26.6	26.6
M20+20%Rha+4%coir	22.0	23.0	25.5	25.5
M20+1%coir	39.11	44.0	45.33	48.88
M20+2%coir	40.0	42.22	44.0	49.9
M20+3%coir	41.1	45.5	46.6	49.9
M20+4%coir	31.55	35.55	36.44	36.44

Maximum compressive strength is achieved at 12.5% Rha +2% coir fibres. The compression strength of composite mix is increased 28%.

Kshitija Nadgouda. (2014) investigate the experimental studies for recover the properties of concrete by reinforcing it with coir fibre. The consumption of coir fibre reinforced concrete likely in the invention of light weight fibre concrete. Compression strength test was conducted a concrete specimen having fibre varying from (0, 3, 5 and7%) volume.

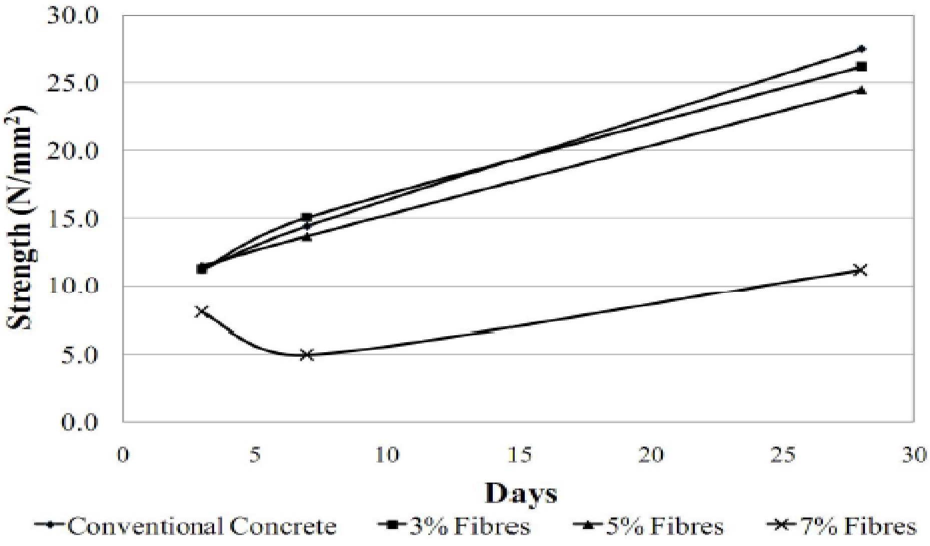

Fig 2.3: Compressive strenght at 7 and 28 days

Kshitija Nadgouda. (2014)

2.2 Split Tensile Strength

Ramakrishnan S et al. (2014) Studying the pavement concrete performance on changed percentage mix of M40 grade concrete growing rice hush ash cement control weight. Change the cement with partially rice husk ash at 0%, 5%, 10%, 15%, 20% and 25% with M40 grade concrete mix for concrete pavement. Split tensile strength of cylinders were calculated after 28 days as shown in fig.

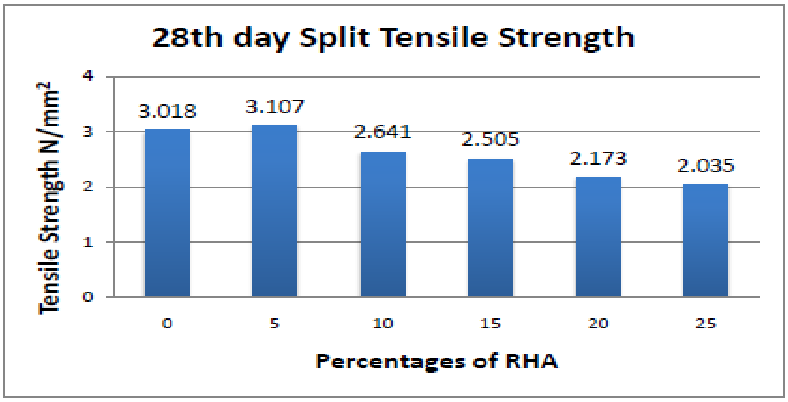

Fig 2.4: Split Tensile Strength after 28 days (Ramakrishnan S et al., 2014)

As the growth in the percentage of rice husk ash (RHA) the split tensile strength will be reduced. The 10% RHA replacement with cement the reduction in strength is very less as we compared with 20% and 25%. The optimal content for split tensile strength is 5% strength slightly increased to the standard mix.

S. I. Khassaf et al. (2014) investigate the Properties of concrete in canal lining to decrease the seepage with partially changed by RHA To determine the split tensile strength the Concrete cylinder specimens was molded with changed of cement with (RHA) at different percentages 10%, 20%, and 30%. The results were compared with the standard concrete mix contain 0% RHA. The results of split tensile strength shown in table:

Table 2.14: Split tensile Strength in N/mm^2 (S. I. Khassaf et al., 2014)

Mix Designation	7 days	28 days	56 days	90 days
MR	2.01	2.5	2.62	2.75
M10%	1.8	2.7	2.85	2.96
M20%	1.3	2.33	2.87	3.05
M30%	1.09	2.16	2.35	2.46

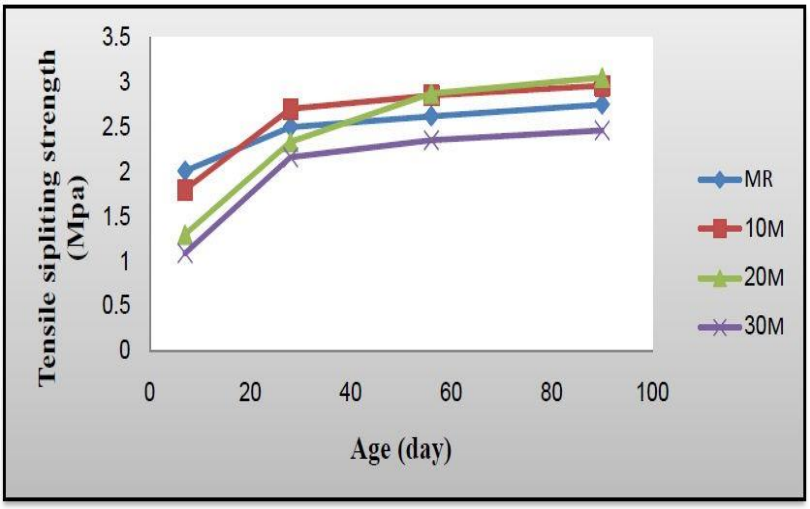

Fig 2.5: Results of splitting tensile strength of mixes (S. I. Khassaf et al., 2014)

At the early ages tensile strength of mixes is improved the tensile strength of concrete is marginally higher with replacement of Rha as compare to the standard mix.

