INVESTIGATION OF CONCRETE BLOCK USING CRUM B RUBBER WITH PARTIAL REPLACEMENT OF FINE AGGREGATE

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***Abstract*: The concrete is heavily used as construction materials in modern society. With the growth in urbanization and industrialization and its demand is increased day by days In order to minimize the negative impact of concrete, the use of waste materials. Our project deals with the partial replacement of fine aggregate by crumb rubber. The substituent to fine aggregate by crumb rubber at level of 10%, 20%, 30% is to be studied for materials and strength properties 100% cement concrete mix is of M20 and water cement ratio is 0.50 the strength will be tested during the period of 7 days 14 days 28 days respective. We will compare the replace concrete with the conventional concrete about the strength and durability of the concrete.**

***Keywords*: cement, coarse aggregate, fine aggregate, crumb rubber.**

1. INTRODUCTION

1.1 GENERAL

Tens of millions of tires are discarded across the world every year. Disposal of waste tires is a challenging task because tires have a long life and non-biodegradable. The traditional method of waste tires management have been stockpiling or illegally dumping or land filling, all of which are short-term solution. The environmental problem from growing, recycling tire is an innovative idea or way in this case. Recycling tire is the process of recycling vehicles. Tires that are no longer suitable for use on vehicles due to wear or irreparable damage such as punctures. The cracker mill process tears apart or reduces the size of tire rubber by passing the material between rotating corrugated steel drums. By this process an irregularly shaped torn particles are commonly known as crumb rubber.

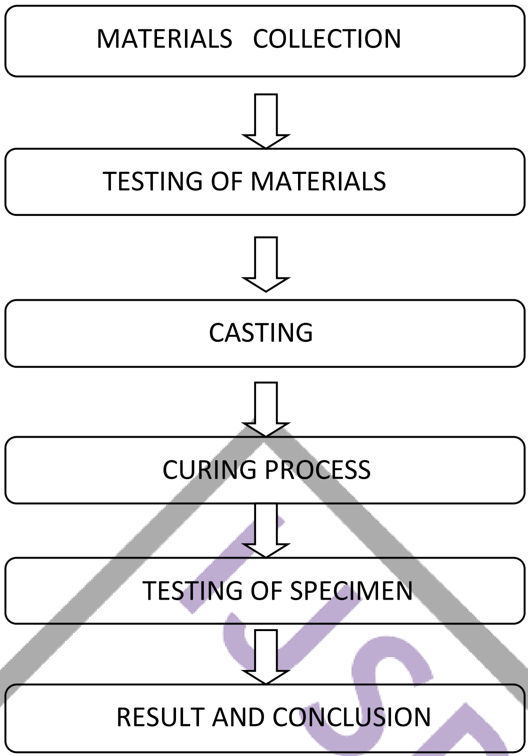
However, most of the developing third world countries have yet to raise their awareness regarding recycling of waste materials and have not developed effective legislation with respect to the local reuse of waste materials the proposed work presents an experimental study of effect of use of solid waste material (crumb rubber) in concrete by volume variation of crumb rubber. One of the objectives of this paper is to make these data regarding the basic properties of modified concrete using crumb rubber in the concrete mix available to aid in the development of preliminary guidelines for the use of crumb rubber in concrete.

1.2 CRUMB RUBBER

In the recent years, solid waste management of used and waste materials is the thrust area. Out of this various waste materials, plastic waste, tire waste and municipal solid waste are of great concern. Hazardous waste materials are being generated and accumulated in huge quantities causing an increasing hazard to the environment. Hazardous materials can be classified as chemical, toxic or non-decaying materials with time. The growth of rubber and plastics can be considered non-decaying materials that disturb the surrounding environment. The tires are among the largest and most tricky sources of waste, due to the large amount produced, their durability, and fact they contain a number of components that are ecologically problematic. It is estimated that 259 million tires are discarded annually. Crumb rubber is a material produced by shredding and commutating used tires. There is no doubt that the increasing piles of tires create environmental concerns. The long term objectives is to find a means to dispose of crumb rubber in ordinary Portland cement concrete and still supply a final product with good engineering properties.

