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Effect Of Crumb Rubber On The Mechanical Properties Of Concrete And Future Possibility In Building Structure

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Abstract—

Rubber is the major waste product in India. The rubber waste is produce by the many fields like sleeper industry, shoes industry and automobile industry. It is very difficult to disposed waste rubber without any negative effect on the environment .day by day number of automobiles increases due to population in India. Waste tire landfills give harmful affect on the environment. Waste tire disposal gives water pollution in ocean. Which gives bad effect on ocean species. Fishes or other water species which is consumed by people results harmful affect on human health. Replacement of crumb rubber which obtained by waste tire in concrete can gives a solution in certain range. Crumb rubber which is obtain by waste rubber replaces by fine aggregate by weight 5,10 and 15 percent and change in concrete property investigated due to replacement of crumb rubber. Crumb rubber which is obtained from the waste tire is replaced with fine aggregate by weight. The amount of crumb rubber has replaced by waste rubber 5 percent 10 percent and 15 percent by weight. Mechanical properties of rubcrete change to reinforcement of crumb rubber. Mechanical and chemical property depend upon the individual bonding between the coarse aggregate fine aggregate cement and crumb rubber which has replaced by fine aggregate.

Keywords- Rubber concrete composite, Railway sleepers, Crumb Rubber, Waste tyre rubber, flexural strength, compression strength

1. Introduction:

According to economics times report India has become the 4th largest auto market by surpassing Germany and now disposal of waste tires becomes very severe in India also. [1] UN report says India is expected to add nearly 273 million people between 2019 and 2050. Previous UN projections had estimated that India will surpass China as the world's most populous country as early as 2022. India is the seventh largest country in the world by land but second by population and forth by numbers of automobile this condition shows how the disposal of waste tire is severe in India .[2]
According to a new research ‘Circulating Tires in the Economy’ by NGO Chintan quoted in The Times of India, approximately 60% of end-of-life tires (ELTs) might end up being discarded at landfills or being burned. India produces 127.34 millions tire in year 2016-17 but 60 % of scrap tire were removed to landfills

or burned. Waste tire produce a risk to health of public and also affect the environment [3].
Following risk to health of people and environment

1. Waste tires gives adaptable living and breeding conditions for insects which can spread diseases such as Encephalitis, West Nile Virus, and Zika Virus.
2. Its Provide breeding grounds for rats, snakes, ticks, and other vectors.
3. They have high risk of a fire hazard due to improperly stockpile.
4. When burned illegally its emitted harmful gases and oil which goes to air and water.
5. Due to land disposal of waste tire agriculture land availability get reduce
6. Waste tire/waste rubber disposal in ocean or river harmful for fishes and aquatic species. Coastal state where theses are the main source of food consumes by human and animals which is dangerous for human health.
7. There is a possibility to proliferate viral deceases by inspects and mosquito.

1.1 Possible Composite material from waste tire rubber powder:

1.1.a) Rubcrete:

It is the mixture of tire waste powder and concrete .The concrete is selected having 48 Mpa compressive strength. when rubber is replaced with fine aggregates it decreases the compressive strength of concrete . mixture of concrete and rubber powder have compressive strength in the range between 28 to 35 MPA. tire rubber have high strength to weight ratio but compressive strength less then concrete but overall strength to weight ratio will be increased when we compare to concrete .
Good compressive strength results were recorded at rubber contents lower than 25% in replacement of crushed sand**.** Up to 8% reduction in density was recorded at 25% rubber in substitution of crushed sand. Enhanced ductility of concrete advantageous for usage in highway barriers or other similar shock-resisting elements. Replacing more than 25% of fine aggregates with rubber crumb causes the compressive strength of concrete to drop extremely. Material is unpredictable; failure stress strain relationship does not follow a fixed pattern in experiments at same point.

1.1.(b).Wood rub: It is the mixture of tire waste powder and wood material. It has been used as a material for chair seats and table tops, etc. and is cheaper than oak. Rubber have better corrosion resistance property and wood material have high environmental effective material due to composition of both material wood rub can have achieve high resistive to environment property and also strength to weight ratio becomes more.