Godwin A. Akeke et al. (2012) studied the development on Structural Properties of concrete by the limited replacement of RHA with OPC. Rice husk ash has been used large scale and found to concrete split tensile strength at replacement percentages of 10-25% in a mix of 1:1.5:3. The results of split tensile strength shown in following table

Table 2.15: Split Tensile Strength after 28 days (Godwin A. Akeke et al., 2012)

S. No.	% replacement	Tensile Strength N/mm^2
1	10%	1.94
2	20%	1.165
3	25%	0.91

The result of tensile strength on the 28days by replaced RHA concrete. From the table it seen that tensile strength will reduce continuously as we increased the the RHA in concrete.

Abhilash Shukla et al. (2011) studied the effect on split tensile strength of concrete with partial replacement of Rice husk ash. The main aim of this work is to determine the optimum percentage (0, 5, 10, 15 & 20%) of RHA as a partial replacement of cement for M30 and M60 grade of concrete and also the effect of super plasticizer on mechanical properties. The split tensile strength was discussed after 28 days in following table:

Table 2.16: % Change in Split tensile strength of M30 Grade of Concrete compared with Control Concrete respective ages (Abhilash Shukla et al., 2011)

Mix	28 Days
BC	-
BC 1	-6.62
BC 2	-16.40
BC 3	-21.20
BC 4	-26.90

Note: Negative Sign shows decrease in strength

Table 2.17: % Change in Split tensile strength of M60 Grade of Concrete compared with Control Concrete respective ages (Abhilash Shukla et al., 2011)

Mix	28 Days
CC	-
CC 1	-9.7
CC 2	-11.60
CC 3	-22.93
CC 4	-26.60

Note: Negative Sign shows decrease in strength

From experimental studies of split tensile strength it seen that the split tensile strength is reduced continuously in both of mixes (i.e. M30 and M60 grade). It varies from 9.7% to 26.67% and 6.62 to 26.90% at 28 days and 7days for variation of RHA at 5% to 20% foe M30 and M60 grade respectively.

Kartini, K. et al. (2006) studied the strength characteristics of concrete by limited replace of ordinary Portland cement with and without super plasticizers (Sp). The main objective of study to determine the optimal quantity of RHA for attaining high strength .The tensile strength of concrete were carried out on 20% and 30% replace of RHA after 1, 3, 7, 28, 90 and 180 days .The results of split tensile strength shown in table

Table 2.18: Split tensile Strength in N/mm^2 (Kartini, K. et al., 2006)

Mix	Sp%	w/b ratio	7 days	28 days	90 days	180 days
OPC(Control	0.63	-	2.1	2.4	2.5	2.6
RHA20	0.68	-	1.4	2	2.6	2.6
OPCSp	0.63	0.40	1.8	2.3	2.4	2.7
RHA30Sp	0.63	1.61	1.2	1.7	2.1	2.1

Pravin V Domke, (2012) has studied Development in strength of concrete by using industrial (RHA) and agricultural (coir fibre) waste to decrease the effect on the environment due to the waste ingredients. Concrete specimen was moulded with changed percentage of RHA and coir fibre replacement of cement, and measured it to the workability, tensile strength. The results were compared with the standard concrete mix and also check the optimal quantity of RHA and coconut fibre with concrete.

Table 2.19: Split tensile strength of cylinder after 28 days (Pravin V Domke, 2012)

MIX	Split Tensile Strength of cylinder (MPa)
M20	4.2
M20+2.5%RHA	4.5
M20+5.0%RHA	4.8
M20+7.5%RHA	5.0
M20+10.0%RHA	5.8
M20+12.5%RHA	6.2
M20+15.0%RHA	6.51
M20+17.5%RHA	3.39
M20+20.0%RHA	2.69
M20+12.5%RHA+1%Coir	6.5
M20+12.5%RHA+2%Coir	6.8
M20+12.5%RHA+3%Coir	6.9
M20+12.5%RHA+4%Coir	6.1
M20+15.0%RHA+1%Coir	6.8
M20+15.0%RHA+2%Coir	7.2
M20+15.0%RHA+3%Coir	7.8
M20+15.0%RHA+4%Coir	7.0
M20+17.5%RHA+1%Coir	4.0
M20+17.5%RHA+2%Coir	4.42
M20+17.5%RHA+3%Coir	4.5
M20+17.5%RHA+4%Coir	4.1
M20+20.0%RHA+1%Coir	2.7
M20+20.0%RHA+2%Coir	2.73
M20+20.0%RHA+3%Coir	2.8
M20+20.0%RHA+4%Coir	2.6
M20+1%coir	6.9
M20+2%coir	7.3
M20+3%coir	7.5
M20+4%coir	6.8

Kshitija Nadgouda (2014) investigate the experimental studies for improve the properties of concrete by reinforcing it with coconut fibre. The use of coconut fibre reinforced concrete potential in the production of light weight concrete. Tensile strength test was conducted a concrete specimen containing fibre varying (0, 3, 5 and7%) volume.

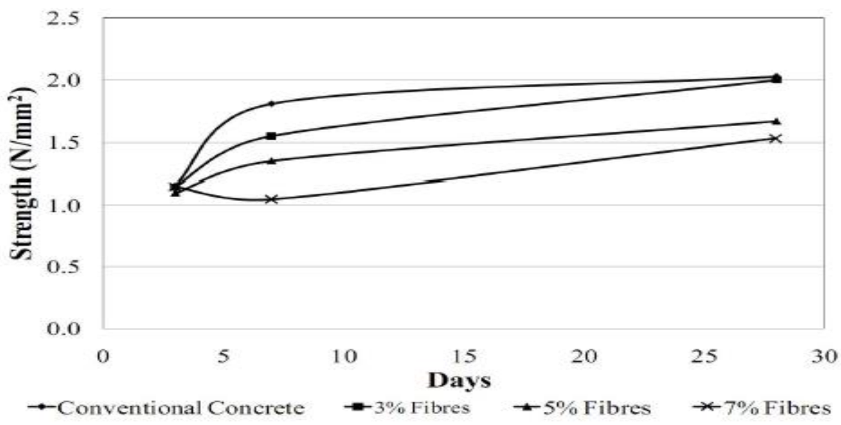

Fig 2.6: Split tensile strength, Kshitija Nadgouda (2014)

2.3 Flexural Strength

Ramakrishnan S et al. (2014) Studying the pavement concrete performance on changed percentage mix of M40 grade concrete growing rice hush ash cement control weight. Change the cement with rice husk ash at 0%, 5%, 10%, 15%, 20% and 25% with M40 grade concrete mix for concrete pavement. The flexure strength of specimen after 7 days and 28 days of curing for two point loading.