CHAPTER 2

2. METHODOLOGY



CHAPTER 3

3. MATERIAL PROPERTIES

3.1 GENERAL

The properties of materials used for making concrete mix are determined in laboratory as per relevant codes of practice. Different materials used in present study were cement, coarse aggregate and fine aggregate, in addition of the aim of studying of various properties of materials is used to check the appearance with codal requirements and to enable an engineer to design a concrete mix for a particular strength. The description of various materials which were used in this study is given below

3.2 CEMENT

Although all materials that go into concrete mix are essential, cement is very often the most important because it is usually the delicate link in the chain. The function of cement is first of all to bind the sand and stone together and second to fill up voids between sand and stone particle to form a compact mass. It constituents only about 20% of the total volume of concrete mix; it is active portion of building medium and is the only scientifically controlled ingredient of concrete. Any various in its quality affects the compressive strength of concrete mix. Ordinary Portland cement is most important type of cement and fine powder produced by grinding Portland cement clinker. The OPC classified into three grades, namely 33 grade, 43 grade, 53 grade depending upon the strength of 28 days

It has been possible to upgrade the qualities of cement by using high qualities limestone, modern requirements, maintaining better particle size distribution, fine grinding and better parking, generally use of high grade cement offer many advantage for making stronger concrete.

Ordinary Portland cement (OPC) of 53grade was used throughout the coarse of the investigation. It was fresh and without any lumps. The cement as determined from various tests confirming to Indian standards IS 8112: 1989 as listed in table 3.1. Cement was carefully stored to prevent deterioration in its properties due to contact with moisture

3.2.1 Specific gravity of cement

1. The flask should be free from the liquid that means it should be fully dry weight the empty flask (W1).
2. Fill the cement on the bottle up to half of the flask (about 50gms) and weight with its stopper (W2).
3. Add kerosene to the cement up to the top of the bottle. Mix well to remove the air bubbles in it. Weight the flask with cement and kerosene (W3).

4. Empty the flask, fill the bottle with kerosene up to the top and weigh the flask (W4).

Specific gravity of cement = (W2-W1) / (W2-W1)-(W3-W4) x 0.75

Specific gravity of cement = 3.15

3.2.2 Consistency test for cement

1. Weight of 400gms of cement on to a non- porous plate form and make it into a depression in to hold the mixing bar.
2. Find out the volume of water to give a percentage of 25 by weigh of dry cements and this amount carefully to the cement
3. Mix the cement and water together thoroughly the process of mixing shall include kneading and threading. The total time elapsed from the amount of moment adding water to the cement and mixing completely shall not be less 4 minutes.
4. Fill the mould completely with the cement paste so gauged and strike off the top level with the top of the mould, slightly shade the jar and mould with the cement to drive to entrapped air.
5. Keep the mould under the vicat plunger and supporting the moving ring by the plunger of the dash pot release the rod.
6. Repeat the experiment with trial plate of varying percentage of water fill the plunger comes to rest between 5mm to 7mm from the bottom used.
7. Amount of water required = (weight of cement x % of water required) / (100
8. The standard consistency to the cement = 33%

INITIAL SETTING TIME

1. Place the test block confirmed in the mould and resting on the non- porous plate, under the rod bearing the needle.
2. Lower the needle gently until it comes in contact with the surface of test block and quick release, allowing it to penetrate into the test block.
3. In the beginning the needle completely pierces the test block. Repeat this procedure i.e., quickly releasing the needle after every 2 minutes till the needle fails to pierce the block for about 5mm measured from the bottom of the mould. Note this time (t_2).

