"MECHANICAL PROPERTIES OF CONCRETE BY USING CRUMB RUBBER AS A PARTIAL REPLACEMENT OF AGGREGATES"

Submitted in partial fulfillment of the requirements for the project presentation

Of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

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MAY 2017

CERTIFICATE

This is to certify that the first project report entitled "MECHANICAL PROPERTIES OF CONCRETE BY USING CRUMB RUBBER AS A PARTIAL REPLACEMENT OF AGGREGATES" is a bonafide record of the work carried out by Mr. Anshul Shandil and Mr. Anshul Kashyap under my supervision and guidance. This report is submitted in partial fulfillment of the Project Part-1 for the award of B-Tech at Jaypee University of Information Technology

The above statement made is correct and to the best of my knowledge.

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ACKNOWLEDGEMENT

We express our sincere thanks to Mr. Anirban Dhulia (Asst. Lecturer, Civil Engineering Department),who guided us through the project also gave us valuable suggestions and guidance for this project. He helped us to understand the intricate issues involved in project-making besides effectively presenting it. These intricate would have been lost otherwise. Our project was completed because of his valuable suggestions, motivation & ideas.

We are also thankful to the whole civil engineering department for providing us the technical support to carry out the project work, to let us utilize all the necessary facilities of the institute and guidance at each and every step during the project.

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ABSTRACT

The transfer of waste tires is transforming into an imperative waste organization issue on the planet at this moment. It is evaluated that 1.2 billions of waste tire flexible conveyed universally in a year, in which 11 % of post buyer tires are exchanged and 27 % are sent to landfill, stockpiled or dumped unlawfully and only 4 % is used for basic building wanders. In this way attempts have been taken to perceive the potential utilization of waste tires in basic outlining wanders. In this encapsulation, our present survey intends to look into the perfect usage of waste tire flexible pieces as fine aggregate in bond composite. Blocks and barrels illustrations were tossed with the substitution of fine aggregate by versatile pieces with the degree of 2 %, 4 % by weight and differentiated and the general cases. Hardened properties of bond, for instance, compressive quality and versatility were done .From the test results, it is proposed that 3 % substitution level of waste tire flexible aggregate will be perfect substitution in strong composites.

The consequences of prominently directed overviews and surveys were as per the the mechanical properties, for eg, ductile and compressive qualities demonstrate diminish,rubber supplanted concrete can't be utilized under high load conditions yet can be utilized as a part of spots, for eg, asphalts where stack bearing prerequisites are low,workability of solid diminishing however are inside admissible breaking points ,optimum results are acquired at 3% substitution.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND SYMBOLS

OPC	**Ordinary Pozzolana Cement**
CA	**Coarse Aggregate**
FA	**Fine Aggregate**
CTM	**Compression Testing Machine**
P	**Load Applied**
L	**Length**
Fck	**Characteristic Compressive Strength**
Mpa	**Mega Pascal**
w\c	**Water Cement Ratio**
Avg	**Average**
Mm	**Millimeters**

CHAPTER 1

INTRODUCTION

Elastic is conveyed from normal or produced sources. Typical versatile is obtained from the smooth white fluid called latex, found in many plants; designed rubbers conveyed from unsaturated hydrocarbons. There are a couple made rubbers in progress. These are conveyed similarly to plastics, by a blend technique known as polymerization. They fuse neoprene, Buna rubbers, and butyl versatile. Designed rubbers have when in doubt been made with specific properties for master applications.

The built rubbers ordinarily used for tire create are styrene-butadiene versatile and butadiene flexible. The utilization of adaptable thing is expanding each year in around the world. India is moreover one the best nation in masses beats 100 cr. So the use of vehicles in addition reached out, as per that the tires for the vehicles moreover particularly utilized and the measure of manhandle of tire flexible is developing. This makes a key issue for the earth and their livings. Just 25 % or less is used as a fuel substitute or as grungy material for the fabrication of various assorted adaptable things. Covering scrap tires in landfills is inefficient, and also exorbitant. Trade of entire tire has been bound in the greater bit of landfill operations as a result of the inconvenience of the blasts and their inclination to buoy to the surface with time. Thus, tires must be destroyed before they are perceived in numerous landfills. Such an extensive number of reusing frameworks for the adaptable tire are passed on by the need. From this one of the frameworks is to making the tire adaptable into piece adaptable.

Fattuhi et al., (1996) proposed that, the security paste, mortar, and bond (containing a OPC or OPC and PFA) mixes were prepared using distinctive degrees of either versatile piece or inferior flexible gotten from pulverizing scrap tires. Properties assessed for the 32 mixes orchestrated included thickness, compressive quality, impact and fire resistances, and nail ability. Comes to fruition exhibited that thickness and compressive nature of various mixes were decreased by the development of flexible (Rubber sort had

quite recently insignificant effect). Thickness moved between around 1300 and 2300 kg/m3. Compressive quality diminished by 70 % when the degree of flexible to total solid substance by mass of bond comes to around 13 %.

PitiSukontasukkul et al., (2004) proposed the paper on scrap flexible bond. In their study they supplanted the course and fine total in bond for trim walker squares. They accept that the solid going about as a cover blended with piece adaptable can make the solid squares more flexible and it give non-abrasiveness to the surface. In this review they saw that the person by strolling demoralizes with scrap adaptable performed unfathomable in slide and scratched domain resistance. In this review the way toward making the solid is beneficial in perspective of the straightforwardness of the gathering philosophy.

As shown by the Center for Monitoring Indian Economy, auto determinations in India reached out to 236761 Cars in December from 228267 Cars in November of 2015. Auto Registrations in India arrived at the midpoint of 100437 Cars from 1991 until 2015, fulfilling a record-softening high of 304900 Cars up March of 2012. With the constantly expanding number of autos, there is a basic ecological issue ascending with it made by the shocking association of disposed of tires. Tires address a genuine natural weight on two or three fronts. Some section of the hazard lies with their designed magnificence mind items. Hurts discharged from tire crumbling, devouring or startling bursts can unsanitary the water, air and soil. Scrap tires are viewed as hurtful waste since they:

1. channel unsafe dangerous substances into nature

2. are a home for mosquitoes, rats and snakes

3. can make ruinous blasts

4. Discharge essential measures of CO2 and dioxins when repeated as fuel all around that truly matters all really watchful nations, covering tires or tire shred in landfills is at this moment unlawful.

In like way, two or three nations and many state and standard governments have restricted the use of tires or tire chose fuel (tire shred) for use as fuel in strong grills and paper plants. In 2007 the European Union constrained tire shred from landfill however then half of all piece tires passed on in the EU are still land filled as delineating spread. There is not a considerable measure of budgetary uses for scrap tires, with piece adaptable being the fundamental thing yet of unimportant mass market utilize. In India there are around 100 crore tires which are discarded each year. Utilizing these waster tires in some packaging in the solid blend can be profitable from different points of view, it can reduce the trademark issues acknowledged by the discarded tires and it can in like way present some individual of a kind properties to the solid blend.