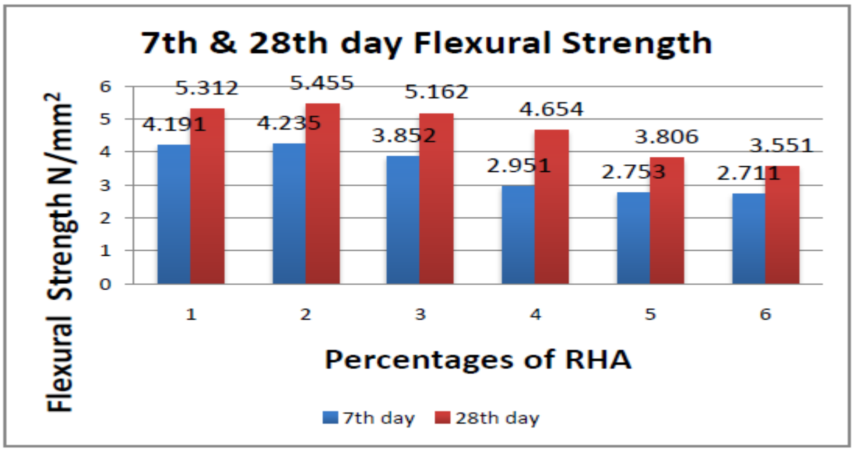

Fig 2.7: Flexural Strength Test results (Ramakrishnan S et al., 2014)

At 5% and 10% of replacement of RHA the flexural strength is reduced slightly as related to 15% and 20%. The 10% replacement of RHA with cement is acceptable for structural slab design to reduce the depth of slab.

Godwin A. Akeke et al. (2012) studied the development on Structural Properties of concrete by the limited replacement of RHA with OPC. Rice husk ash has been used large scale and found to concrete flexural strength changing percentages of 10-25% in a mix of 1:1.5:3.The results of flexural strength shown in following table:

Table 2.20: Flexural Strength after 28 days (Godwin A. Akeke et al., 2012)

S. No.	% replacement	Flexural Strength N/mm^2
1	10%	3
2	20%	2.5
3	25%	2.4

The Flexural strength studies specify that there is a marginal improvement with 10 to 25% RHA replacement levels.

Abhilash Shukla et al. (2011) studied the mechanical properties of concrete with limited replacement of RHA. The aim of this work is to determine the optimal percentage (0, 5, 10, 15 and 20%) of RHA as a partial replacement for M30 and M60 grade of concrete.

Table 2.21: % Change in flexural strength of M30 Grade of Concrete compared with Control Concrete respective ages (Abhilash Shukla et al., 2011)

Mix	28 Days
BC	-
BC 1	6.06
BC 2	8.88
BC 3	0.60
BC 4	-0.40

Note: Negative Sign shows decrease in strength

Table 2.22: % Change in flexural strength of M60 Grade of Concrete compared with Control Concrete respective ages (Abhilash Shukla et al., 2011)

Mix	28 Days
CC	-
CC 1	0.60
CC 2	1.85
CC 3	0.30
CC 4	-1.01

Note: Negative Sign shows decrease in strength

Kartini K. et al. (2006) studied the strength characteristics of concrete by partial replacement of ordinary Portland cement with and without super plasticizers (Sp). The main objective of study to determine the optimum amount of RHA for achieving high flexural strength .The compressive strength of concrete were carried out on 20% and 30% replacement of RHA after 1, 3, 7, 28, 90 and 180 days as shown in table

Table 2.23: Flexural Strength in N/mm^2 (Kartini K. et al., 2006)

Mix	Sp%	w/b ratio	7 days	28 days	90 days	180 days
OPC(Control)	0.63	-	3.5	4.1	4.7	4.9
RHA20	0.68	-	2.4	3.8	4	4.2
OPCSp	0.63	0.40	3.2	4.1	4.6	5.0
RHA30Sp	0.63	1.61	2.8	3.6	3.7	3.9

The addition of Sp did not improve significantly the flexural strength of RHA30Sp concrete Specimen related to the control OPC and OPC (Sp) concrete. RHA30Sp concrete showed slightly lower flexural strengths than the RHA20 concrete without Sp.

Kshitija Nadgouda (2014) investigate the experimental studies for improve the properties of concrete by reinforcing it with coconut fibre. The use of coconut fibre reinforced concrete potential in the production of light weight concrete. Flexural strength test was conducted a concrete specimen containing fibre varying (0, 3, 5 and7%) volume.

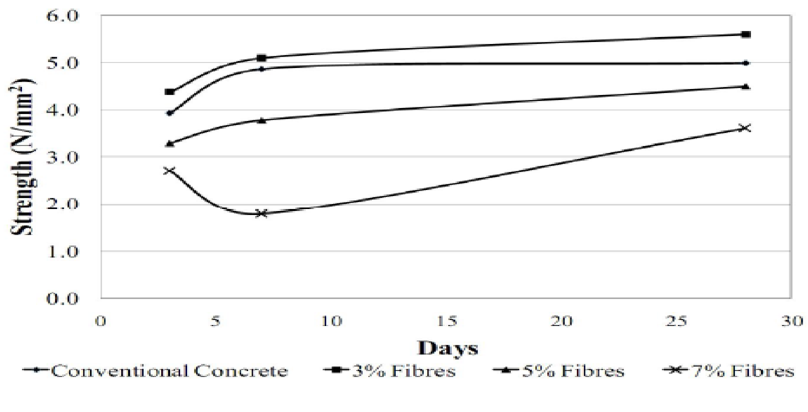

Fig 2.8:Flexural strength of Concrete, Kshitija Nadgouda (2014)

Pravin V Domke, (2012) has studied Improvement in strength of concrete by using industrial (RHA) and agricultural (coir fibre) waste to reduce the impact on the environment due to the waste materials. Concrete specimen was moulded with different percentage of RHA and coir fibre replacement of cement and measured its flexural strength.

Table 2.24: Flexural strength (Pravin V Domke, 2012)

Sr.no.	Mix	Flexural Strength
1	M20	9
2	M20+2.5%RHA	9
3	M20+5%RHA	10.4
4	M20+7.5%RHA	9.2
5	M20+10%RHA	8.8
6	M20+12.5%RHA	8.5
7	M20+15%RHA	9.6
8	M20+17.5%RHA	10.4
9	M20+20%RHA	8
10	M20+12.5%RHA +1%COIR	8.6
11	M20+12.5%RHA+2%COIR	8.8
12	M20+12.5%RHA+3%COIR	8.3
13	M20+12.5%RHA+4%COIR	8.1
14	M20+15%RHA+1%COIR	9.72
15	M20+15%RHA+2%COIR	9.8
16	M20+15%RHA+3%COIR	9.5
17	M20+15%RHA+4%COIR	9.4
18	M20+17.5%RHA+1%COIR	10.8
19	M20+17.5%RHA+2%COIR	10.9
20	M20+17.5%RHA+3%COIR	10.3
21	M20+17.5%RHA+4%COIR	10.1
22	M20+20%RHA+1%COIR	10.7
23	M20+20%RHA+2%COIR	10.9
24	M20+20%RHA+3%COIR	10.5
25	M20+20%RHA+45COIR	10.2
26	M20+1%COIR	7.2
27	M20+2%COIR	14
28	M20+3%COIR	12.4
29	M20+4%COIR	10.4

CHAPTER 3

MATERIALS AND RESEARCH METHODOLOGY

3.1 General

Methodology

The experimental was aimed at studied the compression strength and split tensile strength and experimental work involved casting and testing of conventionally concrete cubes and cylinders having different amount of Rha and coconut fibre. The quality as well as characteristics of the concrete depends upon the properties of the materials therefore the initial test were conduct on cement, course aggregates and fine aggregates before beginning of the experimental planned. The cubes specimen of 150*150*150mm^3 were casted with different amount replacement of cement with Rha and the addition of coconut fibre .the specimen was remolded after 24 hours of casting for curing of water for 7 days and 28 days. The specimen was tested on Compression testing machine and loads are gradually applied on specimen till the failure occur in cubes.