Table 3.1 Initial setting time of cement

Time at which water is added to cement (min)	Time at which the needle fails to pierce the test block by 5 + 0.5mm (min)	Initial setting time (min)
0	48	28

FINAL SETTING TIME

1. For determining the field setting time, replace the needle of the vicat's apparatus by the needle with an annular attachment.
2. The cement is considered finally set when upon applying the final setting needle gently to the surface of the test block; the needle makes an impression thereon, while the attachment fails to do so. Record this time (t_3).

Table 3.2 Final setting time of cement

Time at which water is added to cement (min)	Time at which the needle makes an impression on surface of the test block (min)	Final setting time (min)
0	287	540

3.3 FINE AGGREGATE

The aggregate most of which pass through 4.75mm IS sieve are termed as fine aggregates. The fine aggregates may be of following types:

1. Natural sand, i.e., fine aggregate resting from natural disintegration of rocks.
2. Crushed stone sand, i.e., fine aggregate produced by crushing hard stone.
3. Crushed gravel sand, i.e., fine aggregate produced by crushing natural gravel.

According to size, the fine aggregate may be described as coarse, medium and fine sand. Depending upon the particle size distribution IS 383:1970 has divided the fine aggregate into the four grading zone (Grade I to IV)

3.3.1 Specific gravity of fine aggregate

Specific gravity is used in design calculation of concrete mixes.

Specific gravity of fine aggregate = $(W_2 – W_1) / (W_2 – W_1) – (W_3 – W_4)$

Specific gravity of fine aggregate = 2.61

3.3.2 Fineness modulus (sieve analysis)

The sieve analysis is conducted to determine the particle size distribution in a sample aggregate, which we call gradation. The consist of the simple operation of dividing aggregate into fractions, each consisting of particle of the same size all sieve are mounted in frames one above the other in ascending order. The sieve used for coarse aggregate are of size 80mm, 40mm, 20mm, 10mm,4.75mm, 3.35mm, 2.36mm, 1.70mm, 1.18mm, 850µ, 600 µ.

All the sieve are mounted on a sieve shaker and aggregate of known quality is placed over the top sieve and after sieving the residue in each sieve is weighted.

The aggregate fraction from 40mm to 4.75mm are treated as coarse aggregate and those fraction from 4.75mm to 600 microns are termed as fine aggregate.

The sieve analysis on coarse aggregate was carried out as per IS: 2386 (Part 1)-1963 and results are presented in the table.

3.6 Table sieve analysis of fine aggregates

Weight of sample taken= 1kg

Table 3.3 sieve analysis of the fine aggregate

S.NO	IS- sieve Size(mm)	Weight Retained(kg)	Percentage of Retained	Percentage of Passing	Cumulative % retained
1.	4.75	0.017	1.7	98.3	1.7
2.	2.36	0.37	3.7	96.3	5.4
3.	1.18	0.367	36.7	68.3	42.1
4.	600	0.318	31.8	68.2	73.9
5.	300	0.221	22.1	77.9	96
6.	150	0.033	13.3	96.7	99.3
7.	Pan	0.28	2.8	0.00	
	Total	1.00		SUM	318.4
				FM	3.18

3.3.3 Water absorption test

i. The sample should be thoroughly washed to remove finer particles and dust, drained and then placed in the wire basket and immersed in distilled water at a temperature between 22 and 32ºC.

ii. After immersion, the entrapped air should be removed by lifting the basket and allowing it to drop 25 times in 25sec. The basket and sample should remain immersed for a period of 24+1/2 hrs afterwards.

iii. The basket and aggregates should then be removed from the water. Allowed to rain for a few minutes, after which the aggregates should be gently emptied from the basket on to one of the dry clothes and gently surface-dried with the cloth. Transferring it to a second dry cloth when the first would remove no further moisture. The aggregates should be spread on the second cloth and exposed to the atmosphere away from direct sunlight till appears to be completely surface-dry, the aggregates should be weighted w1.

iv. The aggregates should then be placed in an oven at a temperature of 100 to 110ºC for 24hrs. It should then be removed from the oven, cooled and weight w2.