1.1.(c). Asphalt rubber: In tire powder 58% have rubber. Scrap rubber is converted into crumb rubber and blended with asphalt cement blending process consist of mixing asphalt cement and 15 to 12 % of crumb rubber and rubber is heated to 350 to 450 degree Fahrenheit temperature this mixture reacts and form a gel called asphalt rubber. Additive may be incorporated to adjust the viscosity there are many use of mixture. Use of asphalt rubber in road construction as binder increases pavement life because film thickness and resistance of binding oxidation increases. Due to higher viscosity of asphalt rubber increases the resistance of permanent deformation so that it can use as a shock absorbing element. Elastic character stick provided resistance or thermal cracking.

Raghavan D. et al., 1998, reported that mortars incorporating rubber shreds achieved workability comparable to or better than a control mortar without rubber particles. Because of the low specific gravity of rubber particles, the unit weight of the mixture containing rubber decreases with the increase in the rubber content. They also observed that rubber shreds incorporated into mortar help reduce plastic shrinkage cracking in comparison to control mortar.

Manalo A. et al., 2009, told about the challenges and problem occurs by concrete sleepers, timber sleepers and possibility of replacement with composite material**.** major challenge in civil engineering is to develop an economically competitive structure of suitable strength which will satisfy the needs of the industry and all the requirements for serviceability, durability, maintenance and ease of construction. These challenges need to be overcome for fiber composite sleepers to become a suitable alternative to timber sleepers. The material and geometric properties have a significant effect on the design and performance of railway sleepers. In the Australian railway systems, timber sleepers need to satisfy specific requirements such as strength, durability and stiffness properties. Fiber composite alternatives for railway sleeper have the ability to compete effectively with conventional sleeper materials. Several researches and developments on fiber composite sleepers have shown that this alternative material has physical and mechanical properties comparable or even better than that of timber sleepers. However, the performance history of these new materials is relatively short compared to timber sleepers. Continuous research and development are essential to develop the market and increase confidence in using this alternative material. Field trials and in-service performance evaluation will be very valuable in achieving this goal. Finally, development of national and international standards will encourage the adoption of fiber composites as an alternative railway sleeper material.

Alif S. et al., 2012, in this paper they investigations were carried out to study the mechanical properties like fatigue strength and impact resistance of rubber concrete and ordinary concrete as per Indian standards and ACI standards. The following conclusions are arrived at. Presence of crumb rubber in concrete has increased the resistance to crack initiation under impact load by 80-110%. Impact load at failure was 50% high for concrete with crumb rubber. This is due to the energy absorption capacity of the crumb rubber. Failure cycle for the crumb rubber concrete was high which increases the damage life. In railway sleeper, presence of crumb rubber shows 40-60% increase in impact strength when compared to pre stressed concrete.

Wahid F. et al., 2014, in this paper they investigated the failure mode of different types of sleeper, in timber sleeper fungal decay and terminate attack minimize by the Impregnation with synthetic chemicals/biological treatment and end splitting which is minimize by Providing end plates, in concrete Rail-seat deterioration occur which is minimize by Steel plate/epoxy coating/addition of fly ash and silica fume in concrete/steel fiber reinforced grout multilayer abrasion resistant pad assembly and metallic aggregate in the rail-seat region. Longitudinal cracking also occur which is minimize by providing special expansive concrete/transverse reinforcing bar around bolt hole area. In steel sleeper, corrosion problem occur due to reaction of steel with atmosphere which is minimized by avoiding steel sleeper from the locations having slag ballast/high salinity/moist and corrosive materials zinc coating can be alternative solution. deterioration of concrete sleepers due to DEF and AAR could be minimized by replacing cement concrete with geo polymer concrete as the latter material exhibits excellent engineering properties which provide protection against chemical degradation. On the other hand, the composite properties of resistance to corrosion, high impact loading and fatigue, as well as their durability, make them efficient sleeper materials. Continued efforts are still needed towards the better understanding of these new materials for their more economical exploitation in mainline railway sleepers