Why recuperate or reuse elastic?

Elastic recuperation can be a troublesome strategy. There are many reasons, however why adaptable ought to be recovered or recouped;

1. Recovered adaptable can cost a broad fragment of that of general or composed adaptable.

2. Recovered adaptable has a few properties that are superior to those of virgin flexible.

3. Producing adaptable from recover requires less significance in the aggregate period prepare than does virgin material.

4. It is an astonishing approach to manage discard undesirable adaptable things, which is as frequently as conceivable troublesome.

5. It screens non-viable oil based items, which are utilized to pass on manufactured rubbers.

6. Recycling exercises can make work in making nations.

7. Many pleasing things are gotten from reused tires and other adaptable things.

Elastic Recycling

Kurt Reschner et al., (2008) A succinct centrality of reusing would be the re-utilization of a material for its at first proposed reason, e.g. old aluminium containers are utilized to make new ones. Due to scrap tires, reusing would mean the utilization reused tire flexible as a fortifying segment for new tires. In a more expansive sense, reusing is intimated as beating scrap tires into piece adaptable while clearing steel, fiber and various contaminants. In North America, the business parts and applications for reused tire adaptable ("piece flexible") have grown immensely in the before decade. The specific markets and uses for reused tire flexible are examined in more basic detail in the range Products and Applications (Source scrap tire reusing by Kurt Reschner).

Landfilling

Kurt Reschner et al., (2008) Most landfills perceive entire piece tires precisely at a generous tipping charge since tires are ungainly to oversee and hard to more diminutive. In two or three cases, scrap tires have worked their way to the most lifted motivation behind a nearby landfill, making unnecessary harms the landfill cover. In any case, a titanic piece of the present piece tire time still winds up in landfills. Since a disavowal shoreward's filling entire tires was executed in many States, scrap tires are routinely cut into pieces or pulverized before land filling in the U.S. The EU Landfill Directive correspondingly bans entire tires from landfills by 2003. By 2006, tires in any shape or edge will be kept from landfills in EU Member States. All together for the EU Landfill Directive to be executed beneficially, new trade courses for scrap tires should be made with glorious criticalness in all EU Member States. A grouping of land filling is mono-filling, which recommends that piece tires are not blended with other waste materials, yet rather set away at a presented, endorsed region. Once the monofill has fulfilled its ability,

it is secured like some other landfill to decrease the fire danger what's more dismiss mosquito repeating. (Source scrap tire reusing by Kurt Reschner)

Scrap Rubber as Filler in Virgin Rubber Compound

Kurt Reschner et al., (2008) Since the tire business devours around 65 % of every single adaptable compound made far and wide, utilizing scrap adaptable as an increasing segment for new tires is the most clear application for this reused thing. As the quality and supply of scrap adaptable has wound up being more dependable and clear beginning late, a developing number of tire makers fuse reused material into their mixes. In the event that blending and prepare systems are picked really, critical resources can be capable without trading quality, flourishing or execution attributes. Adjoining lower material cost, including some piece adaptable (5 % – 15 %) to the virgin flexible compound offers the running with focal core interests:

1. Better blending properties and enhanced shape consistency of uncured parts.

2. Improved degassing amidst the vulcanization method.

3. Improved casing discharge.

4. Increased plant sufficiency in perspective of lessened cure times.

5. In a few uses, scratched spot resistance is also unmitigated moved forward.

In perspective of these good conditions, some tire makers routinely utilize piece adaptable as a filler, particularly for tread mixes and at whatever point speed and top of the line is not essential, e.g. for ranch gear or strong adaptable tires. The change potential in this market territory is critical. (Source scrap tire reusing by Kurt Reschner)

Devulcanization

Kurt Reschner et al., (2008) In compound terms, devulcanization reasons returning flexible from its thermo set, versatile state at last into a plastic, adaptable state. This is master by pulling back the sulfur bonds in the atomic structure. With the correct devulcanization methodology, a basically higher rate of piece adaptable old tires can be utilized as chafing. Standard devulcanization strategies included acclimating cured flexible with raised temperatures for an extended time explore. Considering all things, this "warm recover handle" not just withdraws the sulfur securities in the polymer deal with, other than breaks the polymer chains, bringing on a key decreasing in physical properties. In like method for broken cash related matters and commonplace concerns, warm devulcanization is once in a while utilized today. The present cost augmentation of essentially a sweeping gathering of polymers, including trademark flexible, comprehends that for most versatile makers, reprocessing adaptable piece is no longer a bewildering elective, yet a cash related need. (Source scrap tire reusing by Kurt Reschner)

Surface Activation

Kurt Reschner et al., (2008) Surface foundation develops the adhesiveness of scrap adaptable particles. The stretched out adhesiveness makes it conceivable to utilize a more detectable rate of reused material without the appalling impacts for the most part experienced when untreated fillers are combined. This framework may wind up being a middle of the road game-plan between utilizing piece flexible as a minor filler versus finish devulcanization. In a couple uses, surface set up piece adaptable can be shaped self-choice from whatever other individual, without folios or various included substances. Like with devulcanized material, the cash related plausibility of surface began scrap adaptable depends to a monstrous degree open cost of virgin flexible compound. (Source scrap tire reusing by Kurt Reschner)

Restricted Products

Kurt Reschner et al., (2008) In the current years, the creating supply of piece versatile and a beginning late made dampness curing urethane folio has provoked a quick increment in the measure of things made by basic weight binding. Dependably, this technique is used to pass on high-volume, low-tech things, for instance, arranged creatures mats, railroad crossing centers, removable squares and athletic mats. Using piece versatile in blend with urethane catch to make formed things engages makers to in light of current circumstances decrease the managing time and material costs. Notwithstanding, this application is limited to the use of the following to things where essentially organize unyielding nature and scratched spot resistance is required.

CHAPTER 2

LITERATURE REVIEW

2.1 Mechanical properties of concrete

In different research papers it was watched that, gatherings of exhausted vehicle tires make fire and wellbeing perils. As a conceivable answer for the issue of scrap tire transfer, he led an exploratory review to inspect the capability of utilizing tire chips and piece elastic as total in Portland bond concrete. They analyzed the quality and strength properties of cement in which diverse measures of elastic tire particles of a few sizes were utilized as total. They watched that the solid blends showed bring down compressive and part elasticity than did typical cement. Be that as it may, these blends did not exhibit fragile disappointment, but instead a flexible, plastic disappointment, and had the capacity to ingest a lot of plastic vitality under compressive and malleable burdens. A scientific model was utilized to depict the impacts of elastic total on the compressive and rigidity lessening of cement *(Neil N. Aldin and Ahmed B. Seouci, 1993).*

Different properties of cement and contrasted them with cement with elastic totals. They watched that as the elastic substance expanded, the rigidity diminished, yet the resist disappointment expanded. Higher elastic endure disappointment is demonstrative of more malleable blends. He additionally settled that piece elastic cement is more impervious to warm changes *(Kamil E. Kaloush et al., 2015).*

