# CHARACTERISTICS OF CONCRETE AFTER PARTIAL REPLACEMENT OF FINE AGGREGATE BY RECYCLED PLASTIC

A PROJECT REPORT

*Submitted in partial fulfillment of the requirements for the award of the degree*

*of*

**BACHELOR OF TECHNOLOGY**

**IN**

**CIVIL ENGINEERING**

*Under the supervision of*

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**(Assistant Professor- Grade II)**

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*to*


**JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY**

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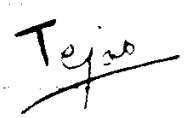
**HIMACHAL PRADESH, INDIA**

**JUNE-2020**

# STUDENT'S DECLARATION

I hereby declare that the work presented in the Project report entitled **"Characteristics of concrete after partial replacement of fine aggregate by Recycled Plastic"** submitted for partial fulfillment of the requirements for the Bachelor degree of Civil Engineering at **JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY** is an authentic record of my work carried out under the supervision of **Mr. Chandra Pal Gautam**. This work has not been submitted elsewhere for the reward of any other degree/diploma. I am fully responsible for the contents of my project report.

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# CERTIFICATE

This is to certify that the work which is being presented in the project report titled **"CHARACTERISTICS OF CONCRETE AFTER PARTIAL REPLACEMENT OF FINE AGGREGATE BY RECYCLED PLASTIC"** in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering and submitted to the Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by **Nikhil Sharma(161001), Tejas Garg(161635), Pritul Jaswal(161653)** during a period from July 2019 to June 2020 under the supervision of **Mr. Chandra Pal Gautam (Assistant Professor- Grade II)**, Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

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

Date: 1st June, 2020

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# ABSTRACT

Because of the over the top utilization and utilization of the ordinary structure materials, these are not the supportable or practical hotspot for building. Thus, we should give the elective structure material. A portion of the traditional structure materials are sand, rock, concrete, and so on. It may give off an impression of being difficult to offer replacements to the existing or to change the fundamental thought regarding these ordinary material as human concurred and taking a shot at using these since before age. Regardless, arrangement elective materials should be comprehensively usable and achievable by planners. To achieve these factors, inspiring forces involve cost sufficiency, genius as well as simple availability of 'elective materials' should accentuate quickly. Use of reused things and wastes is significant.

The point of this examination is to investigate plausibility of utilizing reused plastic waste in definition of concrete as fine total by replacement of variable level of sand (5%, 10% and 15%). This paper shows that solid blends joining Plastic on fresh and hardened properties of the solids: compressive, usefulness and flexural strength of the various concrete must be explored and examined in contrast with control concretes.

**Keywords:** Structure materials, concrete, reused plastic waste, sand, rock, compressive and flexural strength.

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RP- Recycled Plastic

# CHAPTER 1

# INTRODUCTION

## 1.1 General

In our country, Concretes are the broadly and liberally utilized as the wellspring of country's foundation as it gives most extreme quality, backing and strength. It is in fact and financially dynamic and along these lines is promptly used. In any case, with the expansion sought after of these synthetic items, it is antagonistically influencing our condition, it is likewise a costly medium. Likewise, there are now materials which are influencing condition however can supplant these compound items and are less expensive. So materials like waste plastic, squander paint, broken glass, and so on are utilized.

The utilization of plastic is every day expanding and it is helpful just as a perilous material. At the period of scarcity, plastic although is of great importance and value however on using it,it is basically disposed off leading to a huge numbers of problems. Plastic is non-biodegradable that remaining parts as a risky material for more than hundreds of years. The amount of plastic waste in Municipal Solid Waste (MSW) is expanding quickly. It is evaluated that the pace of plastic use is twofold for like clockwork. This is because of quick development of populace, urbanization, developmental activities and changes in lifestyle. They are non biodegradable and furthermore analysts have discovered that the plastic materials can stay on earth for a long time without debasement (around 4500 years). In India around 40 million tons of the civil strong waste is produced every year, with assessed expanding at a pace of 1.5 to 2% consistently.

## 1.2 Need of Study

Since concrete is the most generally and bounteously utilized as wellspring of country's foundation. Specialists are doing different strategies to improve the presentation of cement. Lately, there is an expanding requirement for the manufacture of mortar and solid that can be described as reasonable and ecologically benevolent. In a perfect world, this solid ought to be reasonable, lightweight, and exceptional as far as the mechanical and physical points. Plastics are being used for creating various sorts of mortar parts and solid ad-mixtures. The plastics appear as fillers or destroyed strands got from polyethylene terephthalate and polypropylene .Using plastics have the following advantages : 1) upgraded blend quality as well as 2) a lessening in proportion of assembled one time use plastics that oppositely influence the earth. The project reviews a couple past assessments of use and game plans of plastics and the ramifications for the mechanical and physical properties the concrete has. Various subjects,like solidified cement, new solid, applications and the thermo physical qualities have also been explained

As in this day and age with barely any assets left, utilizing reused or squander items to upgrade solid execution are superior to utilizing new compound items. Also the reused or waste items are less expensive. Along these lines we are likewise diminishing waste from our planet and helping in making eco-accommodating foundations.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 General

The surveys a few past examinations on the usage and arrangements of plastics and their impacts on mechanical and physical properties of cement. This examination have focused on beneficial reuses of recycled HDP for sustainable and economical management in concrete.

## 2.2 Literature Survey

### [1]Youcef Ghernouti, Bahia Rabehi, Brahim Safi and Rabah Chaid

The impact of the PBW on the new and solidified states properties of the solid: functionality, mass thickness, compressive, ultrasonic heartbeat speed testing flexural natures of different concretes, have been looked into as well as examined with the control concrete. Results showed using PBW helps in improving the value and thickness, lessens the inclusive nature of concrete having 10 and 20 % of waste by 10 to 24 % separately, that has a quality agreeable for light material, stays for each situation close to reference concrete (made without PBW). Results of the assessment prove the use of PBW in developments, mainly while defining concrete. Mass thickness of every solid having the substance of replacement of sand by the wastes than in like manner become light than fourty percent of the plastic wastes have been diminished. Considered that the cement should be having great usefulness, ease is altogether improving by the existence of this waste. Diminishing in the mechanical hindrance as showed by the extension in level of plastic sack waste, which stays for each situation close to the reference strong,at the time the record was made a of fall of overall quality at twenty-eight days around ten and twenty four % or the solids having ten and twenty % of waste independently. PBW aggregates could used successfully for supplant customary sums in concrete with no drawn out unfriendly effects and with palatable quality improvement properties.