Compression strength of the cube is =P/A

Where P is maximum load applied on the cubes before failure.

A is cross section area of the concrete cubes

3.2 Materials and methods

Fig 3.1: Aggregates, Sand, Cement, Water.

3.2.1 Portland Cement

Portlandcement is material, generally in powder form, that can made into a paste usually by the addition of water and, when molded or poured, which set into solid mass. Cement is used as a binding material in concrete. It is bluish-grey powder obtained by finely grinding the clinker made by strongly heating intimate mixture of calcareous and argillaceous minerals. The chief raw materials is mixture of high calcium limestone (Cement rock), and clay. The main objective is to develop strength is to create a strong strength property. Usually three cement grade are OPC 33, 43, 53 are available in the market.

3.2.2 Fine aggregates

Fine aggregates are the natural sand which is washed and sieved to remove the large particle and lumps in the sand. According to the Indian standard (383:1970) the fine aggregates are those which is passing through the 4.75 mm sieve which separate the aggregates in different zones. Sand is used for making mortar, concrete, polishing and Sand blasting. In this project work I collected the aggregates from Jalandhar city. The fine sand was dark brown in colour.

Fig 3.2: Sand

3.2.3 Course aggregates

Course aggregates is the crushed stones is used for making concrete. Much of the crushed stones used is granite and limestone. The standard extreme size is gradually 10-20 mm; though unit sizes up to 40 mm or further have been cast-off in Self Compacting Concrete. Gap graded aggregates are normally better than those constantly graded, which valour expensive grader core resistance and give compact flow.

The aggregate used for a combination of two nearby obtainable creased stone of 20 mm and 10 mm size in 60:40 fraction. The aggregates are washed to away eliminate dirt, dust and then dry to surface dry form. The angular shape aggregates are better resist the impact load as compared with flakiness and elongation aggregates.

Fig 3.3:10mm size aggregates

Fig 3.4: 20mm size aggregates

3.2.4 Water

In general the water is fit for drinking is considered good for concrete. Water should be free from acids, oils and alkalis or other organic impurities. Water has mainly two functions in concrete mix. Firstly it cause chemical reaction with the cement to form cement paste in which insert aggregates are held in suspension until the cement paste has hardened. Second it acts as lubricants in the mixture of fine aggregates and cement.

Fig 3.5: Water

3.2.5 Coconut coir fibre

Coir fibre is the agricultural waste material obtained from mature coconut. In this project coconut coir is collected from furniture shop Amritsar and its diameter is 0.22mm having aspect ratio is 110. Coconut fibre having high water absorption property therefore coir fibre is placed in water before mixing in the concrete.

Table 3.1: Coir fibre

Aspect ratio	Length	Diameter
110	2.5cm	0.022cm

3.3 Test on materials

3.3.1 Cement

Ordinary Portland cement of 43 grade conforming to IS 8112-1989 was used .Test was carried out on various physical properties of cement. Before the design mix it is necessary to examined the physical and chemical properties of cement.

Table 3.2: Properties of cement

Sr no	Properties	Value
1	Fineness test	5.28
2	Specific gravity	3.15
3	Water absorption	3.5%
4	Setting time	48min (Initial) 165min (final)

3.3.2 Fine aggregates

Properties of fine aggregates were determined by conducting tests as per IS 2386 (part-1).the result obtained from sieve analysis are determined in table. The result indicate that the fine aggregates conforms to Zone II of IS: 383-1970.

Table 3.3: Property of Sand (Fine aggregates)

S no	Property	Value
1	Sieve Analysis	Zone II
2	Specific gravity	2.65

3.3.3 Course aggregates

Crushed granite stones are collected from Jalandhar city. Two size of course aggregates are used 20mm and 10mm aggregates. The properties of course aggregates are determined by conducting test as per IS: 2386 part III.

Table 3.4: Property of course aggregates.

S no.	Property	Value
1	Specific gravity	2.75
2	Water absorption	1.3%

3.3.4 Water

Portable water free from salts was used for casting and curing of concrete as per IS 456-2000 recommendations.

3.4 Mixing Proportioning for M20 Grade of Concrete.

Experimental values:

Specific gravity of cement = 3.15

Specific gravity of fine aggregates = 2.65

Specific gravity of course aggregates (20mm) = 2.75

Specific gravity of course aggregates (10mm) = 2.75

Concrete mix design of M20 grade of concrete.

1. Targeted mean strength

Fck = Fck+1.65*Standard Deviation

Fck = 20+1.65*4

= 26.66 N/mm^2

2. Water Cement ratio

Exposurte – mild

Minimum water content /m^3 of concrete =300kg

w/c = 0.55

For 20 mm aggregates

Maximum water content / m^3 of concrete = 186 kg

Degree of workability = medium.

Slump value =50-100

Total water for 10mm slump = 6/100*186 =11.61 kg

Total = 186+11.61

= 197.16 kg

Now w/c = 0.55

Cement = 197.19/0.55 = 394.32 kg

1. Water = 198 kg/m^3

2. Cement = 394.32 kg

3. W/c ratio = 0.55

4. Aggregates:

Course aggregates fraction =.62

Fine aggregates fraction = 1-.062 = 0.38

5. Volume of concrete = $1m^3$

Volume of Cement = (395/2.92)*(1/1000) =$0.135m^3$

Volume of water =(198/1)*(1/1000) =$.198m^3$

Volume of aggregates = 1-(0.135+0.198) = $0.667m^3$

Course aggregates = 0.677*0.62*2.75*1000 = $1154.285kg/m^3$

Fine aggregates = 0.677*0.38*2.52*1000 = $648.295kg/m^3$

Table 3.5: Mix design for $1m^3$ concrete

Water	Cement	Fine aggregates	Course aggregates
186 kg	395 kg	648.295 kg	1154.285kg

CHAPTER 4
EXPERIMENTAL WORK

4.1 Casting of Specimen

The experimental Studies consist of testing of 18 specimen (108 cubes 3 for each mix proportion) sample with 5 specimen of cement replaced with Rice husk ash, 3 specimen of coconut fibre reinforced concrete, 9 specimen of composition of Rice husk ash and coconut fibre with different proportions and 1 conventional specimen. All specimen cubes having same M20 grade of concrete. The concrete cubes having size of (150*150*150) mm^3 and cylinder having size of 150 mm dia and 300 mm long.

