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STUDY OF POLYETHYLENE TEREPHTHALATE (PET) PLASTIC BOTTLES IN THREADED FORM AS MICRO LEVEL REINFORCEMENT IN FLY ASH CONCRETE

B B Sourav[*1], Er. Sugam Sehgal[2] & Sameer Malhotra[3]

[*1]Gurukul Vidyapeeth Institute of Engineering and Technology, Maharaja Ranjit Singh Punjab Technical University

[2]Dissertation Guide- Assistant Professor, Bhargava College of Engineering and Technology, Supwal, Samba(J&K)

[3]HOD of Civil Department, Gurukul Vidyapeeth Institute of Engineering and Technology, Banur, Rajpura (Patiala)

ABSTRACT

The growing environmental concerns and proper disposal of construction and demolition waste is a challenge for construction industry. Now a days in our country Solid waste management is one of the major environmental concerns. A substantial growth in the consumption of plastic is observed all over the world in recent years. The use of demolition waste as a resource for recycling or recovery is gaining grounds in many countries. The proper selection and processing of demolition waste can be helpful in producing concrete. In construction industries, concrete masonry units are used commonly. The use of plastic bottles in construction materials has been around for the past twenty years, but with little focus on using threaded plastic bottles in the materials. This work aimed to justify use of threaded plastic bottles and fly ash in concrete. It also aims to investigate the strength of concrete when plastic bottles are used. Plastic bottles are increasingly becoming a menace to the environment due to the chemicals used in the manufacture, improper use and disposal. Waste plastic bottles are major cause of solid waste disposal. This is an environmental issue as waste plastic bottles are difficult to biodegrade and involves processes either to recycle or reuse. As noted by Plastics Industry (2011) reusing plastic bottles may seem safe , but a chemical found in reusable plastic bottles, known as Bisphenol. A (BPA), is suspected of posing a health risk to human beings. Hence, the safest way of disposing plastic bottles is to recycle them, particularly they can be used in the construction .The use of plastic is increasing day by day, although steps were taken to reduce its consumption. This creates substantial garbage every day which is much unhealthy. Plastic bottles are difficult to reuse, recycle and non-biodegrade and hence creates an environment issue. A healthy and sustainable reuse of plastics offers a host of advantages. The suitability of recycled plastics as coarse aggregate in concrete and its advantages are discussed here. Due to ever increasing plastic pollution and construction waste pollution, it has become important to find a way for reducing such waste as it is hazardous to the environment . Plastic bottle is considered as a urban junk with sustainability characteristic which can be used as a material instead of some conventional material such as brick in building in construction. This paper intends to investigate the application of plastic bottles as one of the urban wastage in construction and that how it can lead to sustainable development. M25 design mix casted in which threaded plastic bottles filled with concrete made of using fly ash ,coarse aggregates with plasticizer . Plastic bottles are cut into threaded form. In due course of time, threaded plastic bottles evenly placing in layers into concrete cubes as micro level reinforcement. Later on its compressive strength , split tensile strength , flexural strength are tested . To overcome the above problems of over exploitation of natural resources and environmental issue due to the use of non bio-degradable plastic bottles, attempt has been made to use threaded plastic bottles in concrete. Use of threaded plastic bottles will reduce environmental waste. Hence it also proves to be cost effective.

Key words: *M 25 concrete cube, Threaded Plastic Bottles, Fly ash, Sand, Coarse aggregates, Ordinary Portland Cement (53 Grade).*

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I. INTRODUCTION

Concrete is the most widely used man made construction material in the world and its second only to water as the most utilized substance in the planet. Seeking aggregates for concrete and to dispose of the waste from various commodities is the present concern. Today sustainability has got top priority in construction industry. In the present study the recycled plastics were used to prepare the coarse aggregates thereby providing a sustainable option to deal with the plastic waste. There are many recycling plants across the world, but as plastics are recycled they lose their strength with the number of recycling. So these plastics will end up as earth fill. In this circumstance instead of recycling it repeatedly, if it is utilized to prepare aggregates for concrete, it will be a boon to the construction industry. Most of the failures in concrete structures occur due to the failure of concrete by crushing of aggregates. In simple words concrete is defined as a mixture of four ingredients as coarse aggregates that form the largest proportion of the mix, fine aggregates such as sand that act as filler material in the voids, binding material such as lime or Portland cement that binds these material together and water that reacts with binding material. The mixing of these four materials gives us a paste that is called as matrix. The concrete can be classified on the basis of its characteristic compressive strength on basis of compressive strength concrete have been classified as:

Table 1 classification of concrete:

Classification	Compressive strength of concrete
Low strength concrete	Less than 20 MPa
Moderate strength concrete	20-50 MPa
High strength concrete	50-200 MPa
Ultra-high strength concrete	More than 200 MPa

Based on its compressive strength, the concrete can be graded as M10, M15, M20 and so on, where M is denomination for mix and 10, 15, 20 are the characteristic compressive strength of concrete after 28 days.

For my research purpose I have chosen threaded plastic bottles and fly ash that will replace a proportion of cement in the concrete mix replace a proportion of cement in the concrete mix.

Plastics are mainly highly polymerized compounds consisting of carbon and hydrogen, made from substances such as petroleum and natural gas. Out of the various forms, **Plastic bottles** are commonly used with the commercial name "Polyethylene terephthalate (PET)" bottles. PET bottles are used for storing carbonated beverage and water. After its use the PET bottles becomes as a waste and it should be disposed in proper manner. But there is an environmental issue as waste PET bottles are difficult to reuse, recycle and biodegrade.

Fig (a)   Plastic Bottles (PET) Waste Materials

Fly ash, also known as "pulverised fuel ash" in the United Kingdom, is a coal combustion product that is composed of the particulates (fine particles of fuel) that are driven out of coal-fired boilers together with the flue gases. Ash that falls to the bottom of the boiler is called bottom ash. In modern coal-fired power plants, fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys. Together with bottom ash removed from the bottom of the boiler, it is known as **coal ash**. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide (SiO_2) (both amorphous and crystalline), aluminium oxide (Al_2O_3) and calcium oxide (CaO), the main mineral compounds in coal-bearing rock strata.

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Table 2 physical properties of fly ash:

Parameters	**Fly Ash**
Bulk Density (gm/cc)	0.9-1.3
Specific Gravity	1.6-2.6
Plasticity	Lower or non-plastic
Shrinkage Limit (Vol stability)	Higher
Grain size	Major fine sand / silt and small per cent of clay size particles
Clay (per cent)	Negligible
Free Swell Index	Very low
Classification (Texture)	Sandy silt to silty loam
Water Holding Capacity (WHC) (per cent)	40-60
Porosity (per cent)	30-65
Surface Area (m2 / kg)	500-5000
Lime reactivity (MPa)	1-8

Above properties are just approximation values. Depending on the types of fly ash these values may vary.

Table 3: Chemical Composition of fly ash:

Compounds (%)	**Fly Ash**
SiO2	38-63
Al2 O3	27-44
TiO2	0.4-1.8
Fe2 O3	3.3-6.4
MnO	b.d-0.5
MgO	0.01-0.5
CaO	0.2-8
K2 O	0.04-0.9
Na2 O	0.07-0.43
LOI	0.2-5.0
pH	6-8

bd: below detection limit, LOI: Loss on Ignition Above properties are just an approximation value. Depending on the types of fly ash these values may vary.

So these materials will be added to the concrete as partial replacement of cement and the experiments will be done to check the variation in properties of concrete.

II. LITERATURE REVIEW

(1) Mr. K.Ramadev (2012) in his research paper "Experimental Investigation on the Properties of Concrete with Plastic PET (Bottle) Fibers as Fine Aggregates" invesgating that Waste plastic bottles are major cause of solid waste disposal. Polyethylene Terephthalate (PET, PETE or polyester) is commonly used for carbonated beverage and water bottles. This is an environmental issue as waste plastic bottles are difficult to biodegrade and involves processes either to recycle or reuse. Concrete with 1%, 2%, 4% and 6% PET bottle fibers for fine aggregate were produced and compared against control mix with no replacement. Cube specimens, cylinder specimens and prism specimens of 18 numbers each were cast, cured and tested for 7 day and 28 days strength. This paper concluded that-