### [2]Zainab Z. Ismail, Enas A. Al-Hashmi

Mechanical activities in Iraq are connected with enormous proportions of non biodegradable solid waste, waste plastic one of the most undeniable. The assessment involved 86 examinations and 254 tests that chooses the viability of reusing plastic waste for production

of concrete. 30 kgs of plastic waste of the fabriform shapes is used for partial replacement for sand by zero,ten,fifteen and 20 percent with eight hundred kg of strong mixes. Total of the strong mixes were attempted at room temperature. 70 blocks were shaped for dry thickness and comprehensive quality test, while fifty four precious stones were tossed for quality records tests. Reestablishing ages of three,seven,fourteen and twenty eight days for the strong mixes have been used for the working. The results exhibited the catch of the causing of little scope breaks by introducing waste plastic of surface structure shapes to strong mixes. This investigation guarantees that reusing plastic waste as a sand-replacement total in solid gives a decent way to deal with diminish the expense of materials and settle a portion of the strong waste issues presented by plastics.

## [3]Baboo Rai, S. Tabin Rushad, Bhavesh Kr, and S. K. Duggal

The new and solidified properties of plastic waste blend concrete are mulled over . Different concrete blends were taken containing sand which is fairly superseded by plastic waste pieces in moving rates by volumes. Plastic waste blend concrete having or not having super plasticizer was attempted at room temperature. 48 3-Dimensional square examples are molded for compressive standard tests at 3,7 and 28 days. 8 bars are moreover cast to take the flexural quality characteristic of plastic waste blend concrete. The finding was the abatement in functionality and compressive quality, because in some extent replacement of sand by plastic waste is insignificant that could be redesigned by development of super plasticizer.

## [4]Raju Sharma, Prem Pal Bansal

The usage of various kinds of plastics is a troublesome for environment's security issue. A wide range of used plastic becomes waste and requires colossal zones of land for capacity considering the way that couple of huge amounts of plastics waste cannot be totally reused. Low bio-degradability of plastics and the closeness in gigantic amount of plastic waste antagonistically influence the environment. Already, various assessments are performed to recognize safe, environment pleasant methods for disposing of plastic. Starting late, various sorts of plastics have been solidified in concrete to hinder the prompt contact of plastics with the earth since concrete has an increasingly drawn out help life. In any case, this procedure is surely not a predominant method for disposing of waste plastic. The paper presents a survey

of some conveyed examine with respect to the use of waste plastic in concrete. The effects of waste plastic development on the new, mechanical and warm properties of concrete are also presented in this paper.

## [5]O. Yazoghli Marzouk, R.M. Dheilly, M. Queneudec

Sheer proportion of disposable compartments being made nowadays makes it fundamental to perceive elective procedures for reusing them as a result of being non biodegradable. The paper delineates a creative use of ate up plastic container waste being sand substitution aggregate inside composites material in building applications. Particularly, bottle composed of polyethylene terephthalate (PET) are used as midway, whole substitutes for sand in strong composite. Distinctive volume parts of sands changing from two percent to hundred percent were subbed by a comparable volume of granulate plastic also various sizes of PET aggregates are used.

The mass thickness and mechanical qualities of the composite made were surveyed. To look at the association between composite microstructure and mechanical properties, filtering electrons microscopic procedure was used.

The results presented points subbing sand at a level underneath half by volume with granulate PET, whose upper granular cutoff approaches 5 mm, impacts neither the compressive quality nor the flexural quality of composites.

The examination shows that plastic containers wrecked into minimal PET particles may be used viably as sand-substitution aggregates in cementitious strong composites. These new composites would appear to offer an engaging minimal effort material with consistent properties; additionally, they would help in settling a part of the strong waste issues made by plastics creation and in sparing vitality.

## [6]T.R. Naik, S.S. Singh, C.O. Huber, B.S. Brodersen

The paper depicts an imaginative use of post client squander HDPE plastic in concrete as a

fragile filler. A reference concrete was proportioned to have the twenty eight day compressive quality of 5000 psi. High-thickness plastic was pulverized to little particle for use in the solid. The particles are presented to 3 substance treatments (blanch, dye + NaOH, water) for improving the holding wit cementitious network. Plastic piece were added to the solid in the extent of zero to five percent of complete mix. Compressive quality were evaluated for each test blend. The results showed compound treatment fundamentally influences execution of the plastic adder in concrete. The 3 treatments used on the plastic,best execution was seen with the soluble fade treatment (blanch + NaOH) concerning compressive quality of cement.

## [8]Carolyn, E. Schaefer, Kunal Kupwade-Patil, Michael Ortega, Carmen Soriano, Oral Büyüköztürk, Anne E. White, Michael P. Short

Concrete creation contributes vigorously to ozone depleting substance emanations, in this way we need something which improves the strong and feasible cement having low carbon impression. It is accomplished when concrete is part supplanted with other substance, for example, squander plastic. The investigation talks about advancement towards a medium/high quality cement having a thick, cementitious framework containing a lighted plastic added substance, recuperating the compressive quality while dislodging concrete with squander materials to lessen ozone depleting substance age. Compressive quality tests indicated that the expansion of high portion (100 kGy) lighted plastic in various cements brought about expanded compressive strength when contrasted with tests containing ordinary, non-illuminated plastic. This recommends lighting plastic is a feasible possible answer for recapturing a portion quality which is strayed on adding plastic to solidify glue. X-beam Diffraction (XRD), Backscattered Electron Microscopy (BSE), and X-beam microtomography clarify systems with quality maintenance whenever utilizing illuminated plastic for adder for concrete glue. In part supplanting Portland concrete with a reused squander plastic the plan might can possibly add into diminished carbon discharges.