Fig 4.1: Concrete cube and cylinder mould.

4.2 Mixing of normal concrete.

Firstly mix the cement, dry course aggregates and fine aggregates in the proportion properly before mixing the water. Add the required water in the concrete mixing it for 2 minute to achieve uniformity of the concrete then casted in the mould of cubes and cylinder. Before poured the concrete the cubes are washed and oiled properly so that can remove easily after hardened of concrete.

Fig 4.2: Mixing of normal concrete.

4.3 Mixing of concrete with replacement of Rha.

Dry cement, course aggregates and fine aggregates are mixed manually in the laboratory pan for two minute. Mixing continuous for further two minutes while 80% of water was added and after proper mixing of concrete remaining 20%water was added with the rice husk ash. While mixing ensured that complete distribution of Rha in the concrete mix .Then casted the concrete cubes and cylinders containing Rha in the concrete.

4.4 Mixing of concrete with coconut fibre.

Coconut fibre have high water absorption property so that coconut fibre are placed into the water for 2-3 hours before mixing into the concrete mix so that coconut fibre don't effect to the water cement ratio by absorbing the water. Dry cement, course aggregates and fine aggregates are mixed manually in the laboratory pan for two minute. Mixing continuous for further two minutes with water . The mixing was continued for another few minutes and the coconut fibers were fed continuously to the concrete for a period of 2–3 min while stirrin. and adding the coconut fibre it should ensure that mixing should be uniformly distributed in the concrete mix. Then casted the concrete cubes and cylinders containing Rha in the concrete.

Fig 4.3: Mixing of concrete with coconut fibre.

4.5 Casting and curing.

The mould is arranged properly and placed at smooth surface. The side walls of the mould is oiled properly so prevent to absorbing water from concrete and easily remove after hardened of the concrete. While moulded to ensure that cement, sand and course aggregates are mixed uniformally then placed the concrete cubes on the vibrator machine for compacting of concrete. The specimen was remoulded after 24 hours of casting and placed the specimen in the water for curing of 7 days and 28 days. After 7 and 28 days the specimen was tested on the compression testing machine.

Fig 4.4: casting of concrete cubes and cylinders

4.6 Testing of the concrete cubes and cylinders.

4.6.1 Test Specimen

Manually mix the cement, dry course aggregates and fine aggregates in proportion were mixed first for one moment before mixing the required water the mixing is continued for two minute after mixing the water to achieve uniformity the concrete with Rha and coconut fibre was cast in mould of cubes and cylinders. Concrete cubes each having size is (150*150*150) mm^3 and cylinder having size 150mm dia and 300mm long containing Rha and coconut fibre.

Fig 4.5: Compression testing machine

4.6.2 Test procedure

After 7 days and 28 days specimen was tested by using compression testing machine having capacity of 1000 KN .Specimen placed on the bottom clamp plate of machine top surface of the specimen is slightly touched with the upper clamp plate then continuous loading was applied from both sides of the specimen till we might identify the small hair cracks further the loading is continued until we got the ultimate load. Finally compare the strength of the normal concrete and the composite concrete.

4.6.2.1 Compressive strength of concrete

Cube specimens of size 150 mm x 150 mm x 150 mm were taken out form the curing tank at the ages of 7 days and 28 days and tested immediately on removal from the water (while they were still in the wet condition). Surface water was wiped off, the specimens were tested. The position of cube when tested was at right angle to that as cast. The load as applied gradually without shock till the failure of the specimen occurs and thus the compressive strength was found.

The quantities of cement, coarse aggregate (20 mm and 10 mm), fine aggregate, rice husk ash, coconut coir and water for each batch i.e. for different percentage of rice husk ash replacement was weighed separately. The cement and rice husk ash were mixed dry to a uniform colour separately. The coarse aggregates were mixed to get uniform distribution throughout the batch. Water added to the mix and then super-plasticizer was added. Firstly, 50 to 70% of water was added to the mix and then mixed thoroughly for 3 to 4 minutes in mixer.. Then the concrete was filled into the cube moulds and then get vibrated to ensure proper compaction. The finished specimens were left to harden in air for 24 hours. The specimens were removed from the moulds after 24 hours of casting and were placed in the water tank, filled with potable water in the laboratory

Compressive strength= Ultimate load /cross section area

4.6.2.2 Split Tensile Strength of Concrete

The split tensile strength of concrete is determined by casting cylinders of size 150 mm x300 mm. The cylinders were tested by placing them uniformly. Specimens were taken out from curing tank at age 28 days of moist curing and tested after surface water dipped down from specimens. This test was performed on compression Testing Machine. The magnitude of tensile stress (T) acting uniformly to the line of action of applied loading is given by formula

Split tensile strength ($T_{s)}$= 0.637P/DL

Where,

T_s = Split Tensile Strength in MPa

P = Applied load,

D = Diameter of Concrete cylinder sample in mm.

L =Length of Concrete cylinder sample in mm.

The quantities of cement, coarse aggregate (20 mm and 10 mm), fine aggregate, rice husk ash, coconut fibre and water for each batch i.e. for different percentage of rice husk ash replacement was weighed separately. The cement and rice husk ash were mixed dry to a uniform color separately. Fine aggregate was mixed to this mixture in dry form. The coarse aggregates were mixed to get uniform distribution throughout the batch. Water added to the mix and then super-plasticizer was added. Firstly, 50 to 70% of water was added to the mix and then mixed thoroughly for 3 to 4 minutes in mixer. Super-plasticizer was added in the remaining mix and stirred for further 2 to 3 minutes in mixer to have uniform mix. Then the concrete was filled 54 into the cylindrical moulds and then get vibrated to ensure proper compaction. The surface of the concrete was finished level with the top of the mould using trowel. The finished specimens were left to harden in air for 24 hours. The specimens were removed from the moulds after 24 hours of casting and were placed in the water tank, filled with potable water in the laboratory.

Fig 4.6: Testing of cubes on compression testing machine

CHAPTER 5
RESULT AND DISCUSSIONS

5.1 General

The result of test conducted on 18 different sample having (108 cubes 3 for each mix proportion) sample 5 specimen sample of cement replaced with rice husk ash 3 specimen sample of coconut fibre reinforced concrete 9 specimen sample of composition of rice husk ash and coconut fibre with different proportions and 1 conventional specimen specimen has been discussed in this investigation. The load failure of each cubes is discussed. The aimed of the experimental programmed to achieve many objectives through comparison between the strength with normal concrete. Testing of specimen discovered the compression strength and the split tensile strength on effect of different percentages of Rha and the coconut fibre.

5.2 Compressive strength test

5.2.1 Compressive strength of concrete with partial replacement of cement with Rha .

Concrete construction applications are particularly resistant to the most the compressive stresses. If the plain concrete is under pressure, cube diagonal falls on the vertical plane. Due to the lateral tension strain cracks occurs. Specimen size of (150*150*150) mm^3 cube are testing on compression strength of concrete after 7days and 28 days of curing. The sample was prepared by control Mix and with different percentages of Rha.