- The concrete with PET fibers reduced the weight of concrete and thus if mortar with plastic fibers can be made into light weight concrete based on unit weight
- It was observed that the compressive strength increased up to 2% replacement of the fine aggregate with PET bottle fibers and it gradually decreased for 4% and 6% replacements. Hence replacement of fine aggregate with 2% replacement will be reasonable.
- It was observed that the split tensile strength increased up to 2% replacement of the fine aggregate with PET bottle fibers and it gradually decreased for 4% and 6% replacements. Hence, the replacement of the fine aggregate with 2% replacement will be reasonable with high split tensile strength compared to the other specimens casted and tested.
- It was observed that the flexural strength increased up to 2% replacement of the fine aggregate with PET bottle fibers and it gradually decreased for 4% and remains the same for 6% replacements.
- Hence, the replacement of the fine aggregate with 2% of PET bottle fibers will be reasonable than other replacement percentages like 4% and 6% as the compression and split tensile strength reduces gradually.

(2) Rakesh Fataniya1, Rihan Maaze (2015) in their research papers "Experimental Investigation of Concrete Masonry Units with Plastic Bottle Cores and PET Fibers" studied the use of plastic bottles in construction materials has been around for the past twenty years, but with little focus on using full plastic bottles and PET fibers in the materials. This thesis presents the results of a study conducted to determine the compressive strength of concrete masonry units with plastic bottle cores and PET fibers. Solid waste can be filled in plastic bottle for increase the compression strength of block. PET fibers used as partially replacement of fine aggregate. Concrete with 1%, 2%, 4% and 6% PET bottle fibers for fine aggregate were produced and compared against control mix with no replacement. Determination of the compressive strength of the concrete masonry units allows for further study to continue in concrete masonry units with plastic bottle cores to determine if they are viable in third world countries. This paper concluded that –

- The use of fly ash concrete masonry units with plastic bottle cores could become possible in third world countries. Comfort of masonry unit construction on-site was of utmost importance in the creation of the laboratory units.
- Reducing the CO2 emission in manufacturing the cement by reducing the use of cement. It is counted as one of the foundation's green project and has caught the attention of the architecture and construction industry.
- Generally the plastic bottle core masonry block houses are bioclimatic in design, which means that when it is warm outside is cold inside and vice versa.
- The concrete with PET fibers reduced the weight of concrete and thus if mortar with plastic fibers can be made into light weight concrete based on unit weight.
- It was observed that the compressive strength increased up to 2% replacement of the fine aggregate (Grit) with PET bottle fibers and it gradually decreased for 4% and 6% replacements. Hence replacement of fine aggregate with 2% replacement will be reasonable.

(3) S.Premalatha (2016) in her research paper "UTILIZATION OF WASTE PET BOTTLES AND INDUSTRIAL BY-PRODUCTS AS A CONSTRUCTION MATERIAL" studied Depletion of natural raw materials causes increase in the cost of construction. As resources become scarcer, alternate construction materials has to be used. Therefore, this paper focuses on reuse of waste materials such as Polyethylene Terephthalate (PET) bottles and Industrial by- products as a construction material to reduce the cost of construction and the problem of disposing the waste materials. Based on her tests, they concluded that, the compressive strength of the BBs filled with brick kiln dust is greater than standard bricks. While comparing the cost, the BBs are 41% less than the standard bricks and BB masonry is 22% less than the conventional brick masonry. The finally this paper concludes the brick kiln dust bottle brick masonry can be used for house construction and is economical than the conventional brick masonry. It also provides solution for the disposal of industrial by – products and PET bottles.

CONCLUSION: From the above study, the compressive strength of the BBs filled with brick kiln dust is greater than standard bricks. While comparing the cost, the BBs are 41% less than the standard bricks and BB masonry is

22% less than the conventional brick masonry. The strength of the BB masonry house can be improved by placing mesh between each layers of BB. It can also be used for other construction such as foundation, toiletry etc., Finally this paper concludes the brick kiln dust bottle brick masonry can be used for house construction and is economical than the conventional brick masonry. It also provides solution for the disposal of industrial by – products and PET bottles.