Swapnil G. et al., 2015, investigated the problems that is occur in concrete sleeper due to sun light energy which is emitted by sun on earth is absorb by concrete which makes concrete weaken. In their study they used fly ash instead of cement which containing silica(55 to 65 % by weight),aluminum oxide(22 to 25% by weight),iron oxide(5 to 7%), calcium oxide(5 to 7%)magnesium oxide(less than 1%),titanium(oxide less than 1%), phosphorus(less than 1 %) ,sulphates(0.1 %)alkali oxide(less than 1%) ,loss of ignition (1 to 1.5%).Another GGBFS(Ground Granulated Blast Furnace slag) was used. Chemical composition of GGBFS has 35% by weight silica, 13% by weight alumina and 8% by weight magneia. They prepared the sodium hydroxide solution of 16 molarity and 18 molarity by mixing the pallets in water. They Mixed the above prepared sodium hydroxide solution and sodium silicate solution at least one day prior to adding the liquid to the dry materials. They taken dry material and add the liquid component of the mixture at the end of dry mixing, and continue the wet mixing for another 10-15 minutes. The fresh geo polymer concrete was cast in mould of size 15cm x 15cm x 15cm cubes immediately after mixing. It was compacted using 9000 RPM vibrator. In this work two types of curing regime were adopted that is steam curing and ambient curing. Steam curing was done at an average temperature of 650C for 24 hours and ambient curing was done at an average temperature of 400C for 7 days. They concluded the following results:

1) In short period of 24 hours, Geo polymer concrete prepared using steam curing regime satisfies the strength requirement of Indian railway code for sleepers (T39-85).

2) Required strength for railway sleepers cannot be attained without addition of GGBFS under ambient curing.

3) If we used Ambient curing only the Geopolymer concrete can be used for preparation of sleepers in straight, curved portion, points and crossing portion of the track.

4) Ambient curing method will save the energy required in steam curing.

5) Geo polymer concrete of 16 molarity for alkaline liquid to fly ash ratio 0.35 with steam curing and with addition of 30% GGBFS under ambient curing can be used for preparation of railway sleepers in normal location of tack.

6) Geo polymer concrete of 18 morality for alkaline liquid to fly ash ratio 0.35 and 0.4 with steam curing and with addition of 30% GGBFS under ambient curing can be used for

preparation railway sleepers in all locations of track.

Khaldoon A. et al., 2015, Investigated the performance of using waste tire crumb rubber as an alternative aggregate for concrete pedestrian blocks. They focused on determining the engineering properties of the crumb rubber concrete pedestrian blocks, such as unit weight, water absorption, compressive and flexural strengths, as well as freeze-and-thaw resistance. In that study, crumb rubber was used to replace portions of fine aggregates in the manufacturing of concrete pedestrian blocks. Crumb rubber concrete pedestrian blocks were found to possess good aesthetics and a smaller unit weight than plain concrete pedestrian blocks. They were also found to have good resistance to repeated freezing and thawing cycles. in that experiment they used Five different crumb rubber sizes; namely SRC 12, 20, 30, 40 and 50,. Crumb rubber, which was produced by grinding vehicle tires, was imported from one of the rubber reclaiming plants in Manchester, United Kingdom. The grinding process started by cutting and sorting out rubber and steel parts. After that, rubber pieces was fed into a cutting wheel several times until the desired size was achieved. At the final stage, crumb rubber was sorted out and grouped together according to particle size. The control mix was prepared with cement, limestone aggregate and fine aggregate in the proportion of 1:1.72:1.93 by weight to achieve a target compressive strength of not less than 30 MPa after curing. The control mix was the basis for preparing three crumb rubber mixed, where the fine aggregate of the control mix was replaced by crumb rubber at a percentage of 20, 40 and 60%, respectively. Five replicates were used for the determination of the physical properties (unit weight, water absorption and freeze-and-thaw resistance) of crumb rubber pedestrian blocks. Crumb rubber concrete pedestrian blocks showed acceptable aesthetics. The use of crumb rubber resulted in an appreciable reduction of block unit weight. Crumb rubber concrete pedestrian blocks experienced a rather ductile failure and the ability to absorb a large amount of plastic energy under compression and flexure. The use of crumb rubber reduced the compressive and flexural strengths of pedestrian blocks. The reduction correlates to the percentage of crumb rubber by volume in the mix. Crumb rubber concrete pedestrian blocks have been observed to show a more inferior performance than plain concrete pedestrian blocks in compression and flexure, but showed a great improvement in toughness. Thus, crumb rubber concrete pedestrian blocks have a great potential to be used for pedestrian pavements.