Specialists led a review in which three gatherings of separately estimated elastic molecule tests (3 mm, 0.5 mm and 0.3 mm) and one example of constant size evaluating were utilized to supplant 20 % of the normal fine total by volume. It was watched that the elastic molecule measure influences the solid's workability and water porousness to a more noteworthy degree than the crisp thickness and quality. Concrete with elastic particles of bigger size has a tendency to have a higher workability and new thickness than that with littler molecule sizes. Be that as it may, the elastic totals with littler or consistently evaluated molecule sizes are appeared to have higher qualities and lower water porousness *(Haolin Su and Jian Yang et al., 2015).*

Conclusions were achieved that, expansion of reused morsel elastic totals into typical solid blend prompts diminish in workability for the different blend tests. Flexural quality of solid reductions around 40 % when 3 % sand is supplanted by scrap elastic totals and further decline in quality with increment of rate of piece elastic totals. Part elasticity of solid abatements around 30 % comparing to 3 % sand supplanted by piece elastic and further declines the quality with increment in rate of morsel elastic. One reason that part rigidity of rubber treated cement is lower than traditional cement is poor bond quality between concrete glue and elastic tire totals. The rubber treated cement can be utilized as a part of non-load bearing individuals i.e., lightweight solid dividers, other light building units, in this manner concrete containing fine elastic totals could give a practical contrasting option to where quality is not prime necessities. Exploratory after effects of study demonstrate that it is conceivable to utilize reused elastic tire as far as totals in solid development as halfway substitution to common fine totals. The utilization of reused tires as fractional total in cement has been considered for quite a long while. Past research led indicate sensational changes in the mechanical properties of solid when elastic is acquainted with the blend. An elastic solid blend for the most part has a diminished compressive quality that may constrain its utilization in certain auxiliary applications; it has various alluring properties, for example, bring down thickness, higher strength, bring down fragility record values, higher effect resistance, upgraded flexibility, and more proficient sound and warmth protection contrasted with ordinary cement. Basic applications including elastic cement may at present be conceivable if suitable rates of elastic totals are utilized *(Tushar R More et al., 2015*).

Compressive quality of piece elastic cement with 5 % substitution is 38.66 N/mm2; it is higher than the quality of typical cement (36.73 N/mm2) on 28th day. The compressive quality of scrap elastic cement with 10% substitution, it gives satisfactory quality of 33.47 N/mm2. In part elasticity the quality of morsel elastic cement is lower than the quality of ordinary cement. In the flexural quality test directed on scrap elastic solid it demonstrates a lessening in quality when contrasted with the quality of ordinary cement. From the test outcomes, it is found that the piece elastic groups less holding capacity which has influenced on the quality of the solid *(S.Selvakumar and R. Venkatakrishnaiah, 2015).*

Slump test

The consequences of the droop trial of waste elastic solid blends demonstrate that the droop is inclined to diminishing forcefully with expanding the waste plastic proportion. The diminishments of droop are 68.3%, 88.33%, and 95.33%. This lessening can be credited to the way that a few particles are precise and others have non-uniform shapes bringing about less smoothness. Disregarding the droop diminishment, the waste plastic solid blends have simple workability and are appropriate for use in precast applications and vast destinations in light of the accompanying thought:

Workability has a wide range from low (at hang = 0 mm - 25 mm) associated for vibrated concrete in avenues or other broad territories, to high workability (at hang = 100 mm - 180 mm) associated for fragments with congested support *(Koehler and Fowler, 2003).*

2.2. Other Properties of Concrete

2.2.1 Freezing and thawing effect

Savas et al., (1996) completed examinations to concentrate the quick solidifying and defrosting solidness of elastic cement. Different blends were made by joining 10 %, 15 %, 20 % and 30 % elastic by weight of total. In view of their review it was reasoned that: (i) elastic solid blends with 10 % to 15 % elastic showed strength components higher than 60 % after 300 solidifying and defrosting cycles however blends with 20 % to 30 % elastic by weight couldn't meet the ASTM prerequisites (ii)air entrained did not give any enhancements in solidifying and defrosting sturdiness for solid blends with 10 %, 20 % and 30 % ground tire elastic (iii) increment in (scaling gives an assessment of surface presented to solidifying and defrosting cycles as measured by loss of weight) expanded with increment in solidifying and defrosting cycles.

Benazzouk and Queneudec, (2002) concentrated the stop defrost sturdiness of bond elastic composites through utilization of two sorts of elastic totals to be specific smaller elastic total (CRA) and extended elastic total (ERA). Volume proportion run from 9 to 40

%. The outcomes demonstrated change in sturdiness of composites containing 30 % and 40 % elastic by volume. Change in composites of ERA sort total is superior to anything CRA sort total.

2.2.2 Shrinkage

Raghavan et al., (1998) communicated that mixing of flexible pieces constitutes of mortar helps diminishing plastic shrinkage softening up appear differently in relation to control mortar. They also communicated that control case make breaks having a typical width of 0.9 mm while ordinary split width of case with mass segment 5 %rubber pieces was around 0.4 - 0.6 mm. It was moreover reported that onset time breaking was conceded by alternative of 5 % piece flexible.

2.2.3 Toughness and impact resistance

Tantala et al., (1996) investigated the quality (strength is generally called imperativeness absorption constrain and is generally described as the zone under load–deflection curve of a flexural case) of a control strong mix and rubcrete mixes with 5 % and 10 % buff versatile by volume of coarse aggregate. They reported that strength of both rubcrete mixes was higher than the control strong mix. In any case, the toughness of rubcrete mix with 10 % buff versatile (2 mm - 6 mm) was lower than that of rubcrete with 5 % buff flexible in light of the decrease in compressive quality. *Eldin and Senouci, (1993)* displayed that the failure technique for cases containing flexible particles was consistent rather than frail. Biel and Lee, (1996) uncovered that mistake of strong cases with 30 %, 45 % and 60 % supplanting of fine aggregate with versatile particles occurred as a nonstop shear that achieved a corner to corner disillusionment, while dissatisfaction of plain (control) strong cases was dangerous, leaving cases in a couple pieces.

2.2.4Permeability

Bayasi and Zeng, (1993) examined the impact of reused elastic on the porousness of cement. They reasoned that these composites altogether expanded the porousness of cement with a conflicting impact on volume division of penetrable voids.

Soroushain et al., (2003) exhibited that there was reduction in air porousness with the consideration of discrete support in cement. The air penetrability tests were appeared in Fig.1 measured the rate of air through solid example. Bring down wind stream rates are best, demonstrating lower penetrability . Discrete support frameworks were utilized as a part of the venture to decrease the porousness of solid, which could be ascribed to diminished shrinkage smaller scale breaking.

CHAPTER 3

MATERIALS AND METHODS

3.1 Collection of Material for Mix Design of Concrete

Material Used in Concrete mix are:-

1. Cement
2. Fine Aggregates.
3. Coarse Aggregates.
4. Crumbed Rubber.

3.2 Various Tests Performed

3.2.1 Fineness of Cement by Sieve analysis:

This test is performed to check proper grinding of cement. Finer Cement has quick action with water and gain earlier strength.