Table 5.1: Compressive strength of concrete with Rha after 7 and 28 days .

S.NO	MIX	RHA REPLACEMENT	STRENGTH (N/mm^2)	
			7 Days	**28 Days**
1	**M20**	0%	22.5	24.4
2		5%	21.7	25.8
3		10%	20.4	26.8
4		15%	19.7	26.5
5		20%	18.8	25.2
6		25%	16.5	21.8

The compressive strength examined for different percentages of Rha is replacement of cement with weight for 5%, 10%, 15%, 20% and 25% Rha. As compared to the normal concrete mix strength is increased by 5.7% at 5% replacement of Rha after 28 days. For 10 % replacement strength is also increased by 8.9% as compared to the normal mix after 28 days testing. After replacement of 15%, 20% and 25% it starts decreases as compared to 10% replacement by 1.1%, 5.97% and 18.65% respectively. So the optimum level of partial replacement of cement with Rha is 5-15% which gives the increase in strength after 28 days after 10% replacement compressive strength of concrete will starts decreases.

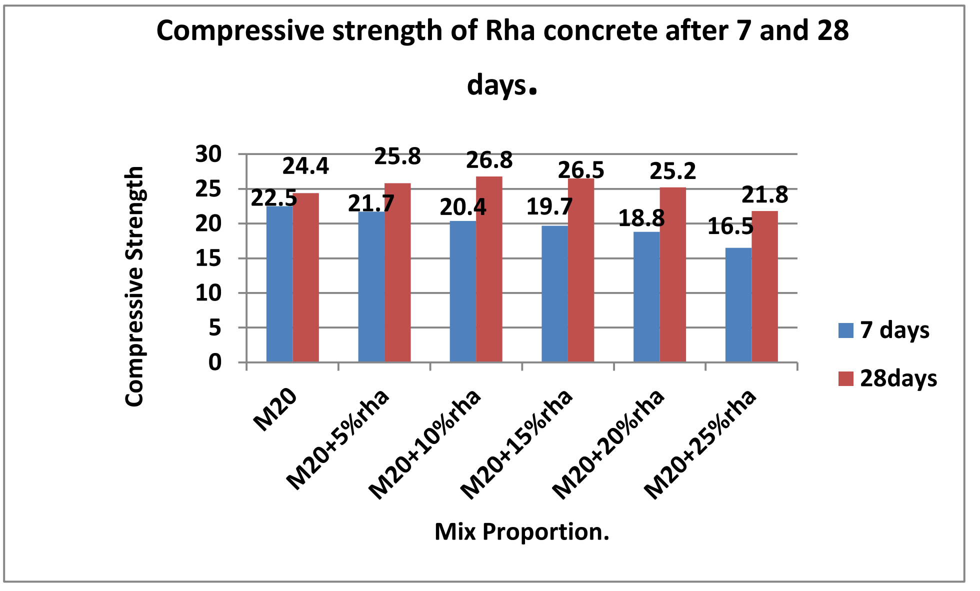

Fig 5.1 Compressive strength of concrete with Rha after 7 and 28 days in N/mm^2

5.2.2 Compressive strength of concrete with addition of Coconut fibre.

Concrete construction applications are particularly resistant to the most the compressive stresses. If the plain concrete is placed in compression testing machine, cube diagonal falls on the vertical plane. The main use of fibre in the concrete is to hold the cracks that developed on concrete due to applied loads and to increases the durability of the concrete.

Table 5.2: compressive strength of coconut fibre reinforced concrete after 7 and 28 days

S. No	MIX	Coconut fibre Addition	Strength N/mm^2	
			7 days	28 days
1	M20	0%	22.5	24.4
2		1%	22.9	25.8
3		2%	26.3	28.1
4		3%	24.1	25.7

At 1% addition of coconut fibre increases the compressive strength of the concrete by 5.64% after 28 days. For 2% addition the compressive strength is also increased 15.1% as compared to the normal concrete mix. After addition of 3% fibre compressive strength is reduced as compared to the 2% addition of coconut fibre. So the optimal level of addition of coconut fibre is upto 2% after that compressive strength is reduced.

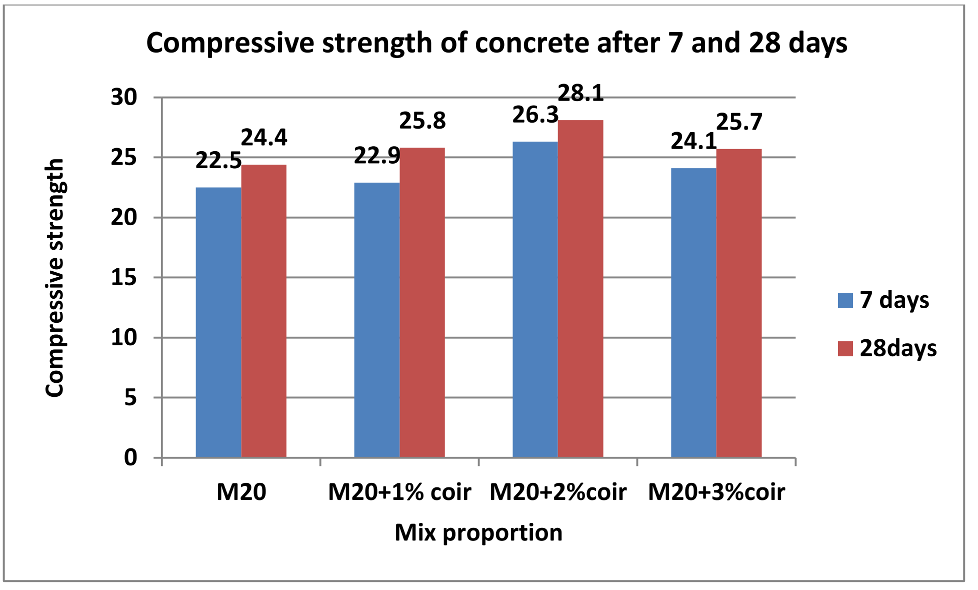

Fig 5.2: Compressive strength of coconut fibre reinforced concrete after 7 and 28 days in N/mm^2.

5.2.3 Compressive strength of concrete with partial replacement of cement with Rha and Coconut fibre

Specimen having sizes of 150mm*150mm*150mm are casted with composite concrete material having different proportion of Rha and the coconut fibre.

Table 5.3: compressive strength of composite materials (Rha +coconut fibre) .