## [9]VS Punith, A Veeraragavan

The paper examines conduct of the dark solid blend having a folio added substance as reused destroyed waste plastic sacks. The added substance was put into the eighty by hundred infiltration graded bitumen while essential test like ductility, softening point and penetration

are completed and features of changed cover are contemplated. Lab test uncovered that the entrance, pliability esteems diminished when rate substance of the plastics modifier expanded, anyway relaxing point expanded with the rate expansion of the plastic modifier. Marshalll strength test are completed for deciding the ideal bitumen contents as well as ideal modifier contents of the bituminouses solid blend. These level of the modifier is changed to decide the OMC blend as well as the ideal substance in the cover is seen as eight percent. Rehashed loading test were completed onto Marshall examples utilizing quickened stacking hardware. The conduct of the bituminous solid blend in with and without the plastic modifier was concentrated under continued stacking conditions at different temperatures (250C, 300C and 350C) and feelings of anxiety (40% and half of a definitive disappointment load) separately. Weariness testing was done at 1 HZ by applying sinusoidal sort of waveform to Marshall examples. Research facility weakness examines uncovered that, the elastic strain expanded with expanding feelings of anxiety, however the quantity of redundancies to disappointment diminished with expanding feelings of anxiety. Research center weakness tests on bituminous concrete and plastic adjusted bituminous cement directed at 250C, 300C and 350C under consistent pressure mode showed that the exhaustion life of the plastic changed bituminous concrete is essentially higher than that of the plain bituminous concrete.

## [10]Nabajyoti Saikia, Jorge de Brito

A critical improvement in the usage of plastic is observed wherever all through the world lately, which has provoked huge measures of plastic-related waste. Reusing of plastic waste to make new materials like cement or mortar appears as a champion among other response for disposing of plastic waste, in view of its money related and natural focal points. A couple of works have been performed or are in progress to evaluate the properties of solid composites containing various types of plastic waste as total, filler or fiber. This paper presents a review on the reusing plastic waste as total in solid mortar and solid manifestations.

For better introduction, the paper is isolated into four distinct areas alongside presentation and end segments. In the principal segment, sorts of plastics and kinds of strategies used to plan plastic aggregate just as the techniques for assessment of different properties of total and cement were quickly examined. In the accompanying 2 regions, the features of plastic sums

and the distinctive new and solidified solid properties of solid mortar and concrete in proximity of plastic all out were inspected. The 4th portion revolve around the sensible implications of the usage of waste plastic in solid creation and future research need.

## [11]P. Asokan, Mohamed Osmani, ADF Price

A broad research community preliminaries are coordinated to improve the mechanical features of GRP waste powder filled concrete using super plasticiser for enlarging the degree for GRP waste reusing for different uses. Noted twenty eight days mean compressive quality of strong models made with five to fifteen percent GRP waste powders using two percent super plasticiser came about 70.25 ± 1.43–65.21 ± 0.6 N/mm2 that equals approximately fourty five percent more than that of without the development of super plasticiser (with GRP waste) also approximately eleven percent more than control concrete (without GRP waste) having two percent super plasticiser. The moldable splitting nature of the strong showed 4.12 ± 0.05–4.22 ± 0.03 N/mm2 with 5–15% GRP waste powder which is furthermore higher than that of the control concrete (3.85 ± 0.02 N/mm2). Drying shrinkage, starting surface maintenance also thickness of GRP waste filled concrete were surveyed and found better than the appealing quality for use in auxiliary and non-basic applications.

## [12]Rafat Siddique, Jamal Khatib, Inderpreet Kaur

Different waste materials are delivered from collecting structures, organization ventures and metropolitan solid wastes. The growing care about nature has greatly added to the concerns related with expulsion of the created wastes. Solid waste organization is one of the significant characteristic concerns on the planet. With the deficiency of space for landfilling and in view of its reliably growing expense, waste use has gotten an engaging alternative rather than evacuation. Research is being done on the utilization of waste things in concrete. Such waste things consolidate discarded tires, plastic, glass, steel, devoured foundry sand, and coal start symptoms (CCBs). All of these waste things has given a specific effect on the properties of new and set concrete. The use of waste things in solid makes it productive, yet also helps in diminishing evacuation issues. Reuse of gigantic wastes is seen as the best normal choice for

dealing with the issue of evacuation. One such waste is plastic, which could be used in various applications. In any case, tries have moreover been made to explore its use in solid/black-top cement. The improvement of new advancement materials using reused plastics is basic to both the turn of events and the plastic reusing endeavors.

This paper presents an unmistakable overview about waste and reused plastics, waste the board decisions, and research dispersed on the effect of reused plastic on the new and set properties of concrete. The effect of reused and waste plastic on mass thickness, air content, usefulness, compressive quality, parting rigidity, modulus of versatility, sway obstruction, penetrability, and scraped spot opposition is discussed in this paper.

## 2.3 Summary of literature review

From the literature review, it is affirmed that as the total populace develops, squanders of different kinds are being created. The formation of non–rotting and low biodegradable waste materials, joined with a developing purchaser populace has brought about waste removal emergency. One answer for this emergency is reusing squanders into valuable items. Concrete has a few constraints, for example, its low rigidity, low solidarity to-weight proportion and moderate warm protection. Improving these attributes was the point of a research center based examination concerning the conduct of cement made within the sight of plastic waste as a sand substitution. Concrete containing Plastic displays higher malleability, however lower top pressure contrasted with ordinary cement. Reused plastic can be utilized in transportation related parts. Fibrillated polypropylene strands will in general increment the impermeability of cement. Reused plastic can be viably utilized in the fix and overlay of harmed concrete solid surfaces in asphalts, extensions, floors, and dams. The expense of development will lessen and furthermore assists with evading the general removal method of waste plastics specifically land filling and cremation which have certain weight on biology.