Paulo L. et al., 2015, The rheology of binary and ternary PP based blends, with EPDM, EPR and GTR (ground tire rubber) as rubber components was studied, revealing characteristic pseudo plastic behaviour of all the analysed blends. The use of a highly flow able PP material proved to be a suitable strategy for the development of TPE(GTR) blends with adequate flow ability for the injection moulding process, counterbalancing the viscosity increase induced by (GTR). The incorporation of a rubber component in the ternary blends, such as EPR, with low viscosity, pseudo plastic behaviour and compatible with PP, enables the production of new TPE (GTR) blends with good process ability characteristics for injection moulding applications. The numerical method used for the determination of the Cross- WLF rheological parameters provided a very close estimation to the experimental data obtained by capillary rheometry. The Cross-WLF model can be used in a new stage of the TPE(GTR) industrialization process, supported by numerical simulations and experimental trials of the injection moulding process. This study shows that injection moulding has the potential to be considered for large scale recycling of GTR. The development of TPE(GTR) blends can be an adequate strategy to up cycle this type of potentially wasted material.

Bashar S. et al., 2017, reviewed the effect of concrete sleepers adding or decreasing rubber percentage by weight and latest works have been conducted to investigate rubcrete properties in both fresh and hardened state. The fresh properties include unit weight, air content, and workability while the hardened properties include compressive, tensile and flexural strengths, static and dynamic modulus of elasticity, shrinkage, abrasion resistance, impact resistance, ductility, energy absorption, toughness and fatigue properties. It also covers durability performances which include chloride Ion Penetration, water absorption, porosity, carbonation resistance, corrosion resistance, and freeze/thaw resistance. Other physical properties such as sound absorption, electrical resistivity, and thermal conductivity had been reviewed.

1. Rubcrete has improved workability and freeze / thaw resistance.

2. Reduction in the strengths of rubcrete can be offset economically using nano silica as cementitious addition.

2. The lower drying shrinkage of rubcrete will promote it as good repair mortar and also in mass concreting application such dams and rigid pavements.

3. Due to the ability of rubcrete in absorbing impact loading, members subject to accidental impact loads can be made of rubcrete such as crush barrier.

5. The improved fatigue load cycles and toughness of rubcrete make it suitable for roller compacted rigid pavement

6. The rubcrete can be used in producing of members/products that can be used in improving life quality of habitants due to its high sound absorption, high electrical resistivity and lower Thermal conductivity.

Vinita V. et al, 2017, reviewed on green concrete which means waste materials from agriculture, industries, bio-waste, marine waste and e-waste can be recycled and used as supplementary Green Concrete materials. This will reduce environmental impact of the production of OPC and reduces energy consumption. The application of nanotechnology for a Green building in the current and future is very much significant. So another alternative of Green Concrete technology has to be found for potential use of these waste materials. It can be used as aggregates which exhibited lower compressive and splitting-tensile strength than normal concrete. The properties of these types of concrete can be enhanced by the additives which depend on the size and distribution of the rubber particle. Rubber concrete also called ‘‘rubcrete” can solve the problems of uses of natural rubber. Tyre waste modified concrete is recommended for concrete structures especially in areas of severe earthquake risk, severe dynamic actions like railway sleepers and can be used for non-load bearing structures noise reduction barriers. The mechanical behavior of the concrete such as compressive strength and dynamic loading can be analyzed in this rubber filled concrete.

Chaudhry R. et al, 2017, investigated the use of tire rubber particle as a replacement of fine aggregate concrete Up to 30% crumb rubber may be allowed for use in concrete mixtures produced for construction applications. It is anticipated that the use of crumb rubber in future concrete construction will have to be incentive based in order to introduce its use to designers and contractors. Utilization of waste tires in the study process had been focus to reduce tire wastes, economic, environmental management. Test results of 28 days rubberized concrete shown 10%, 15% replacement of junk tire rubber gives low compressive strength than conventional concrete specimens. Checking for rubberized concrete in non-structural elements like concrete work, pavements, runways, drainage, harbors etc. The present study aims to investigate the optimal use of waste tire rubber aggregates as fine aggregate in concrete composite. Based on the literature survey it was seen that compressive strength of concrete reduces with the addition of rubber aggregate, so selected M35 as reference mix. And they observed that addition of rubber aggregates did not affect the slump value of concrete. and gradual reduction in compressive strength was observed with the increase in the percentage of rubber aggregates. and Up to 3% of rubber aggregates can be added into concrete mixes without considerable reduction in strength of concrete. And Percentage of water absorption decreases as the % of rubber aggregate increases. Irish P. et al., 2018, by this research they carried out conducting tests on the raw materials to ascertain their properties and suitability for the experimental programmed. The specimens were prepared with replacements of the normal coarse and fine aggregate by 2, 4, 6, 8 and 10 % of rubber aggregate. Moreover, a control mix with no replacement of the coarse and fine aggregate was prepared to make a comparative study. The laboratory tests conducted included slump value, unit weight, compressive strength, splitting tensile strength and impact resistance. The test results were compared with the corresponding properties of the conventional cement concrete. They use Ordinary Portland Cement (43 grade conforming to IS: 12269-1987) ,sand (Fine grained sand of Narmada river near Nemawar is used in this investigation. The sand has fineness modulus of 2.35 and specific gravity of 2.62),Coarse aggregate tyre and natural coarse aggregates(Crushed coarse aggregates with angular shape is used for preparation of concrete specimens. Coarse rubber aggregate
with 20 mm maximum size is used for the replacement of natural coarse aggregate. Shredded rubber crumbs are used for fine aggregate replacements. Crumb rubber used has 100 percent of the particles finer than 4.75 mm) and water used for making concrete is o portable standard. concrete significantly decreases the slump and workability. It was noted that the slump decreased as the percentage of tyre derived aggregate was increased in all the rubberized mixes. Rubberized concrete can be used at the situations where less workable concrete is required (e.g., in case of underwater concreting).The results of the bond strength tests show that, there is increase in strength