S. no	Mix	Rha Replacement	Coconut fibre	Strength (N/mm^2)	
				7 days	28 days
1	M20	10%	1%	22.7	26.1
2		10%	2%	23.4	28.7
3		10%	3%	23.9	29.1
4		15%	1%	24.6	31.2
5		15%	2%	25.1	33.4
6		15%	3%	22.6	31.2
7		20%	1%	22.2	28.1
8		20%	2%	20.8	27.1
9		20%	3%	20.1	25.6

Compressive strength of the composite material is strength is increased by at mix M20+10%Rha +1%coir fibre as compared to the normal conventional mix. At M20+15%Rha+2% coir fibre gives the maximum strength in the composite mix so that mix gives the optimal level after that the strength starts reduced.

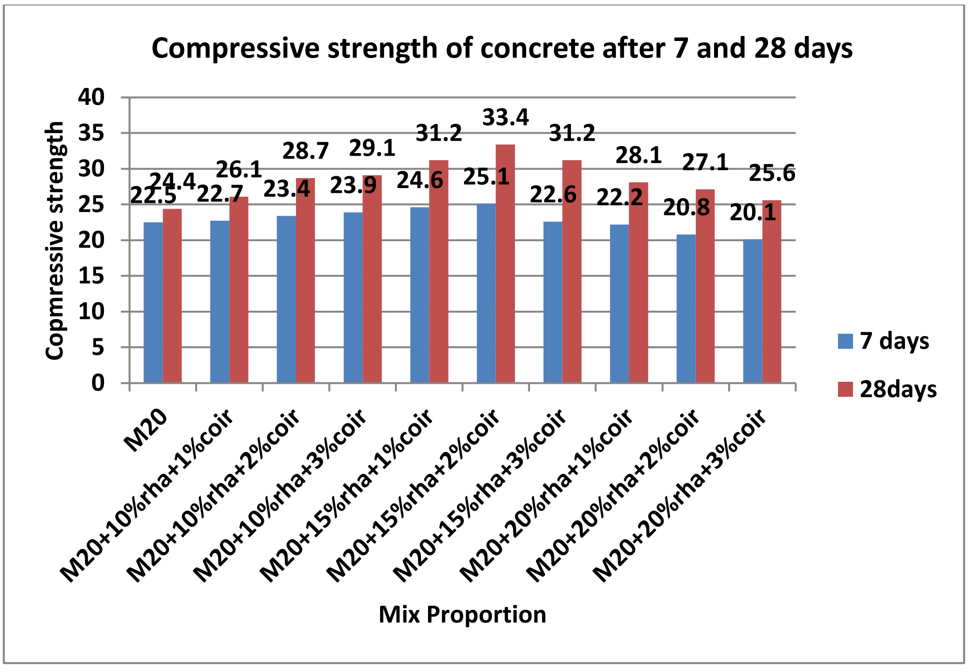

Fig 5.3: Compressive strength of composite concrete(Rha +coconut fibre) after 7and 28 days in N/mm^2

Rha is a pozzolanic material contain high amount of silica same property like cement, due to the fineness property of Rha it will make fill maximum void in the concrete and make good bond to other materials like sand and cement. Due to the pozzolanic property of Rha will increased the compressive strength of the concrete. But due to the high heat of hydration excess amount of Rha is reduced the strength of the concrete. As discussed in table 5.1 after 15% replacement the compressive strength of the concrete is reduced due to the high heat of hydration. So the optimal level replacement of cement is upto 5-15%. For composite material mix M20+15%Rha+2%coir fibre give the maximum strength but M20+15%Rha+1%coir fibre and M20+15%Rha+3%coir fibre gives almost same compressive strength slightly decreased in the strength so we use the Mix proportion to reduce the cost of the construction materials.

5.3 Split tensile Strength

5.3.1 Split tensile strength with partial replacement of cement with Rha

The concrete cylinder having 150mm diameter and 300mm long were used for testing the split tensile strength after 7 days. The concrete specimen has been made for different percentages having Rha content of 5%, 10%, 15%, 20% and 25% replacement. 3 sample has been casted for each percentage for various replacement level of Rha in concrete mix. The results of split tensile strength are reported in table 5.4, which shows the gain in split tensile strength for different percentages of Rha.

Table 5.4: Split tensile strength of concrete with Rha after 28 days.

S.no	Mix	Rha Replacement	Strength (N/mm^2) 28 days
1	MIX	0%	4.2
2.		5%	4.8
3		10%	5.8
4		15%	3.4
5		20%	2.3
6		25%	2.1

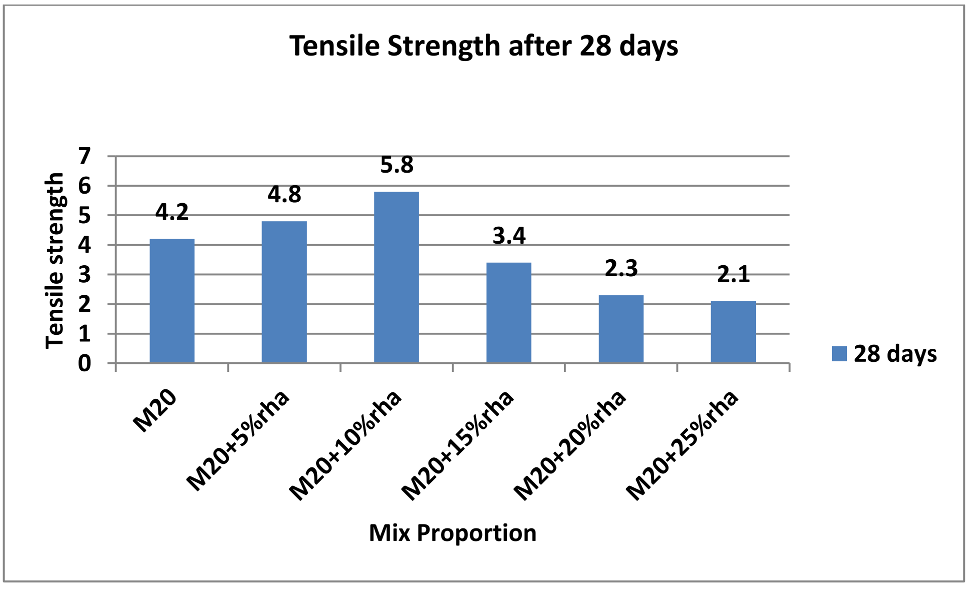

Fig 5.4: split tensile strength of concrete with Rha after 28 days

The split tensile strength result of separate concrete mix is shown graphically. Split tensile strength of 5% replacement is increases by 12.5% also increased after the replacement of 10% Rha 38% as compared to the conventional mix. After the replacement of 15%, 20% and 25% strength starts decreasing by23.8%, 45.2% and 50% respectively, At 15% addition of rice husk ash decreases in strength. For strength purpose 10% replacement is acceptable for split tensile strength.

5.3.2 Split tensile strength with addition of coconut fibre.

The concrete specimen has been made for different percentages having coconut fibre content 1%, 2% and 3%. Three sample has been casted for each percentages for various addition level of coconut fibre in normal concrete mix. The results of split tensile strength are reported in table 5.5, which shows the gain in split tensile strength for different percentages of coconut fibre.