3.3.4 Physical properties of fine aggregates

Table 3.4 Physical properties of fine aggregates

Characteristics	Value
Specific gravity	2.62
Fine modulus	3.18
Water absorption	1%

3.4 COARSE AGGREGATE

The aggregate which is retained over IS sieve 4.75mm is termed as coarse aggregate. The coarse aggregate may be following types:

1. Crushed graves or stone obtained by crushing of gravel or hard stone.
2. Uncrushed graves or stone resulting from the natural disintegration of rocks.
3. Partially crushed gravel obtained of product of blending of above two types.

The normal maximum size is gradually 101-20mm; however particle size up to 40mm or more have been used in self compacting concrete. Regarding the characteristics of difference type of aggregate, crushed aggregates tend to improve the strength because of interlocking of angular particles, while rounded aggregates improve the flow because of lower internal friction.

Locally available coarse aggregate having the maximum size of 20mm was used in this work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition.

3.4.1 Specific gravity coarse aggregate:

Specific gravity of coarse aggregate = $(W_2 - W_1) / (W_2 - W_1) - (W_3 - W_4$

Specific gravity of coarse aggregate = 2. 57

3.4.2 Sieve analysis of coarse aggregates

Weight of sample taken=5000gm

S.NO	IS- sieve Size(mm)	Weight Retained(kg)	Percentage Of retained	Percent of passing	Cumulative % retained
1.	80	0.00	0.00	100	0.00
2.	40	0.00	0.00	100	0.00
3.	25	0.106	2.12	97.88	2.12
4.	20	1.291	25.82	74.18	27.94
5.	12.5	3.421	68.54	31.46	96.48
6.	10	0.102	2.04	97.96	98.52
7.	4.75	0.074	1.48	98.52	100
8.	Pan	0.00	0.00	0.00	
	Total	5.00		SUM	325.06
				FM	3.25

3.3.3 Water absorption test on coarse aggregate

Percentage of water absorption = ((W2-W1) / W1) x 100

% of water absorption = 0.5%

3.3.4 Physical Properties of coarse aggregates

Table 3.6 Properties of coarse aggregates

Characteristics	Value
Shape	Angular
Maximum size	20 mm
Specific gravity	2.58
Water absorption, %	0.5%

CHAPTER 4

4. MIX DESIGN

Design of concrete mix requires complete knowledge of the various properties of the constituent materials .The implications in case of change of these conditions at the site, is complicated interrelationship between the variable strength of concrete as an inverse function of the water/cement ratio.

4.1 MIX DESIGN

Step by step procedure for design of "concrete mix" is given as follows:

- The target mean strength is first determined.
- The water/cement ratio for the target mean strength is chosen.
- The water/cement ratio so chosen is checked against the limiting water/cement ratio.

- The air is estimated from the maximum size of aggregate used as in the table.
- The water content & the percentage of sand in total aggregate by absolute volume are next selected from table for medium and high strength concrete respectively for the following standard reference condition.
- Crushed coarse aggregate.
- Fine aggregate consisting of natural sand conforming to zone II of table.
- The water cement ratio of 0.06 and 0.35 for medium and high strength concrete respectively.
- Workability factor of 0.90.
- For other conditions of workability (w/c) grading of fine aggregate and of rounded aggregate, adjustments of water, percentage of water content and percentage of sand in total aggregate are calculated.
- The cement is calculated from the (w/c) and final water content mixed after adjustments. The cement content so calculated is against the minimum cement from the requirements of durability and the greater of the two values adopted.
- With the quantities of water and cement per unit volume of concrete and the proportion of sand in the total aggregate is determined. The coarse and fine aggregate content per unit volume of concrete are calculated from the following equations

Fine aggregate:

4.2 DESIGN STIPULATION:

1. Characteristic compressive strength Required in field @ 28 day - 20 Mpa
2. Max size of aggregate - 20 mm(Angular)
3. Degree of workability - 0.90 C.F
4. Degree of quality control - Good
5. Type of exposure - Moderate
6. Specific gravity of cement - 3.15
7. Specific gravity of fine aggregate - 2.61
8. Specific gravity of coarse aggregate - 2.57

4.3 TARGET MEAN COMPRESSIVE STRENGTH:

The target mean strength for specified characteristic cube strength

$$s = f_{ck} + (t \times s)$$

$$= 20 + (1.65x4)$$

$$= 26.6 \text{ Mpa}$$

Where f_{ck} = Characteristic compressive strength at 28 days

t = risk factor

S = standard deviation

4.4 SELECTION OF W/C RATIO:

The water cement ratio required for target mean strength of 26.6 Mpa is 0.4.This is lower than the maximum value of 0.6 prescribed for moderate exposure. Hence adopt water cement ratio 0.50.

4.5 SELECTION OF WATER AND CEMENT CONTENT:

From table 4 in IS 10262,for 20 mm max size aggregate, sand conforming to grading zone II, water content per cubic meter of concrete = 186 kg and sand content as percentage by absolute volume = 35 %

For change in value in w/c ratio, compacting factor, for sand belonging to Zone II, following adjustment is required.

Table 4.1 Adjustments for water and sand

Change in condition (Table 6 in IS 10262)	Water content	Sand in total aggregate
For decrease in w/c ratio by (0.60 – 0.45= 0.15)	0	-3.0
For increase in compacting factor (0.90.8=0.10)	+3	0
For sand conforming to Zone II of table 4,IS 383 -1970	0	0
Total	+3	-3

Therefore, required sand content as percentage of

= 35 – 3

Total aggregate by absolute volume = 32%

= 186 + 5.58

Required water content = 191.6 kg/m^3

4.6 DETERMINATION OF CEMENT CONTENT:

Water/cement ratio = 0.50
Water = 191.6 lit
Cement = 191.6/0.5
= 383.20 kg/m^3

This cement content is adequate for 'moderate' exposure condition.

4.7 DETERMINATION OF FINE AND COARSE AGGREGATE:

From table 3 in IS 10262, for the specified max size of aggregate of 20 mm, the amount of entrapped air in the wet concrete is 2 %.

Fine aggregate:

V = $[W+(C/S_c) + f_a/P \times Sf_a][1/1000]$

Coarse aggregate:

C_a = $(1-P)/P \times f_a \times (Sc_a/Sf_a)$

Where,

V = Absolute volume fresh concrete, which is equal to gross Volume (M^3) minus the volume of entrapped air,

W = Mass of water (kg) per m3 of concrete

C = Mass of cement (kg) per m3 of concrete

Sc = Specific gravity of cement

P = Ratio of FA to total aggregate by absolute volume

f_a, C_a = Total mass of FA and CA (kg) per m^3 of concrete respectively

Sfa, Sca = Specific gravities of FA and CA respectively

Fine aggregate:

V = $[W+ (C/Sc) + f_a/P \times Sf_a][1/1000]$

1- 0.02 = $(191.6+ (383.2/3.15) + (f_a/0.32 \times 2.61) \times (1/1000)$

Hence f_a = 568.07 kg / m^3

Coarse aggregate:

C_a = $(1-P)/P \times f_a \times (S_{ca}/S_{fa})$

C_a = $(1-0.32)/0.32 \times 550.26 \times (2.57/2.61)$

C_a = 1188.65 kg / m^3

The mix proportion then becomes:

Water :	**Cement :**	**Fine Aggregate :**	**Coarse Aggregate**
191.6 :	383.20kg :	568.07 kg :	1188.65kg
0.50 :	1 :	1.48 :	3.10

CHAPTER 5

TEST AND RESULTS

5.1 GENERAL

This chapter deals with the presentation of results obtained from various tests conducted on concrete specimens cast. The main obtained of the research is to understand the strength and durability aspects of concrete obtained using crumb rubber as partial replacement of fine aggregate. In order to achieve the obtained of present study, an experimental program was planned to investigation the effect on compressive strength and split tension test. The experimental programs consist of casting, curing, and testing test. The experimental program consist of casting, curing and testing of concrete specimen at different percentage.