with increasing rubber aggregate content reported in literature. One of the reasons why bond strength of the rubberized concrete is higher than that of the conventional concrete may be the sufficiently better grip of rubber aggregates over embedded reinforcement as compared to that in case of concrete made with natural aggregates. Rough texture of tyre derived aggregate may also help to increase bond strength of rubberized mixes. A few desirable characteristics such as lower density, higher impact and toughness resistance, low crushing value, ductility and higher bond strength can make the rubberized concrete as an useful alternative to normal concrete.

3. Material and method:

Felicitous properties of the materials are required for properties. So the specification of the material has listed in Table .following material and testing has been used during experiments to investigate the mechanical properties of concrete.

Table 1: material specification and mechanical testing

S. N.	Name of Item	Specification		Quantity
1.	Waste Tyre Crumb Rubber	Range: 4.75 to 0.075mm Fineness Modulus: 2.72 Bulk Density: 670 kg/m^3		One number By Weight (Initially 40 kg)
2.	Cement	Ordinary Portland Cement of 43 grade to 53 grade		Four number(each bag 40 kg)
3.	Coarse Aggregate and Fine Aggregate	IS Sieve Conforming Grade Zone II	4.75 mm	Four number(each bag 40 kg)
		Crushed Stone particle	Size less than 20 mm	
4.	Super Plasticizer	Naphthalene based Super Plasticizer		Two number
5.	Testing	1. Compressive Strength Test (7th, 14th and 28th day) 2. Flexural Strength of Rubber Concrete(7^{th,} 14th and 28 day)		

3.1. Control design (no rubber R0):

In control deign there is no rubber replacement with fine aggregate and by this control design we compare the other sample.

Calculations for control design:

a) For M 50(R0)

1) Target mean strength = 50+(5×1.65)MPa=58.25 MPa

2) Selection of water cement ratio:

3) Calculation of cement for M 50

Assume water content ratio =0.34

As we use 495 kg/m^3 cement and mould size is 15cm×15cm×15 cm then Amount of cement for 15×15×15cm^3 = 3375 cm^3

Amount of water for 495 kg/m^3 = (495×3375×10^$^{-6}$) = 1.670625 kg

4) Fine aggregate is 684 kg/m3

For 15 ×15×15 cm3 = (684 .003375)=2.3085 kg

5) Coarse aggregate is 1097 Kg/m3

For 15×15×15cm3 =1097 ×.00375 = 4.1137 kg

Crushed stone size is 20 mm

6) Water ratio is 158 Kg/m3

For 15×15×15 cm3 = (158 ×.00375) =(.5925) kg

7) Super plasticizer = (36.75 mg)

8) Silica fume = .34×0.00375=0.1275 kg

Six sample is prepare by mould which dimension is 15 cm ×15 cm ×15 cm Therefore the amount will be needed is six times as calculated earlier. So the amount is six times as we used.

Ratio for M 50 is

Cement: fine aggregate: coarse aggregate:water:silica fume =0.2034 : 0.28:0.50076:0.071:0.0155

Cement =11.5 kg

Fine aggregate =15.96 kg

Coarse aggregate =28.54 kg

Water = 4.047 kg

Silica fume= 0.8835 kg.