## 2.4 OBJECTIVES

- To check the change in compressive strength of concrete after adding RP.
- To check the change in tensile strength of concrete after adding RP.
- To check the change in workability after addition of RP to concrete.
- To check the change in block density of concrete after adding RP.
- To check if the concrete with RP is good enough for structural use.

So as to fulfill the above targets, compressive strength test, initial & final setting time test, slump test, drop test, block density test and split tensile strength test are done on concrete blocks and concrete mix.

A total of 52 blocks are to be made, out of which 13 blocks are M30 mix design concrete block with no additive and 39 blocks for M30 with variable grouping of RP (5%, 10% and 15%) for testing on $7^{th}$ and $28^{th}$ day for compressive strength test, drop test, split tensile strength test and block density test.

# CHAPTER 3

# MATERIALS AND METHODOLOGY

## 3.1 Materials

### 3.1.1 Cement

Cement is a clasp, a material which is used for advancement that sets, hardens, and holds quick to various materials to integrate them. Concrete is just some of the time used isolated, yet rather to tie sand and rock (all out) together. Cement mixed in with fine aggregate produces mortar for block work, or with sand and rock, produces concrete. Concrete is the most extensively used material in nearness and is the most used substance after water. Portland concrete is by a wide edge the most notable kind of solid with everything taken into account usage around the world. It is produced by warming limestone (calcium carbonate) with various materials, for instance, earth to 1,450 °C in a heater, in a technique known as calcination that liberates a molecule of carbon dioxide from the calcium carbonate to shape calcium oxide, or quicklime, which by then misleadingly gets together with various materials in the mix to outline calcium silicates and distinctive cementitious blends. The resultant hard substance formed is called 'clinker', which is than mixed with humble amount of gypsum into a powder to make standard Portland concrete, the most normally used kind of cement (as often as possible insinuated as OPC). Concrete used in this errand is OPC grade-43 cement.

**Fig.-1**

### 3.1.2 Recycled Plastic Granules

Plastic is material containing any of a wide extent of made or semi designed normal exacerbate that are malleable subsequently can be framed into solid things. On account of their straightforwardness, effortlessness of gathering, adaptability, and solidness to water, plastics are used in an enormous number of consequences of different scale, including paper fastens and transport. They have beaten traditional materials, for instance, wood, stone, horn, etc. Almost all plastics are extreme and degrade slowly, because their substance structure leave them impenetrable to various trademark methodology of defilement. Around 1,000,000,000 tons of plastic waste have been discarded since the 1950s. Others check a total human making of 8.3 billion tons of plastic of which 6.3 billion tons is waste, with a reusing pace of just 9%. Plastic reusing is the route toward recovering piece or waste plastic and reprocessing the material into accommodating things. There are seven sorts for plastic specifically a] Polyethylene Terephthalate, b] High Density Polyethene, c] Polyvinyl Chloride, d] Low Density Polyethene, e] Polypropylene, f] Polystyrene or Styrofoam, g] Miscellaneous plastics (fuses: polycarbonate, acrylonitrile butadiene, fiberglass, polylactide, acrylic, styrene, and nylon). Barely any sorts of plastic are recyclable.

The waste plastic utilized in this task is Recycled HDPE (High Density Polyethene) which is around 3-5mm non-uniform granules.

**Fig.-2**

### 3.1.3 Aggregate

Aggregate are generally from coarse to medium grained particulate material utilized in development, including sand, rock, squashed stone, slag, reused concrete and geosynthetic totals. Aggregate is mostly mined matter on our earth. Totals are a part of composite materials, for example, cement and black-top cement; the total fills in as support to add solidarity to the general composite material. Due to its high water conductivity system when contrasted with most soils, aggregates are widely used for seepage operations, for example, establishment and French channels, septic channel fields, holding divider channels, and side of the road edge channels. Aggregates are also used as base in many construction projects like under establishments, railway ballasts, streets.

The proportion of coarse to fine total utilized is 0.8. Fine and coarse total utilized for venture are sand of Zone-I and 20mm separately. Coarse Aggregate =654 kg/$m^3$.

**Fig.-3**

## 3.2 Testing Methodology

### 3.2.1 Compression Test

Cubic concrete specimen are broken down ina compression test machine to measure compressive strength. It is calculated by dividing the failure load by the cross section area that resists the load. The unit is megapascals. M30 concrete cubes without any addition are casted for compressive strength testing of normal cubes. 3 cubes are casted for measuring strength at 7, 14 and 28 days each. Similarly, 3 cubes for different concentration of plastic granules (i.e. 5%, 10% and 15%) are made. The cubes casted are of 15cm x 15cm x 15cm dimension. The cubes are to be kept in water for curing and must be undergone tests once in every seven day and the temp. of the water should be at 27$\pm$20C. The result for M30 concrete cubes generally is 20N/mm$^2$ at 7$^{th}$ day and 30N/mm$^2$ at 28$^{th}$ day.


**Fig.-4**

### 3.2.2 Initial and Final Setting Time Test

Initial setting time of cement is the duration between extension of water to solid blend till the time at one mm square region needle neglects to enter the solid glue, put in the Vicat's shape five mm to seven mm from the base of the form. Last setting time is that interval of time between the point of time at which water is added to solid blend and the time at which 1 mm needle sets up an association with the paste in the shape yet five mm association doesn't set up any impression.