Result: - Fineness of cement = **9.0 %**

The fineness percentage should not exceed 10 % for good quality of cement.(According to **IS:4031(Part1):1996**).

3.2.2 Initial Setting time:

It is the time between the time water is added to concrete and time at which 1mm square area needle neglects to infiltrate the bond glue, put in the Vicat's form 5 mm to 7 mm from the base of the shape.

3.2.3 Final Setting time:

It is the time between the time water is added to concrete and the time at which 1 mm needle makes an impact on the glue in the form however 5 mm connection does not make any impression.

Result: - Initial Setting time Of Cement= 35 minutes.

Last Setting time of Cement= 400 minutes.

3.2.4 Specific gravity of concrete:

Particular gravity of the Cement is characterized as the proportion of the mass of strong in a given volume of test to the mass of an equivalent volume of water at a similar temperature.

Specific Gravity of cement almost equal to **3.15 gm/cc (As Per IS: 2720-Part 3-1980).**

Result: - Specific gravity of cement= **3.148 gm/cc**.

3.2.5 Sieve Analysis of Aggregates:

Sieve used are 4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron, 150 micron, pan **(As per IS 2386-Part 1-1963).**

3.2.6 Concrete Slump Test:

1. Slump test is the technique utilized for measuring the workability of cement. It is not an exceptionally appropriate technique for extremely wet or dry cement.

2. . It is used accommodatingly as a control test and gives indication of the consistency of concrete from bundle to gathering.

3. Repeated bunches of a comparative mix, passed on to a comparative hang will have a comparative water substance and water solid extent gave the largeness of the aggregates, bond and admixtures are uniform and aggregate looking into is inside sufficient cutoff focuses.

4. Additional information on workability and nature of bond can be procured by viewing the route in which strong hangs.

5. Quality of concrete can in like manner be moreover assessed by giving a few recordings or leaves behind pressing bar to the base plate

6. The twisting demonstrates the qualities of cement concerning inclination of isolation.

7. The mechanical assembly to conduct the droop test basically comprises of a metallic pole as a cone having inward measurements as under:

   Bottom diameter: 20 cm
   Top diameter: 10 cm
   Height: 30 cm

Figure 3.1: Slump test.

The test is performed in the accompanying strides:

1 Put the hang shape on a smooth level and non-penetrable surface.

2. Blend the dry components of the strong totally till a uniform shading is gained and subsequently incorporate the required measure of water in it.

3. Put the mixed concrete in the shape to around one-fourth of its stature.

4. Reduced the strong 25 times with the help of a pressing bar reliably wherever all through the range.

5. Put the mixed bond in the frame to about part of its stature and diminished it afresh.

6. So also, put the strong upto its three-fourth height and after that up to its top. Limited each layer 25 times with the help of pressing shaft reliably. For the second and subsequent layers, the pressing post should go into shrouded layer.

7. Strike off the top surface of frame with a trowel or pressing bar so that the shape is filled to its top.
8. Evacuate the frame rapidly, ensuring its improvement in vertical bearing.

9. At the point when the settlement of strong stops, measure the subsidence of the strong in millimetres which is the required hang of the strong

3.2.7 Compacting factor test

1. The compacting factor test is designed primarily for use in the laboratory but it can also be used in the field.

Figure 3.2: Compaction Factor Test

3. It is more exact and touchy than the slump test and is especially valuable for cement blends of low workability as are regularly utilized when cement is to be compacted by vibration.
4. One of the effective tests for measuring the workability of cement.

5. It chips away at the guideline of deciding the level of compaction accomplished by a standard measure of work done by enabling the solid to fall through a standard height.
6. The dimensions of the compacting factor test are as under:
7. Upper hopper,
    i. Top internal diameter: 25.4 cm
    ii. Bottom internal diameter: 12.7 cm
    iii. Internal height: 27.9 cm
8. Lower hopper,
    i. Top internal diameter: 22.9 cm
    ii. Bottom internal diameter: 12.7 cm
    iii. Internal height: 27.9 cm
9. Cylinder,
    i. Internal diameter: 15.2 cm
    ii. Internal height: 30.5 cm

The degree of compaction, called the compacting factor is calculated by:

$$\text{The compacting factor} = \frac{\text{weight of partially compacted concrete}}{\text{weight of fully compacted concrete}}$$

3.2.8 Flow Table Test

1. Flow table is created from a metal of minimum thickness 1.5 mm.

2. The center of table is separate with a cross, the lines which run parallel to and out to the edges of the plate, and with a central circle 200 mm in separation over.

3. The signify mass of the mass table is around 16 kg.

4. The stream table is rotated to a base packaging using remotely mounted turns with the end goal that no aggregate can twist up discernibly got easily between the turns or rotated surfaces.

5. The cone is set in the point of convergence of the table and stacked with concrete in two layers.

6. Each layer is pressed 10 times with a pressing bar.

7. The cone is lifted and the strong is allowed to stream.

8. The stream table is then lifted 40 mm and dropped 15 times making strong stream.

Figure 3.3:Flow Table Test

Procedure

1. Before beginning test, the table top and inside the shape is to be wetted and cleaned of all coarse material and the plenitude water is to be emptied with a versatile squeezer.

2. The shape is to be steadfastly held tight the point of convergence of the table and stacked with bond in two layers, each around one-an extensive part of the volume of the frame and rodded with 25 strokes with a pressing bar, consistently over the cross portion of the shape.

3. After the top layer has been rodded, the surface of the strong is to be hit off with a trowel so that the shape is definitely filled.

4.The shape is then removed from the strong by a continuing upward draw.

5The table is then raised and dropped from a stature of 12.5 mm, 15 times in around 15 seconds.

6. The width of the spread bond is the ordinary of six symmetrically circled caliper estimations examined to the nearest 5 mm.

3.2.9 Strength testing:

M-30 Mix Design is used to make to cubes, cylinders and beams samples.

These samples will be used to find the compressive strength, tensile strength and flexural strength of the concrete after 7 days and 28 days

Size of cubic mould = 15 cm x 15 cm x 15 cm

Size of cylindrical mould = 10 cm diameter X 30 cm height

Size of beam mould = 10 cm X 10 cm x 50 cm

3.2.9.1 Compressive strength:

1. Compression test creates complex arrangement of stresses.
2. Because of pressure block or chamber experiences sidelong extension.
3. Tangential drive is created between end surfaces of the solid example and the nearby steel platens of the testing machine.
4. Due to this platen limits the horizontal extension of the solid in the parts of the example close to its end.
5. The level of limitation rehearsed depends on upon the pounding made. The illustrations are attempted by weight testing machine taking after 7 or 28 days curing.
6. Load should be associated constantly at the rate of 140kg\cm2 till the illustration misses the mark. Stack at the mistake segregated by the region gives the compressive nature of bond.