Figure 1: Cubic mould (15cm ×15cm ×15cm)

Figure 2: Make a polish for easily withdrawn for freeze sample

Figure 3: Mixing of coarse aggregate fine aggregate cement and silica

Figure 4: Prepared sample

When all the samples are ready, than wait for one day and all sample goes set up in 24 hours. After 24 hours when sample is set in shape then remove the mould. All six samples are put in the water. Compressive strength becomes increases with time .but after 28 days the compressive strength becomes constant. When sample puts in water its porosity get decreases and compressive strength increases

Fig 5: Sample in water

1. Mix design (With 5% rubber R5):

From the earlier equation for R0

Cement: fine Aggregate: coarse aggregate: water: silica =(0.2034:0.28:0.50076:0.071:0.155)

R5 sample fine aggregate is replaced by crumb rubber 5% as in preparing six sample.

Amount of cement for 6 sample =10.02 kg

Amount of fine aggregate for 6 sample=15.96 kg

But we replace 5% of fine aggregate with rubber 15.96 ×0.95 =15.162 kg

Amount of rubber = 0.69 kg

Amount of Coarse aggregate =24.66 kg

Amount of water =3.4 liter

Silica fume = .9161 kg

2. Mix design (with 10 % rubber R10):

In R10 mix design all amount would be same except fine aggregate which reduce 10 percent by weight so fine aggregate will be =(15.95×.90 =14.36 kg

Amount of crumb rubber will be =15.95×.10 =1.59 kg

3. Mix design (with 15 % rubber R15)

In R15 mix design all amount would be same except fine aggregate which reduce 10 percent by weight so fine aggregate would be =(15.95×.85)= 13.56 kg

Amount of rubber =15.95×.15 =2.93 Kg

Compression Test for cube sample:

Compression test perform on universal testing machine. Which body is metallic and destructive test is performed.

Figure 6: R0 Sample prepared for testing (7 Day)

All 24 samples are tested in the interval of 7, 14, 21 and 28 days approximately. It has been found that there is decrement in compressive strength when rubber percentage increases when we replacing with fine aggregate.

Figure 7: testing setup for R5 sample

Compressive strength of concrete sample is increases day by day and then saturated up to 28 days and constant after 35 days .porosity is deceases by water.

Two point bend test: Beam type sample with square cross section is used. Samples with three different compositions have been prepared. The rubber powder is used to replace fine aggregate. fine aggregate is replaced by crumb rubber with 5,10 and 15 percent .two point bend test would be performed on flexural testing machine. There are 6 sample has been prepared because there would be chance to ruin sample during came out from mould. After preparing insert all the samples in the water and check the sample's flexural strength in 7, 14, 21 and 28 days

Control sample: In control size there is no crumb rubber. This control sample is use to compare the result with other sample. Control sample has been prepared. The test has been performed in the interval of 7, 14, 21 and 28 days. Flexural test is performed on flexural testing machine. Sample size is $40\times10\times10$ cm^3. For cubic sample approximate weight of the sample is 9 kg and the size is about to 15*15*15 cm^3. Then approximate weight of beam is:

$9/x= (15\times15\times15)/ (10\times10\times50)$

Where, x is equal to weight of beam. The value of x is about to 13.33 kg.

Cement: fine aggregate; coarse aggregate: water=0.2034:0.28:0.50076:0.071

For 1 meter^3 cube sample the amount of cement is equal to 495 kg.

For $10\times10\times50$ cm^3 the amount of cement would be= 2.475 kg

For 6 sample amount of cement =2.475 ×6 =14.850 kg

Similarly Fine aggregate 1 meter^3 required = 684 kg

For $10\times10\times50$ cm^3 would be $^=$3.420 kg

For 6 sample =3.420×6 =20.520 kg

Similarly 1 meter 3 coarse aggregate the amount of coarse aggregate is equal to 1097 kg

For $10\times10\times50$ cm^3 would be $^=$ 5.485 kg

For 6 sample =5.485×6= 32.91 kg

Similarly water required or 1 meter^3 is equal to 158 kg

For $10\times10\times50$ cm^3 would be $^=$.790 kg

For 6 sample= 4.740 kg

Figure 8: sample prepare or flexural test

R5 sample: in this sample 5 percent rubber is replaced with fine aggregate.