III. ADVANTAGE OF PLASTIC BOTTLES IN CONCRETE

The use of plastic waste as a natural aggregate substitute in concrete is a relatively recent concept. One of the first significant reviews on the use of waste plastic in concrete focused on the advantages and financial benefits of such use, besides their physical and mechanical properties. And more over use of plastic as aggregate gives a solution to the problems encountered with the quarrying of natural aggregate. The followings advantages of plastic bottles in concrete are given below:

(1)Waste management - To build a small house one can use as many as 10,000 used bottles which are readily available. Waste that would otherwise be deposited in a landfill can now help solve other social problems like housing, schools and clinics. If the communities want to get rid of other plastic waste the bottles can be filled prior to construction. Waste like paper and plastic is then permanently removed from the environment.

(2)Environmental benefits - Unlike "traditional" bricks, bottle bricks are not fired, this as well as the weight consideration in terms of transport contributes to a more eco- friendly building system.

(3)Provide structures - Any statistic would have to be an educated guess, since in many parts of the world homeless people are considered outside normal society. Approximately 1 billion people do not have suitable housing and 500 million have no housing whatsoever.

(4)Cost effective- The use of recycled material makes it more affordable than conventional building methods and will increase the accessibility to suitable housing. It is a well-insulated solution that will reduce energy consumption to control temperatures.

Advantages of Building Construction with Plastic Bottles:
The following benefits are gained to the whole environment and society by employing plastic bottles in building construction:

- The total waste generated is reduced
- The source of building material is local. No additional cost for the same
- The natural resources are preserved

IV. OBJECTIVE OF THE STUDY

The materials we are using for our research are waste materials but their chemical composition shows that they can be used to enhance the properties of the concrete. So it is up to us that how effectively we make use of these materials so that these materials can be used in service mankind. The properties of concrete that can be modified using plastic bottles and fly ash are its,

a) compressive strength
b) split tensile strength
c) flexural strength and workability

- ➢ There are some other important properties of concrete will also be under consideration such as workability, compaction, bleeding and segregation of concrete. The main objective of the study is to:-
- ✓ To make use of waste materials (plastic bottles) in concrete.
- ✓ To make the concrete cheaper.
- ✓ To increases the properties of concrete.

- ➢ The important objectives of this research work are to find the possibility of using threaded plastic bottles. The followings are given below:
- ✓ Check the compression strength of concrete masonry block when plastic bottle can be used as core part of concrete block.
- ✓ As partial substitute for the fine aggregate in concrete composites.
- ✓ To investigate the mechanical behaviour of the components by using fibers.
- ✓ To determine the percentage of long threaded plastic fibres which gives more strength when compared to control concrete.
- ✓ It is considered as one of the foundation for green project through reduce land and air pollution.

The amount of plastics of all types consumed annually all over the world has increased significantly. The manufacturing processes, municipal solid wastes and service industries generate a large amount of waste plastic materials. Recycling is one of the ways to reduce the environmental impact of the waste plastic bottles. But the biggest problem with plastic recycling is that it is difficult to automate the sorting of plastic waste and so is labour . It is clear that the plastics are not harming our natural environment and health all by themselves; it is our use of them that has catastrophic consequences.

V. RESEARCH METHODOLOGY AND MATERIALS

The research methodology for performing this research is given below:

1. Studying past research on innovative masonry
2. Material Collection
3. Finding Material Characteristic
4. Calculating different proportion, aspect ratio of fibre
5. Casting and curing concrete masonry units with plastic bottle core or use PET fibres.
6. Testing compression strength of block
7. Analysing the result.