Calculations

$$\text{Initial setting time} = t_2 - t_1$$

$$\text{Final setting time} = t_3 - t_1$$

$t_1$ =Time at which water is first added to cement

$t_2$ =Time when needle fails to penetrate five mm to seven mm from bottom of the mould

$t_3$ =Time when the needle makes an impression but the attachment fails to do so

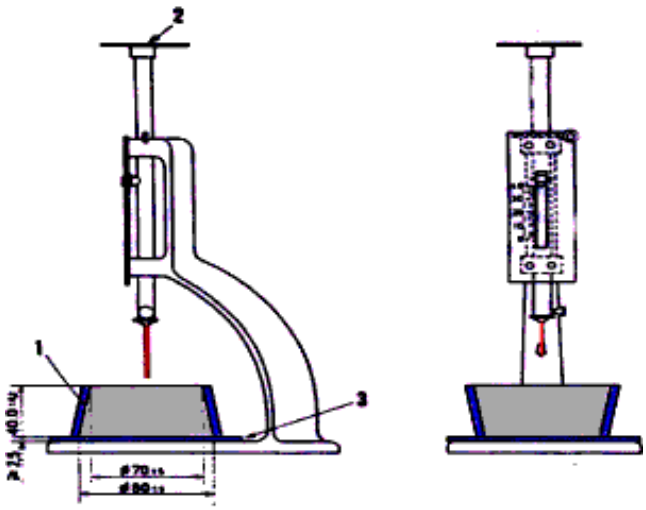


**Fig-5**

### 3.2.3 Slump Test

Concrete droop test decides the usefulness or consistencies of strong mix arranging at the examination community or the structure site during the headway of the work. Solid droop tests is finished from gathering to bunch for checking the uniform idea of cement in the coarse development. The slumped concrete takes various shapes and is shown below, the slump is named as true slump, zero slump, shear slump or collapsed slump. In case of shear or collapsed slump, another sample should be prepared and test is to be redone.

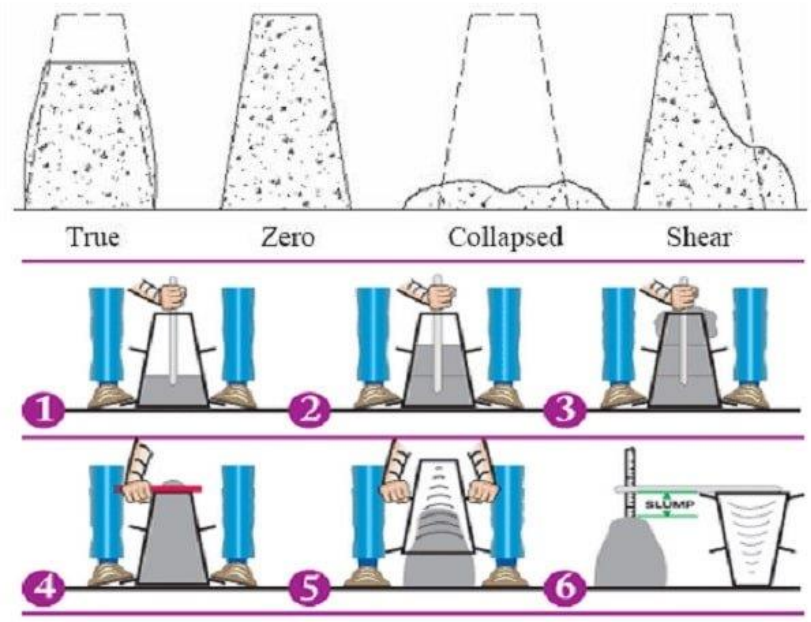


**Fig-6**

### 3.2.4 Drop Test

A drop test is the least complex approach to test the quality of a structure square: if the square endures a 6-ft fall, it is sufficiently able to go into a structure.

### 3.2.5 Block Density

The square should be dried to consistent mass in a sensible stove warmed to generally 100°C. When we cool the square to room temp, the elements of square will be evaluated in cm to the nearest mm and the general volume figured in cm^3. The square will by then be weighted in kgs to the nearest ten gram. The thickness of square decided as below:

Density($Kg/m^3$) = Mass of block(kg) / Volume of block($cm^3$) $*10^6$

### 3.2.6 Split Tensile Strength Test

A strategy that decides the tensile strength of concrete using a chamber that parts onto the vertical breadth. It is an indirect strategy to test the concrete's tensile strength. In this test, concrete block is taken and put on compression testing machine with steel loading pieces on both ends. Load is applied and the load at which failure appears is noted. For measuring tensile strength following formula is used:

$f_{ct} = 2P / \pi dL$

where,

P= the max load that is put,kN

L : length, mm

d : Diameter, mm

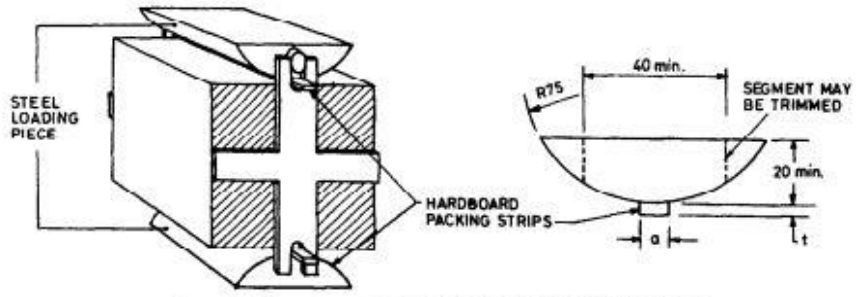


**Fig-7**

## 3.3 Methodology

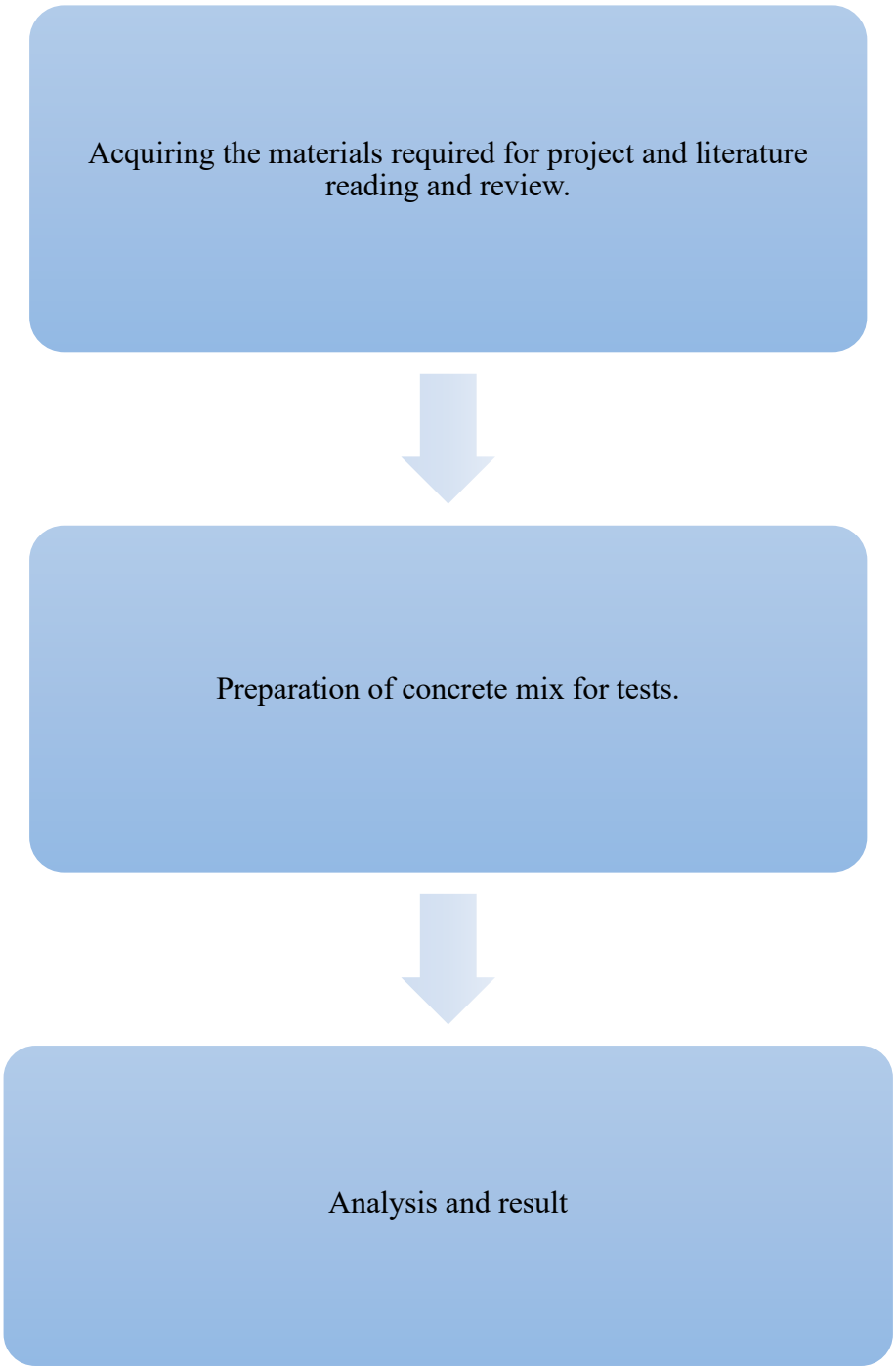


**Fig-8**

### 3.3.1 Design of M30 Concrete

| **A-1** | **Requirement for proportioning** | |
|---|---|---|
| 1. | Grade Designation | M30 |
| 2. | Cement type | OPC 43 grade |
| 3. | Max. aggregate size | 20mm |
| 4. | Min. cement content | 320Kg/$m^3$ |
| 5. | Max. water cement ratio | 0.45 |
| 6. | Workability | 75-100mm (slump) |
| 7. | Degree of supervision | Good |
| 8. | Aggregate type | Crushed angular aggregate |
| 9. | Max. cement content | 540Kg/m3 |
| **A-2** | **Test Data of Materials** | |
| 1. | Sp. Gravity of Cement | 3.14 |
| 2. | Sp. Gravity of Water | 1.00 |
| 3. | Sp. Gravity of 20mm Aggregate | 2.885 |
| 4. | Sp. Gravity of 12.5mm Aggregate | 2.857 |
| 5. | Sp. Gravity of Sand (Zone-I) | 2.723 |
| 6. | Water Absorption of 20mm Aggregate | 0.42% |
| 7. | Water Absorption of 12.5mm Aggregate | 0.47% |
| 8. | Water Absorption of Sand | 1.38% |

| | | |
|---|---|---|
| **A-3** | **Target Strength for Mix Proportioning** | |
| 1. | Target Mean Strength | 38.25MPa |
| | | |
| 2. | Compressive Strength on 28 day | 30MPa |
| **A-4** | **Selection of Water Cement Ratio** | |
| 1. | Max. Water Cement Ratio | 0.45 |
| 2. | Adopted W/C Ratio | 0.45 |
| **A-5** | **Water Content** | |
| 1. | Max. Water Content | 186 L |
| 2. | Estimated Water content for 75-100mm Slump | 160 L |
| **A-6** | **Calculation of Cement Content** | |
| 1. | W/C Ratio | 0.45 |
| 2. | Cement Content (160/0.45) | 360 Kg/m3 |
| | | i.e. more than 310kg/m3 |
| **A-7** | **Proportion of Volume of Coarse Aggregate & Fine Aggregate Content** | |
| 1. | Vol. of C.A. as per table 3 of IS 10262 | 62% |
| 2. | Adopted Vol. of Coarse Aggregate | 63% |
| 3. | Adopted Vol. of Fine Aggregate( 1-0.63) | 37% |
| **A-8** | **Mix Calculations** | |
| 1. | Vol. of Concrete in m3 | 1.00 |

| | | |
|---|---|---|
| 2. | Vol. of Cement in m3 | 0.11 |
| | (Mass of Cement) / (Sp. Gravity of Cement)x1000 | |
| 3. | Vol. of Water in m3 | 1.60 |
| | (Mass of Water) / (Sp. Gravity of Water)x1000 | |
| 4. | Vol. of all Aggregate in m3 | 0.73 |
| | Sr.1 – (Sr. 2+3+4) | |
| 5. | Vol. of Coarse Aggregate in m3 | 0.49 |
| 6. | Vol. of Fine Aggregate in m3 | 0.27 |
| **A-9** | **Design for One cum of Concrete** | |
| 1. | Cement in kg/m3 | **360 (1.215kg for 150mm cube)** |
| 2. | Water in kg/m3 | **160 (540ml for 150mm cube)** |
| 3. | Fine Aggregate in kg/m3 | **815 (2.75kg for 150mm cube)** |
| 4. | Coarse Aggregate in kg/m3 | **1284 (4.33kg for 150mm cube)** |
| 5. | 20 mm in kg/m3 | **645** |
| 6. | 10 mm in kg/m3 | **639** |
| 7. | W/C Ratio | **0.45** |