For 6 sample amount of fine aggregate =20.520×.95= 19.494 kg

Amount of crumb rubber =20.520×.05=1.026 kg

Similarly amount of cement or 6 sample = 14.850 kg

Similarly amount of coarse aggregate or 6 sample= 32.91 kg

Similarly water required for 6 sample = 4.740 kg

R 10 sample: in this sample 10 percent rubber is replaced with fine aggregate.

For 6 sample amount of fine aggregate =20.520 ×.90 =18.468 kg

For 6 sample amount of crumb rubber = 2.052 kg

Similarly amount of cement or 6 sample = 14.850 kg

Similarly amount of coarse aggregate or 6 sample= 32.91 kg

Similarly water required for 6 sample = 4.740 kg

R 15 sample: in this sample 10 percent rubber is replaced with fine aggregate .

For 6 sample amount of fine aggregate =20.520 ×.85 =17.422 kg

For 6 sample amount of crumb rubber = 3.078 kg

Similarly amount of cement or 6 sample = 14.850 kg

Similarly amount of coarse aggregate or 6 sample= 32.91 kg

Similarly water required for 6 sample = 4.740 kg

Compression test on cube sample:

Compressive strength is the ability of structure to carry the loads on its surface without any crack or deflection. A material under compression tends to reduce the size. Its a destructive type of taste where the sample brakes into two or more than two many part. Concrete cube sample are brittle in nature.

Compressive strength formula:

Compressive strength = (load applied /cross section area)

Automatic Compressive testing machine:

Maximum load =200 ton

Ram diameter = 8.486 inch

Body type: metallic

Figure 9: Compression strength testing machine

R0 Sample has been prepared at the date 16/10/2018. Similarly R 5 ,R 10 AND R 15 also prepared at 26/10/2018, 20/11/2018 and 14/12/2018.

In December atmosphere temperature is low so setting time become increases and water is also at low temperature so there will be minor change in the property o concrete sample which can reduce by increasing setting time.

Testing procedure:

The sample which are in water tank, Leave them out and keep them for 2 to 3 hours. Then put on the lower plate and close by the top plate.

Figure 10: Testing of R0 sample

The amount of load gets increasing. After some time loads get decreasing and the sample goes to fracture point. The maximum load on which shows on indicator machine is call the maximum load. The ratio of maximum load to cross section area of cube sample is called compressive strength of sample.

Table 2: compression test results on cubic mould

	Compression test(load in kN)					
Rubber composition	Day 7	Day 14	Day 21	Day 28	Day 35	Day 42
R0(control sample 0 % rubber)	65	80	95	106	85	92
R5(5% rubber)	68	68	68	70	66	77
R10(10% rubber)	42	45	40	47	45	45
R15(15 % rubber)	35	35	33	40	38	37

Flexural strength (two point bend test): flexural strength is the material property. It is defined as the stress in material just before the yield in flexure test. Flexural strength, also called a modulus of rupture, or bend strength, or transverse rupture strength. The flexural strength is highest stress induced during the time of bending. It is denoted as σ.

In flexural strength sample size 50×10×10×10 cm^3 has been prepared with replacement of crumb rubber with fine aggregate in 0%,5% ,10% and 15%..Flexural test use to measure the tensile strength indirectly. It inspects the ability of unreinforced concrete beam to withstand failure in bending. The results of flexural test

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on concrete expressed as a modulus of rupture which denotes as (MR) in MPa or psi.

Figure 11: Flexural testing machine

Ram diameter: 62 mm

Maximum load: 100 kN

1 division: 0.5 kN

Figure 12: prepared beam sample for flexural test

Length of the sample is 40 cm and point is consider to l/3 distance from the right and left side of the beam and mid point is 20 cm to left and right side of the beam. Sample is placed upon the flexural testing machine according to figure and load increases slowly. This is the destructive type of test. Maximum strength would be achieved at yield point when material starts showing plastically behaviour.

Figure 13: testing of sample on flexural strength machine

Centre point load testing has been performed on flexural testing machine and the failure of sample is from the middle. There is minor plastically deformation occur.

Table 3: flexural testing results

	Flexural test(Load in kN)					
Rubber composition	Day 7	Day 14	Day 21	Day 28	Day 35	Day 42
R0(control sample 0 % rubber)	2	8	8.2	8.6	9	9.5
R5(5% rubber)	1.5	7.5	7.55	8	8.1	8.5
R10(10% rubber)	1	6	7	7.7	7.9	8
R15(15 % rubber)	1	5.8	6.6	7	7.4	7.8

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Compression strength and flexural strength result and discussion:

From the result tables it is found that compressive strength becomes deceasing as the amount of crumb rubber increases. Fine aggregate have high capability to achieve compression strength as the number of days becomes increasing the compressive strength becomes increasing but after 28 day its achieved maximum compressive strength after 28 days compressive strength start decreasing in other condition while testing on flexural strength also increasing when the number of days has been increasing. But in case of flexural strength the decrement is slowly and there is minor change in flexural strength.