Figure 3.4: Compressive Testing Machine.

3.2.9.2 Tensile strength testing:

1. Tensile quality is the essential and imperative properties of cement.
2. Concrete is especially week in weight due to its frail nature and is not expected that would restrict organize strain.
3. Specimen is set in the machine in such a route, to the point that the pile is associated with the most noteworthy surface. The turn of the illustration is agreed with the center point of the stacking contraption.
4. The load is connected without stun and expanded ceaselessly at a rate to such an extent that anxiety increments at the rate of 0.7 kg\ sq. cm\ min at a stacking of 400 kg\ min.
5. The load is expanded until the example comes up short and the most extreme load connected amid three tests is recorded.
6. The appearance of the broke countenances of concrete and any unordinary includes in the sort of disappointment is noted.

Figure 3.5: Tensile Strength Testing

Figure 3.6: Casting of M30 samples

Figure 3.7: Concrete Mixing Machine.

Figure.3.8:Mixer used for preparation of M30 samples

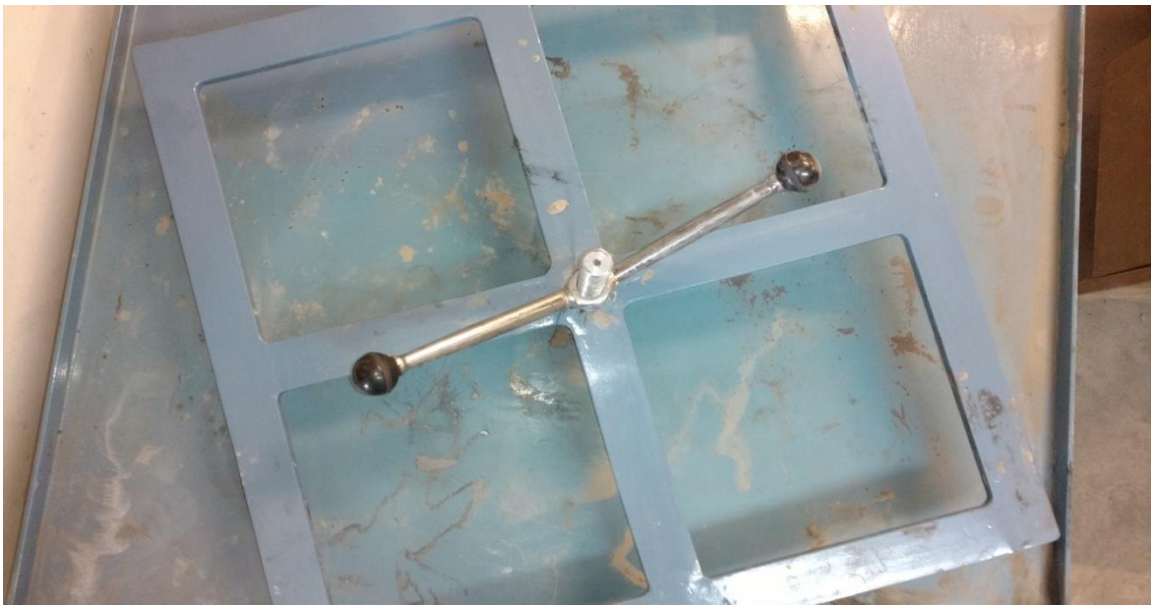

Figure 3.9: Vibration of the Concrete Moulds

Figure 3.10: Sample Casting.

Figure 3.11: Process of Curing.

Figure 3.12: Compressive Testing Machine.

Figure 3.13: Crumb rubber used

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Compressive strength

The most extreme of compressive nature of the bond concrete depends on upon both, the nature of the matrix and the particle inflexibility of the aggregate. The nature of the strong is regularly related to the bond substance and water to solid extent. Regardless, in this audit the piece versatile is fairly supplanted with fine aggregate and test the quality under weight. The weight nature of the strong at seventh, fourteenth and 28th day were driven is given in Table 1.

Table 1: Compressive Strength of Normal and Crumb Rubber Concrete.

Replacement of Fine Aggregates by Crumb rubber (%)	**7 Days (N/mm^2)**	**14 Days (N/mm^2)**	**28 Days (N/mm^2)**
0	19.50	27.50	32.50
2	17.33	25.70	28.58
4	16.11	24.30	26.82

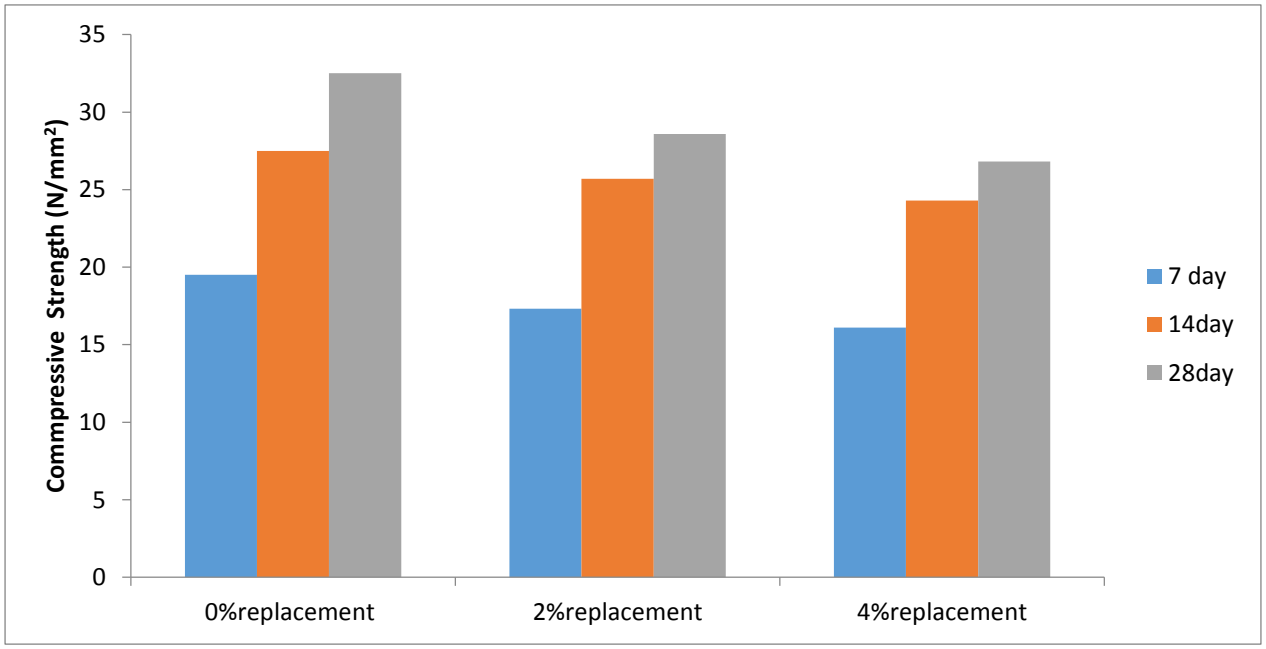

Figure 4.1: Graph Showing Variation of Compressive Strength with Percentage of Replacement.