**Fig-9**

| **A-10** | **Design for One cum of Concrete (adding 5% RP)** | |
|---|---|---|
| 1. | Cement in kg/m3 | **360 (1.215kg for 150mm cube)** |
| 2. | Water in kg/m3 | **160 (540ml for 150mm cube)** |
| 3. | Fine Aggregate in kg/m3 | **774.25 (2.61kg for 150mm cube)** |
| 4. | Coarse Aggregate in kg/m3 | **1284 (4.33kg for 150mm cube)** |
| 5. | 20mm in kg/m3 | **645** |
| 6. | 10mm in kg/m3 | **639** |
| 7. | W/C Ratio | **0.45** |
| 8. | Mass of RP | **40.75 (0.13kg for 150mm cube)** |

| A-11 | **Design for One cum of Concrete (adding 10% RP)** | |
|---|---|---|
| 1. | Cement in kg/m3 | **360 (1.215kg for 150mm cube)** |
| 2. | Water in kg/m3 | **160 (540ml for 150mm cube)** |
| 3. | Fine Aggregate in kg/m3 | **733.5 (2.47kg for 150mm cube)** |
| 4. | Coarse Aggregate in kg/m3 | **1284 (4.33kg for 150mm cube)** |
| 5. | 20mm in kg/m3 | **645** |
| 6. | 10mm in kg/m3 | **639** |
| 7. | W/C Ratio | **0.45** |
| 8. | Mass of RP | **81.5 (0.27kg for 150mm cube)** |

**Fig-10**

| **A-12** | **Design for One cum of Concrete (adding 15% RP)** | |
|---|---|---|
| 1. | Cement in kg/m3 | **360 (1.215kg for 150mm cube)** |
| 2. | Water in kg/m3 | **160 (540ml for 150mm cube)** |
| 3. | Fine Aggregate in kg/m3 | **692.75 (2.33kg for 150mm cube)** |
| 4. | Coarse Aggregate in kg/m3 | **1284 (4.33kg for 150mm cube)** |
| 5. | 20mm in kg/m3 | **645** |
| 6. | 10mm in kg/m3 | **639** |
| 7. | W/C Ratio | **0.45** |
| 8. | Mass of RP | **122.25 (0.41kg for 150mm cube)** |

# CHAPTER 4

# RESULTS & DISCUSSION

## 4.1 General

### 4.1.2 Results for Compressive Strength Test

| Sr. no. | Days at which test is done | M30 ( in $N/mm^2$) | With 5% RP ( in $N/mm^2$) | With 10% RP ( in $N/mm^2$) | With 15% RP ( in $N/mm^2$) |
|---|---|---|---|---|---|
| 1 | At $7^{th}$ day | 20.6 | 19.9 | 18 | 17.8 |
| 2 | At $28^{th}$ day | 31.8 | 30.2 | 29 | 27.9 |

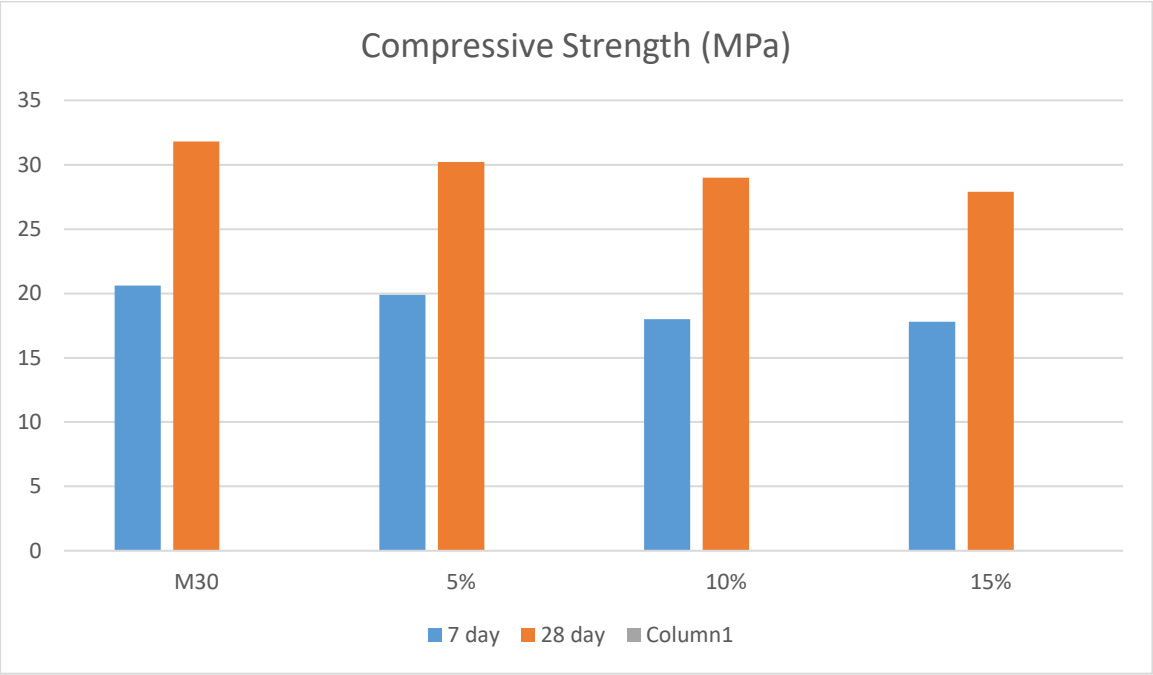


**Fig-10**

### 4.1.2 Results for Initial & Final Setting Time Test

There is almost no change in Initial & Final Setting Time of concrete blocks which are approximately 30-32min. and 10hrs respectively.