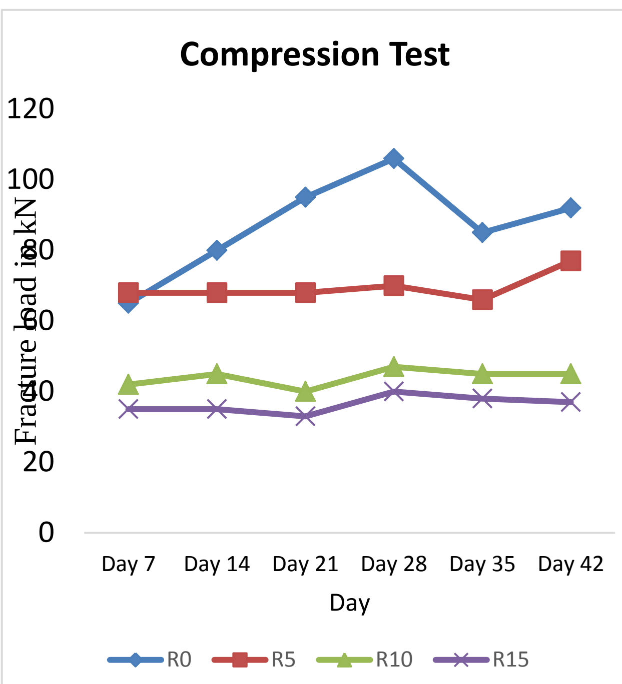

Figure 14: Graph between compression test and no of days

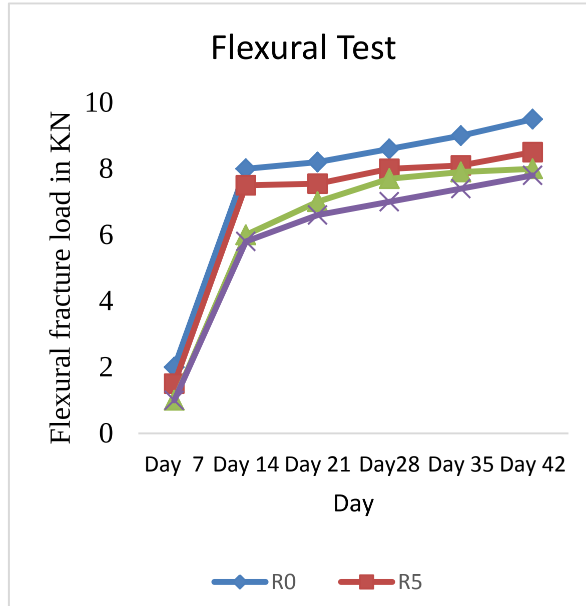

Figure 15: Graph between flexural strength and number of days

4.Results: following conclusion has been maid during the testing.

1) During the replacement of waste tire into fine aggregate decreases the compression strength of mix sample.
2) Highest compressive strength achieved at 28 days in every control and mix sample.
3) Flexural strength and compressive strengths decreases when waste tire rubber is added in concrete due to lack of bonding between matrix and reinforcement particles.
4) Addition of waste rubber tyre into normal concrete mix leads to decrease in workability for the various mix samples.
5) When 10% fine aggregate was replaced by waste rubber tyre compressive Strength decreases with increasers the

waste rubber tyre due to poor bonding strength between cement and waste rubber tyre chips at both 14 and 28 days strength.

6) Comparative study shows the amount of decrease in compressive strength as compare to the flexural strength is higher.

5. Discussions:

Usage of waste tire in concrete have the capability to improve damping properties of rubcrete. There is also a possibility to reaction with TMT bar. Waste tire use in building structure can improve the acoustic property which reduces the noise pollution and this type of building structure plays very important role in the field of education and making hospital building. Rubcrete material can also plays very important role in earthquake for lightweight structure property. Rubber bumper use in ships and naval .it has the capability to use in making automobile bumper which will be very effective in severe accident and collision of automobiles.

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