From the above results it can be concluded that with an increase in the amount of replaced crumb rubber in the mix, there is a decrease in compressive strength. An increasing amount of replaced rubber can lead to further decrease in strength with an optimum and acceptable value being reached at 2% replacement.

4.2 Tensile strength

The splitting tensile strength of the crumb rubber concrete with the different percentage replacement of crumb rubber by fine aggregate in normal concrete at the 7^{th} and 14^{th} day results was to be tabulated in Table 2.

Table 2: Tensile strength of normal and crumb rubber concrete

Replacement of Fine Aggregates by Crumb rubber %	**7 Days (N/mm^2)**	**14 Days (N/mm^2)**	**28 Days (N/mm^2)**
0	1.60	2.85	4.52
2	1.43	1.88	2.50
4	1.03	1.20	1.85

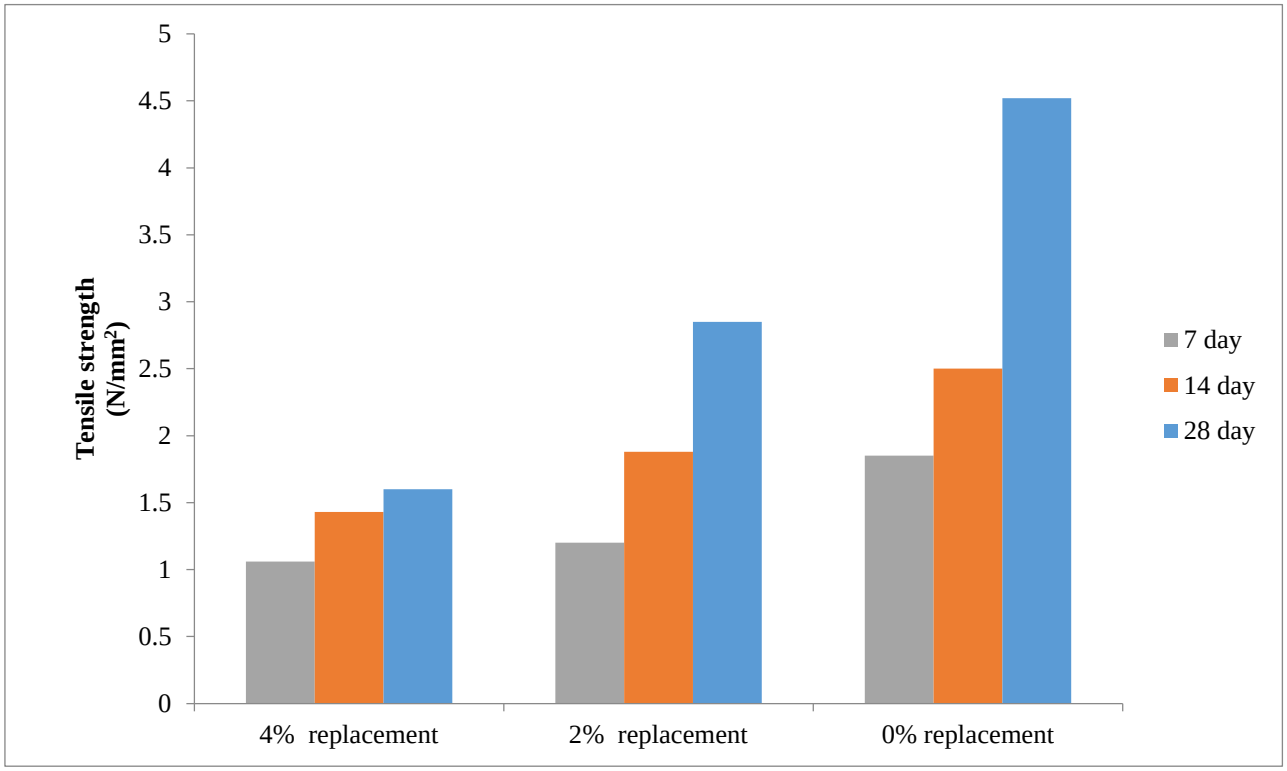

Figure 4.2: Graph showing variation of tensile strength with percentage of replacement.

As was the case with compressive strength with increase in replacement the strength decreased. A similar scenario has been observed in case of tensile strength as well. Thus the use of rubber replaced concrete mix is not desirable at places where loading can be quite large.

4.3Workability tests

4.3.1 Slump cone test

A crumple in the droop as a rule implies that the blend is excessively wet or that it is a high workability blend. Exceptionally dry blends having droop 0 mm - 25 mm are utilized as a part of street making, low workability blends having droop 10 - 40 mm are utilized for establishments with light fortifications and high workability having droop > 100 are utilized where strengthening has tight dispersing and the solid needs to stream a more noteworthy separation.