Table 5.5: Split tensile strength of Coconut fibre reinforced concrete after 28 days.

S.no	Mix	Coconut Fibre	Strength(N/mm^2)
			28 days
1	M20	0%	4.2
2		1%	6.4
3		2%	6.7
4		3%	6.8

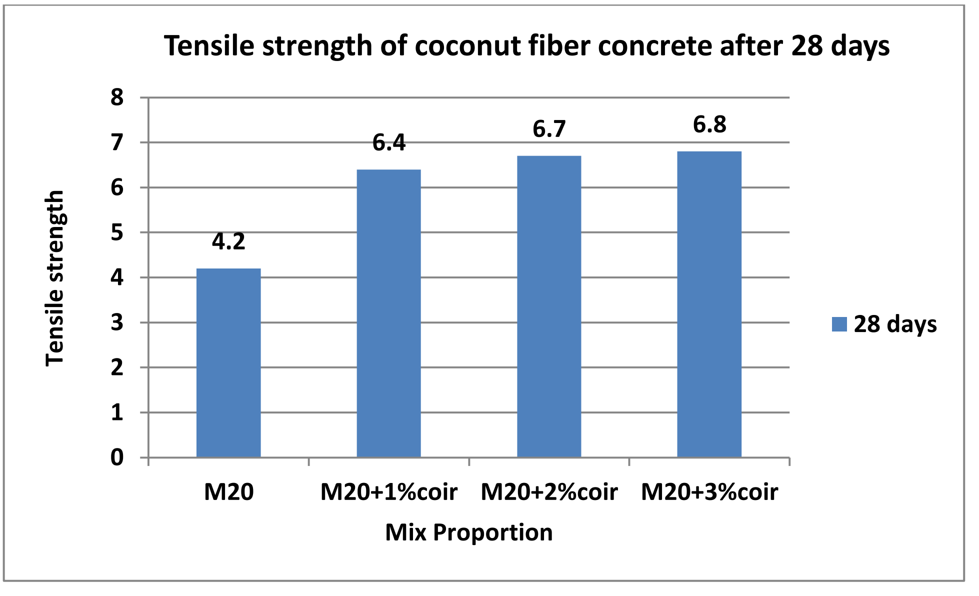

Fig 5.5: Tensile strength of Cooconut fibre reinforced concrete after 28 days.

The split tensile strength results of separate concrete mix are shown graphically. After addition of coconut fiber in each proportion the Split tensile strength is increased by 52%, 59.5% and 61.9% respectively.

5.3.3 Split tensile strength of concrete with partial replacement of cement with Rha and proportionate Coconut fibre.

Specimen having sizes of 150 mm diameter and 300mm long is casted with composite concrete material having different proportion of Rha and the coconut fibre. 9 different sample are casted for testing of split tensile strength for each proportion 3 specimen are casted.

Table 5.6: Split tensile strength of concrete having Rha and coconut fibre after 28 days.

S.no	MIX	Rha replacement	Coconut fibre addition	Strength(N/mm^2) 28 days
1	**M20**	10%	1%	6.3
2		10%	2%	6.8
3		10%	3%	6.5
4		15%	1%	6.4
5		15%	2%	6.45
6		15%	3%	5.4
7		20%	1%	3.4
8		20%	2%	3.1
9		20%	3%	2.67

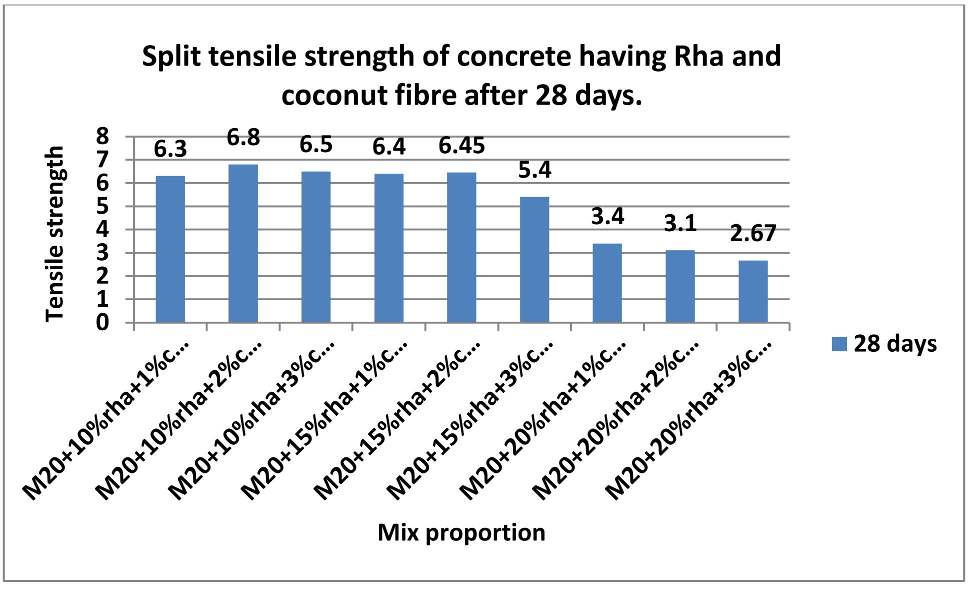

Fig 5.6: Split tensile strength of concrete having Rha and coconut fibre after 28 days.

M20+15%Rha+2% coir fibre gives the maximum Tensile strength as compared to other composite concrete. Due to high pozzolanic property of Rha produce heat of hydration which will reduced the strength of concrete when use in high amount in case of coir fibre addition in the concrete decrement in the strength is less as we compared to the composite material i.e Rha and coconut coir.

5.4 Ideal combination mix.

After the entire experimental work it is concluded that mix M20+15%rha+2%coir fibre is the best combination among all the mixes which gives the maximum compression strength and split tensile strength.

Chapter 6

CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

1. The compression strength and split tensile strength of composite materials is increased as we compared with normal mixed.
2. The density of coconut fiber is much lower, so that the total weight of the material can be reduced and used as lightweight construction materials.
3. RHA produce a large amount of silica gel when water is added in concrete which provide high strength concrete.
4. The maximum Split Tensile strength is achieved at 10% replacement of Rha with cement.
5. Rha and coconut fiber are waste material both reduce the material cost of construction.
6. Replacement of Rha is economical for 10%-15% replacement after that the Compressive strength is reduced due to high heat of hydration produced by Rha.
7. Disposal the the waste material in concrete not only increases the strength of concrete but also reduced the environmental effect due to the waste materials.
8. The purpose of fibre used in concrete is to hold the small hair cracks that developed in concrete due to applied loads but due to high water absorption property of the coconut fibre are placed in water before mixing in the concrete.

6.2 Future scope

1. The workability of the concrete with fibre is reduced it can be improved using super plasticizers
2. Hand mixing becomes very tedious and lead to formation of non -homogeneous mix certain chemicals can be added so as to replace hand mixing by machine mixing.

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