The experimental program included the following;

1. Testing of properties of materials used for making concrete.
2. Design mix (M20).
3. Casting and curing of specimens.
4. Testing to determine the compressive strength and split tension strength of concrete.

5.2 COMPRESSIVE STRENGTH

Test specimen of size 150mm x 150mm was prepared and tested using the compressive testing machine. The concrete mixes with varying percentages (10%, 20%, and 30%) after 24 hours the specimens was removed was from the moulds and placed in fresh water. The specimen so cast was after 7 and 14 and 28 days of curing were tested to determine the compressive strength of concrete.

The specimen of size 150mm x 150mm x 150mm

Table 5.1 Compressive Strength Of Concrete

S.NO	% REPLACEMENT OF CRUMB RUBBER	7 DAYS (N/mm^2)	14 DAYS (N/mm^2)	28 DAYS (N/mm^2)
1	CONVENTIONAL	25.66	27.98	28.50
2	10%	24.03	26.15	28.30
3	20%	24.44	25.22	28.45
4	30%	18.05	22.45	20.68

5.3 SPLIT TENSILE STRENGTH

For split tensile strength test, cylinder specimens of dimensions 150mm diameter and 300mm length were cast. The split tensile strength of concrete is determined by casting cylinder of size 150mm x 300mm. The cylinders were tested by placing them uniformly. Specimens were taken out from curing taken at age of 28 days of moist curing and tested after surface water dipped down from specimens.

The magnitude of tensile stress (T) acting uniformly to the line action of applied loading is given by formula.

$T_{sp} = 2p/\pi dl$

Table 5.2 split tensile strength of concrete

S.NO	% REPLACEMENT OF CRUMB RUBBER	7 DAYS (N/mm^2)	28 DAYS (N/mm^2)
1	CONVENTIONAL	1.723	2.234
2	10%	1.432	2.314
3	20%	1.216	1.865
4	30%	1.137	1.734

CHAPTER 6

RESULT AND DISCUSSION

6.1 GENERAL

The strength and durability characteristic of concrete mixture have been computed in the present work by replacing 10%, 20%, and 30% crumb rubber material with the fine aggregate and cement. On the basis of present study, following conclusion are drawn.

6.2 COMPRESSIVE STRENGTH

The compressive strength for the concrete samples is done during the duration of 7 days, 14 days, and 28 days. After the replacement of materialist is found that he compressive strength of concrete has been a considerable rate. The above chart shows that compressive strength of concrete at 7days, 14 days, and 28 days ss gradually increase as the percentage of replacement increases. We conclude that the fine aggregate replaced with crumb rubber at 20% in concrete is suitable for construction.

6.3 SPLIT TENSILE STRENGTH

For split tensile strength test, cylinder specimens of dimensions 150mm diameter and 300mm length were cast.

The above chart shows that tensile strength of concrete at 7 days and 28 days increases gradually as the percentage of replacement increases. However, replacement by 10% and 20% and 30% is equal to the conventional concrete. We conclude that the fine aggregate replaced with crumb rubber at 20% in concrete is suitable for construction.

CHAPTER 7

CONCLUSIONS

In this project we tried to replace the fine aggregate partially crumb rubber (10%, 20%, 30%) respectively to increase the strength of concrete. But the strength is same with the conventional concrete only at 10% and 20% replacement of aggregate by crumb rubber. The strength is gradually decreasing at 30% replacement of crumb rubber. So we conclude that the fine aggregate replaced with crumb rubber at 20% in concrete is suitable for construction. Moreover it reduces the construction cost by reducing the cost of fine aggregate and it also reduce the environmental pollution due to crumb rubber.