Table 3: Results of slump test

Replacement (%)	0	2	4
Slump value	27mm	23mm	20mm

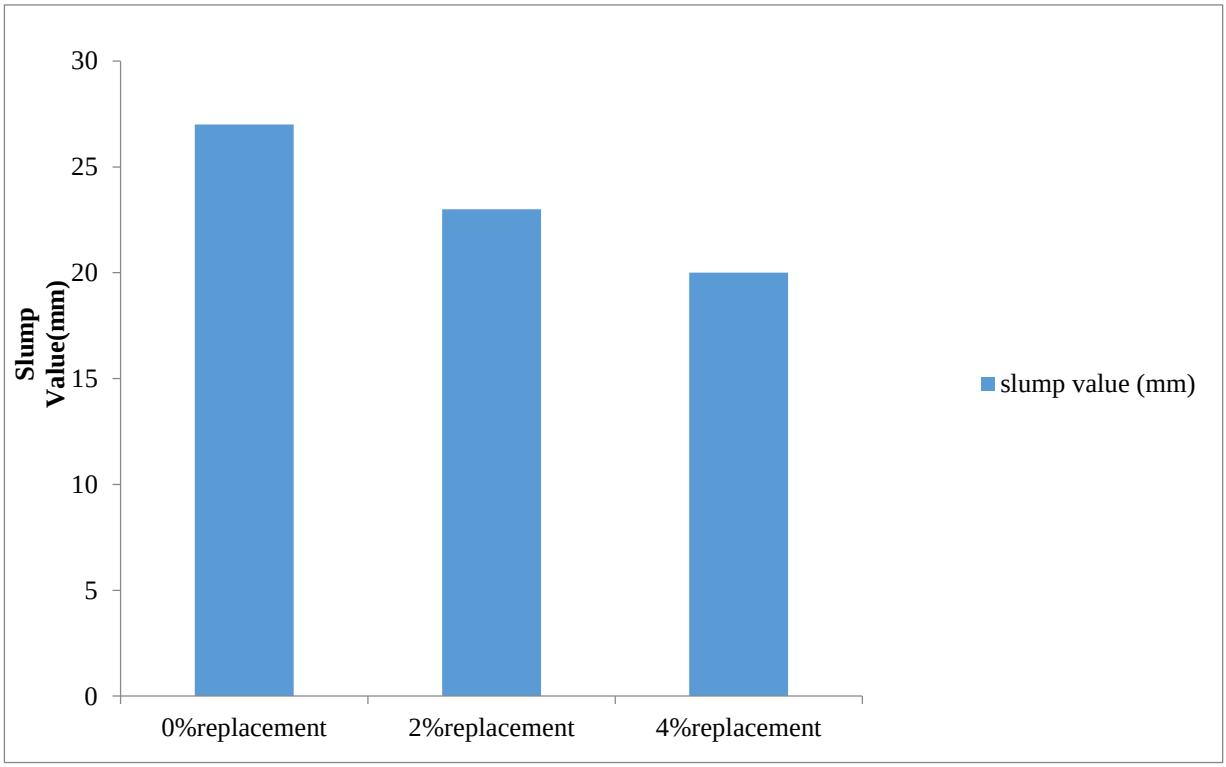

Figure 4.3: Results of slump test

4.3.2 Compaction factor test

The estimation of the compaction ascertain lies between 0.8 - 0.92 for the conventional extent of concrete. This test is particularly profitable for dryer mixes for which the hang test is not worthy. The affectability of the compaction part is diminished outside the normal extent of workability and is all around prohibited for compaction figure more imperative than 0.92.

The esteem can be figured by utilizing the accompanying equation:

$$\text{The compacting factor} = \frac{\text{weight of partially compacted concrete}}{\text{weight of fully compacted concrete}}$$

Table 4: Results of compaction factor

Replacement (%)	0	2	4
Compaction factor	0.85	0.76	0.72

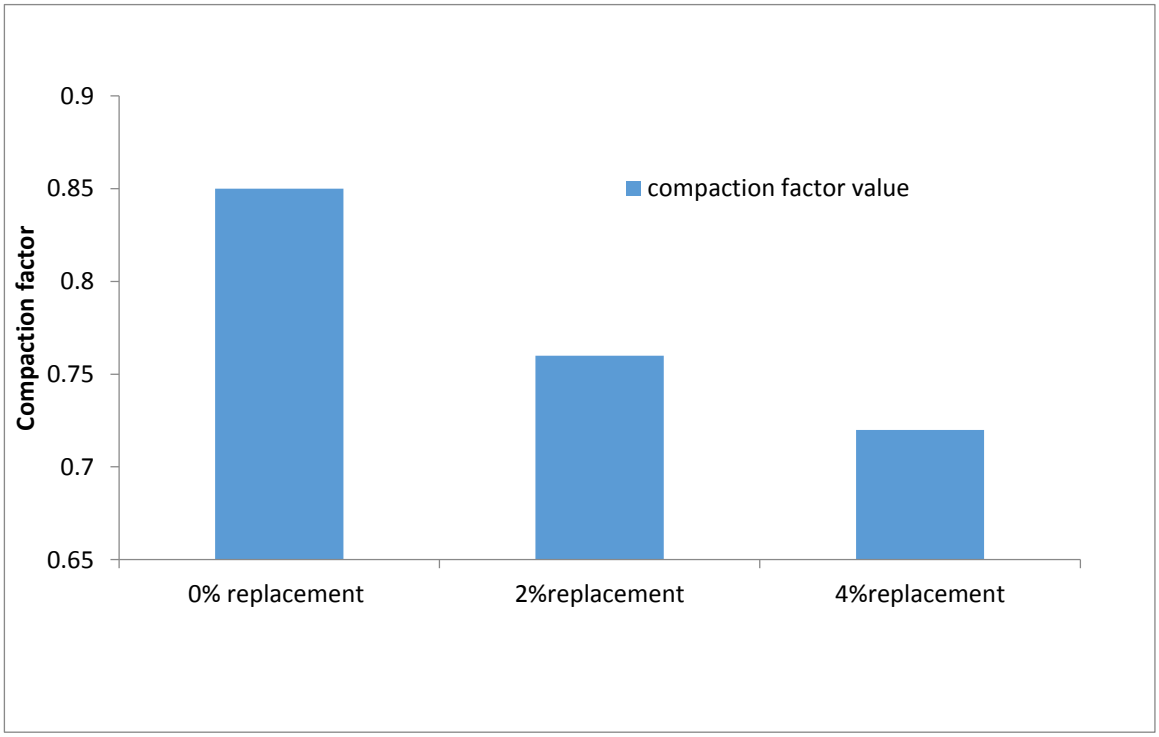

Figure 4.4: Graph showing compaction factor value

4.3.3 Flow table test

Getting precise estimation of the workability of cement, the stream table gives the sign of attachment. Blends that are inclined to isolation will deliver a non round pool of cement. In the event that the blend is inclined to dying, an unmistakable ring of water will be framed following a couple of minutes.

The typical and piece elastic cement are tried for their execution by deciding their compressive quality, part rigidity and flexure quality improvement at various times of seventh and 28th days. The outcomes got are talked about in detail in the accompanying areas. The outcomes are appeared in the accompanying table:

Table 5: Results of flow table test

Replacement (%)	0	2	4
Diameter	310	270	265

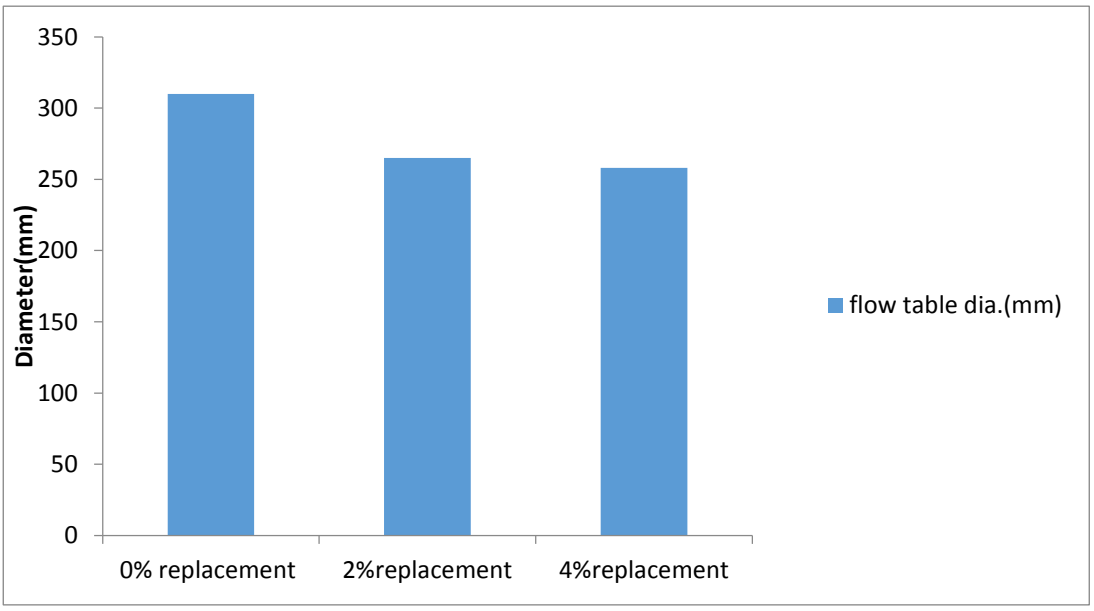

Figure 4.5: Graph showing flow table diameter

CHAPTER 5
CONCLUSION

From these results it can be concluded that the compressive and tensile strengths decrease as we increase the quantity of rubber replacement. The optimum replacement quantity as shown from the results is 2%

From the results of workability it is obtained that the value of workability is reduced after replacement with crumb rubber, but these values are still within the permissible limits.