### 4.1.3 Results for Slump Test

Slump of normal M30 concrete block is **95mm (true slump).**

Slump of concrete block with 5% RP is **93mm (true slump).**

Slump of concrete block with 10% RP is **91mm (true slump).**

Slump of concrete block with 15% RP is **84mm (shear slump).**

### 4.1.4 Result for Drop Test

The M30 blocks after dropping doesn't show much of the difference only impact area is slightly disfigured whereas, in case of RP additives (5%&10%) cracks are formed starting from impact zone(10% RP blocks have more longer cracks) but in case 15% RP additive, bits of crust seemed to have fallen down.

### 4.1.5 Result for Block Density Test

The block density of M30 concrete block is – 2460kg/$m^3$

The block density of M30 concrete block with 5%RP is – 2455.68kg/$m^3$

The block density of M30 concrete block with 10%RP is – 2448.45kg/$m^3$

The block density of M30 concrete block with 15%RP is – 2439.29kg/$m^3$

### 4.1.6 Result for Split Tensile Strength Test

| Sr. no. | Days at which test is done | M30 ( in N/$mm^2$) | With 5% RP ( in N/$mm^2$) | With 10% RP ( in N/$mm^2$) | With 15% RP ( in N/$mm^2$) |
|---|---|---|---|---|---|
| 1 | At $7^{th}$ day | 2.5 | 2.34 | 2.29 | 2.13 |
| 2 | At $28^{th}$ day | 3.67 | 3.56 | 3.43 | 3.23 |

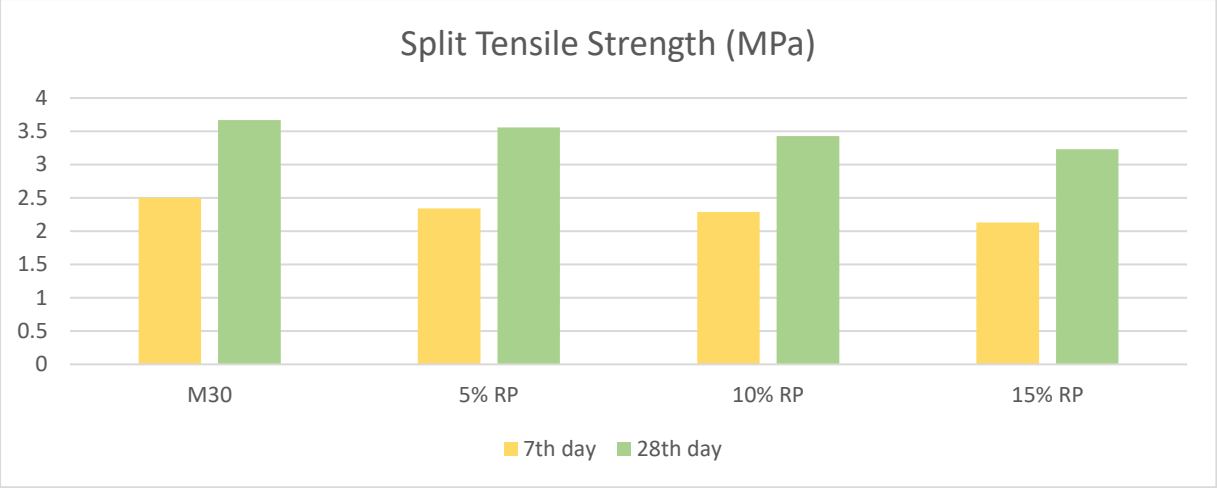


**Fig-11**

## 4.2 Discussion

Above outcomes shows that with increasing the amount of recycled plastic the tensile and compressive strength of the concrete is decreasing as the density of RP used is not on par with the density of fine aggregate. There could also be problem with the cohesion between plastic and cement due to smooth surface or shape of RP's granules used. This could also prove the cracks appearing on blocks during drop test. Reduction in slump size on adding RP indicates reduction of workability of concrete and if more RP is added it could have led to bleeding and segregation of concrete block. There also seems to be slight reduction in block density with increasing amount of RP due to density difference in the two materials.

# CHAPTER 4

# CONCLUSIONS

This study investigates the valorization of recycled high density polyethylene as fine total in field of development. The impacts of a joining of this loss on the physic mechanical properties of the solid have been broke down. The accompanying primary ends could be drawn:

- A reduction in the compressive strength at 28th days is about 3, 10 and 18% of the concretes containing 5%, 10% and 15% of RP respectively.
- The addition of RP does not affect the setting time of concrete.
- With the increasing addition of RP, the workability is decreasing and on further addition can cause bleeding or segregation of concrete. This shows the lack of cohesion between plastic and cement particles.
- Due to lack of cohesiveness, it may lead to cracking or crazing of concrete.
- There is no major change in density of concrete.
- The tensile strength is also decreasing about 3, 7 and12% for concrete with 5, 10 and 15% resp.

It could be concluded that due difference in density of plastic and fine aggregates, it is not suitable to be used partially or fully in place of fine aggregates. This can make concrete lose more of its properties and result in collapsing of the structure. But as the partial substitution of RP can lower the cost as well as help in saving environment. As plastic is also bad conductor of heat and electricity, it can also help in making better insulated concrete structures. Hence, addition of RP in the concrete between the range of 0-10% could be considered effective.

## Future Scope

As, in our case, on addition of 5% RP lead to minimum reduction in compressive and tensile strength and drop test could also be said to have barely pass, we could say it is possible to substitute RP in construction material as it could reduce the total cost of project as well as help in reducing waste plastic which is degrading our environment. Further studies on this topic is also required to check out possibilities for future development of RP additives in concrete and helping in diminishing of plastic waste.

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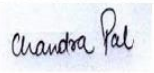

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