CHAPTER 8

LITERATURE REVIEW:

1) Tushar R more, pradip D Jadhao and SM Dumme:

In the study the aim was to study of waste tyre as waste partial replacement of fine aggregate to produce rubberizes concrete in M20 grade of mix. Different partial replacement of crumb rubber i.e., 0%, 3%, 6%, 9%, 12%, by volume of fine aggregate are casted and tested of compression strength and split tensile strength. The result shows that there is reduction in all types of strength of crumb rubber mixture, but crumb rubber content concrete become more lean due to increasing in partial replacement of crumb rubber of fine aggregate i.e., 3%, 6%, 9% and 12%. For split tensile strength decrease with 3% replacement of sand and further decrease in strength with the increase in percentage of crumb rubber. This is mainly due to lower bond strength between cement paste and rubber type aggregate.

2) Prof. M.R. Wakchaura and Mr. Prashant. A. Charan :

In this study they did partial replacement of fine aggregate as crumb rubber as 0.5%, 1%, 1.5%, and 2% in M25 grade of concrete and its effects on concrete properties like compressive strength, flexural strength were investigated. Addition to this combination of glass fiber at ratio 0.4% and 0.5% addition to the weight of cement are used to regain the reduced strength due to use of waste tyre crumb rubber particle. Result indicate that replacement of waste tyre crumb rubber particle to the fine aggregate in concrete at ratio 0.5% and 1% there is no effect on the concrete properties would occur but their was a considerable change for 1.5% and 2% replacement ratio.

3) Dr. B. Krishna Rao:

In this investigation he did casting and testing of cubes, cylinders and prisms for M20 grade of concrete and added 5% and 10% of rubber fiber by volume of concrete. There the specimen are tested for compression, split tensile and flexure strength. The test result is were done and noted that due to addition rubber fiber, strength of concrete decreases, but as observing ductility is improving. Hence it is used for medium grade of concrete. The various rubberized concrete mixes were designed in accordance with standard mix procedure for normal concrete with grade of M20. As expected that target strength were not achieved for the mixes incorporating rubber fiber.

4) Nithiya P and Portchejian G:

It this research paper the mix design was done as per IS:10262-2009 to achieve the target strength. The concrete mixes were made by replacing fine aggregate with 5%, 10%, 15% and 205 for M20 Grade concrete. So the founded that compressive strength decreases with the replacement of crumb rubber increased and 5% replacement of crumb rubber proves exceptionally well in the compressive and tensile strength. It is also gives more strength at 28th days for 5% replacement for M20 Grade of cement and split tensile strength decreases at the maximum at the maximum of 25% when the crumb rubber is replaced up to 10% of fine aggregate. Thus by replacing fine aggregate by crumb rubber safeguard the environment.

5) Jaylina Rana and Reshma Rughooputh:

The broad aim of this work was investigate the effects of partially substituted fine aggregate by rubber on the properties of fresh and hard concrete. Different tests were performed to determine slump, compressive strength, flexural strength, tensile splitting strength and initial surface absorption of the concrete mixes. The compressive, tensile splitting strength, flexural decreases with increasing rubber content. Rubber fails the initial surface absorption test that is the surfaces of their concrete mixes are almost impermeable. However, partial replacement of fine aggregate with 5% of rubber can potentially be used in low strength concrete applications.

6) S.Selvakumar and R.Venkatakrishnaiah:

They did concrete mix as per IS:10262-2009 for M30 grade of concrete for their investigation. The specimen was casted and used to determine the compressive strength, split tensile strength and flextural strength of concrete. They were tested for 7 and 28 days with replacement of fine aggregate with 5%,10%, 15%, 20% of crumb rubber. Finally, they concluded that compressive strength of crumb rubber4 concrete with 5% replacement is 38.66 N/mm^2 , it is higher than the strength of the normal concrete ie.,36.73 N/mm^2 on the 28 days.

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