From this review the successful use of elastic tire squander as been produced and it made to utilize as a part of the solid blend as fine total. In light of the test outcomes the accompanying conclusions were made. These can likewise incorporate non essential basic utilizations of medium to low quality prerequisites, profiting from different elements of this sort of cement:

1. It is apparent that the compressive and elastic qualities of rubber treated solid diminishing with the expansion in elastic substance. Some different properties like strength and flexibility of the solidified rubber treated blend increments.
2. Economically Rubberized concrete is more exorbitant than the ordinary mixes.

Fire resistance of elastic treated concrete is more imperative than ordinary mixes.
Water Compressive quality of scrap elastic blends diminish as the rate of substitution by piece elastic increment

RECOMMENDATIONS

In light of the conclusions drawn above and the lab perceptions, the accompanying were prescribed:

1. Since the development of scrap versatile lessened compressive quality, it is recommended to use piece flexible for non-assistant Portland bond strong parts in structures, for instance, floor pieces, floor ribs, underground segments, reinforce stone structures, packages, strong squares, ribbed strong piece, and for walkway clearing.

2. It is endorsed to use percent of substitutions in the area of 25 % for elastic treated PCC mixes, since compressive quality is still inside a commendable range, in like manner extraordinary warm and confusion assurance can be proficient.

3. It is recommended to use substitutions in an expansion of 10 % for better unmistakable evidence of behavioural changes in the physical qualities in future research.

4. It is recommended to focus the effect of various sizes of piece flexible on PCC other than the 60 microns used as a piece of this examination.

5. It is endorsed to further test the physical qualities of PCC through volume change, cement defrost, and permeability.

6. PCC mix with crumbed flexible should be striven for break improvement as adaptability augmentations.

FUTURE SCOPE

The durability tests like corrosive resistance, sulphate attack tests can be taken up. Mortar properties of all the mix can be studied. Study can be made to determine strength parameters of cement with crumb rubber as fine aggregate and mineral admixture like fly ash and Ground-granulated blast-furnace slag (GGBS).

In future research following points can be taken:-

a) Tyre powder can be used as fine aggregate.

b) Tyre chips can be replaced by same size of coarse aggregate.

CHAPTER 6
REFERENCES

1. Segre, N., & Joekes, I. (2000). Use of tire rubber particles as addition to cement paste. *Cement and Concrete Research*, *30*(9), 1421-1425.
2. Khatib, Z. K., & Bayomy, F. M. (1999). Rubberized Portland cement concrete. *Journal of materials in civil engineering*, *11*(3), 206-213.
3. Avcular, N. (1997). Analysis of rubberized concrete as a composite material. *Cement and Concrete research*, *27*(8), 1135-1139.
4. Raghavan, D., Huynh, H., & Ferraris, C. F. (1998). Workability, mechanical properties, and chemical stability of a recycled tyre rubber-filled cementitious composite. *Journal of Materials science*, *33*(7), 1745-1752.
5. Topçu, I. B. (1997). Assessment of the brittleness index of rubberized concretes. *Cement and Concrete Research*, *27*(2), 177-183.
6. Topçu, I. B., & Avcular, N. (1997). Collision behaviours of rubberized concrete. *Cement and Concrete Research*, *27*(12), 1893-1898.
7. IS:456-2000: Design code for RCC structures
8. IS:10262:2009
9. Reschner, Kurt. "Scrap tire recycling." *A summary of prevalent disposal and recycling methods. Entire-Engineering, Berlin* (2008).
10. Shende, Abhay Mahadeorao, and Anant M. Pande. "Comparative study on steel fiber reinforced cum control concrete under tension." *Journal of Civil Engineering (IEB)* 40.1 (2012): 61-66.
11. Fattuhi, N. I., and L. A. Clark. "Cement-based materials containing shredded scrap truck tyre rubber." *Construction and building materials* 10.4 (1996): 229-236.
12. Aniruddh, Mr, Abhishek Kumar, and Mohd Afaque Khan. "EFFECT ON COMPRESSIVE STRENGTH OF CONCRETE BY USING WASTE RUBBER AS PARTIAL REPLACEMENT OF FINE AGGREGATE: A Review." (2016).
13. Hafeez, Imran, M. A. Kamal, and M. W. Mirza. "An experimental study to select aggregate gradation for stone mastic asphalt." *Journal of the Chinese Institute of Engineers* 38.1 (2015): 1-8.

14. Su, Haolin, et al. "Properties of concrete prepared with waste tyre rubber particles of uniform and varying sizes." *Journal of Cleaner Production* 91 (2015): 288-296.
15. Selvakumar, S., and R. Venkatakrishnaiah. "Stregth Properties of Concrete Using Crumb Rubber with Partial Replacement of Fine Aggregate." *International Journal of Innovative Research in Science, Engeneering and Technology* 4.3 (2015).
16. Koehler, Eric Patrick, and David W. Fowler. *Summary of concrete workability test methods*. 2003.
17. Benazzouk, A., and M. Queneudec. "Durability of cement-rubber composites under freeze thaw cycles." *Proceeding of International congress of Sustainable Concrete Construction, Dundee-Scotland*. 2002.
18. Tantala, Michael W., John A. Lepore, and Iraj Zandi. "Quasi-elastic behavior of rubber included concrete(RIC) using waste rubber tires." *Proceedings of the International Conference on Solid Waste Technology and Management. 8 ppp. 1996.*. 1996.
19. Soroushian, Parviz, Jesus Plasencia, and Siavosh Ravanbakhsh. "Assessment of reinforcing effects of recycled plastic and paper in concrete." *Materials Journal* 100.3 (2003): 203-207.
20. Marzouk, O. Yazoghli, R. M. Dheilly, and M. Queneudec. "Valorization of post-consumer waste plastic in cementitious concrete composites." *Waste management* 27.2 (2007): 310-318.

ANNEXURE A

Pictures taken during the project

A1:Cement, coarse aggregate and fine aggregate

A2: Hand mixing of concrete mix

A3: Cylinder and cube moulds

A4: Crumb rubber used

A5: Mixer used for preparation of M30 mix

A6: Vibration being done on samples

A7: Preparation of samples

A8: Loading in split tensile machine

A9: Slump test

A10: Cracking patterns obtained in cube and cylinder

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