The flow chart shown in **Figure (b)** illustrates the methodology of the project:

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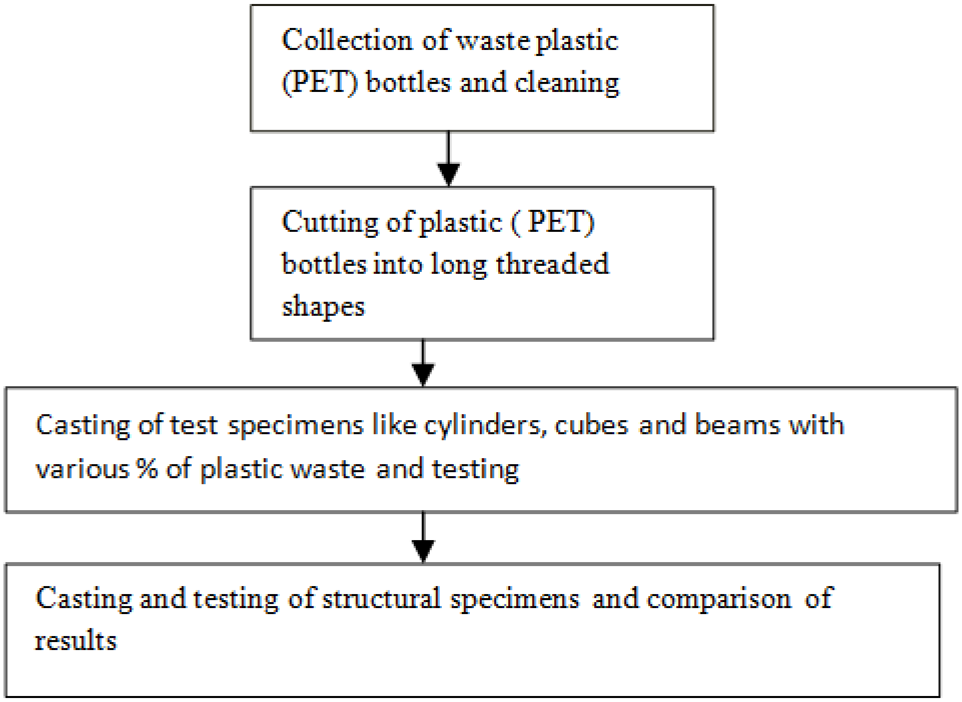

Materials

1. Ordinary Portland Cement of 53 Grade.
2. Coarse Aggregates: Natural crushed stone of size 10mm.
3. Coarse Aggregates: Natural crushed stone of size 20mm.
4. Fly Ash.
5. Threaded Plastic bottles
6. Water: normal tap water

Fig (c): Ordinary Portland Cement 53 Grade and Threaded Plastics Bottles

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Fig (d) Crushed stone aggregates of size 10mm and 20mm

Equipment

The equipment and setups we will use are listed as under

1. Compression testing machine.
2. Split Tensile Strength Testing Machine.
3. Flexural Strength Testing Machine.
4. Moulds for cubes, cylinders and beams.

- ✓ Test on cube shape mould-compressive strength.
- ✓ Test on cylinder shape mould-split tensile strength.
- ✓ Test on beam shape mould-flexural strength.

Prepareation ofmix design–m25 concrete:

The mix design for M25 grade concrete is calculated using IS 456:2000, IS 10262:2009. The value of fine and coarse aggregates is evaluated below steps. The materials required as per design are given in Table 1.

Table I Materials Required As Per Is Method of Design

W/C Ratio	Quantity of Materials (Kg/m3)		
	Cement	Fine aggregate	coarse aggregate
0.4	465	778.15	1461.51

Target Strength for mix Design:

$\mathbf{F_{ck}} = \boldsymbol{fck} + \boldsymbol{t} \times \boldsymbol{s}$ Where *Fck* = target mean compressivestrength at 28 days,***fck***=characteristic compressive strength at 28 days,
s = standard deviation i.e. 6.3, and t = a statistic, depending upon the accepted proportion of low results and the number of tests.
$F_{ck} = 25 + 1.65 \times 63 = 35.395$ N/mm^2

a) **Water-Cement Ratio:**
   w/c ratio for corresponding f_{ck} value = 0.4
   taking minimum value = 0.4
b) **Air content**: For nominal maximum size of 20 mm aggregates air entrapped is 2% ofvolume of concrete.

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c) **Water content and fine to total aggregates ratio:** For nominal maximum size of 20 mm aggregates concrete grade below M35 the water and sand content obtained are 186 kg/m^3 and 35%(of total aggregates volume) respectively.

d) **Determining cement content** :
w/c ratio= 0.4, water content =186 kg/m^3
cement content= 186/0.4 = 465 + 10 % = 511.5 kg/m

e) **Determination of coarse and fine aggregate content:**

- Fine aggregates**:** The value of fine aggregates is solved by volumetric formula-

Total volume in m^3 = [weight of water/ specific gravity of water + weight of cement/specific gravity of cement + F_a / (% of fine aggregates×3.52)] ×1/1000

Fa= 0.98 [186 + 511.5/3.15 + F_a /(0.35×3.52)] ×1/1000
Fa= 778.15kg

- Coarse aggregates : The value of coarse aggregates –

Ca= 0.98 [186 + 511.5/3.15 + F_a /(0.65×3.56)] ×1/1000
Ca= 1461.56kg

a) **Total quantities of ingredients and mix proportions:**

Water	Cement	Sand	C.A
186kg:	520kg	750kg	1450kg
0.36:	1	1.44	2.78
0.4:	1	1	2

b) **Check for minimum and maximum cement content:**
The calculated cement content of 511.5 kg/m^3 is greater than the minimum cement content of 300 kg/m^3 and less than the maximum cement of 520 kg/m^3

Experimental procedure:

1) **Mixing, Casting & Curing:** The Plastic bottles waste concrete is manufactured by as similar to the classical concrete. Initially the dry materials Cement, Aggregates i.e. 20mm and 10mm coarse aggregates & sand are mixed. Plastics bottles were cut into long threaded form as shown in figure below.

Fig(e): Threaded plastic bottles

- **Casting of cubes, cylinder & beams moulds:** A cube of size 150mm x 150mm x 150mm , a beams of size 150mm x 150mm x 700mm and a cylinder of size 150mm diameter and 300mm height was used in this expirement. Cement of 7 kg was used for 5 numbers of beams Cement of 7 kg was used for 6 number of cubes casting with 3kg fly ash and 4kg water and 16.7 kg coarse aggregates of size 20mm, 11.1kg coarse

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aggregate of size 10mm were used with 14.4 kg sand i.e. fine aggregates. Ordinary Portland Cement 53 grade was used in this experiment. 1 bag cement(50kg), 2 bag sand, 2 bag coarse aggregates 10mm, 3 bag coarse aggregates 20mm and 1 bag fly ash. Concrete was prepared by mixing ingredients. The liquid component of the mixture was then added to the dry materials and the mixing continued for further about 4 minutes to manufacture the fresh concrete. The fresh concrete was cast into the moulds immediately after mixing, in three layers for cube specimens by 5cm layers, and then placed threaded plastic bottles in horizontal form. Before the fresh concrete was cast into the moulds, the slump value of the fresh concrete was measured. Plastic bottles were placed in horizontal with 5 or 6 numbers on concrete and compacted each layers after placing plastics on concrete. Threaded plastic bottles were used as micro level reinforcement in concrete. Curing of cube moulds was done for 7, 14 and 28 days. Figures show mixing, casting, and curing given below:

Fig (f): Mixing

Fig (g): Casting

Fig (h): Curing

Fig (i): Casting of cylinder moulds

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Fig (j): Casting and Curing of Beam moulds

- Procedure for compression test:

Casting:

1. Oil is applied to the interior surface of the moulds .
2. Concrete is filled in the mould in three layers of 5cm and threaded plastic bottles placed in horizontal form as micro level reinforcement.
3. Each layer is tamped with tamping rod 25-35 times to achieve good compaction.
4. The test specimens are kept at room temperature for 24 hrs and moulds are opened carefully after 24 hrs from the casting.
5. The specimens are kept in water for curing.

Fig (n): Casting of cube moulds with thread shaped plastic bottles

At the time of testing, each specimen must keep in compressive testing machine. The maximum load at the breakage of concrete block will be noted. From the noted values, the compressive strength may calculated by using below formula:

Compressive Strength = Load / Area
Size of the test specimen = 150mm x 150mm x 150mm

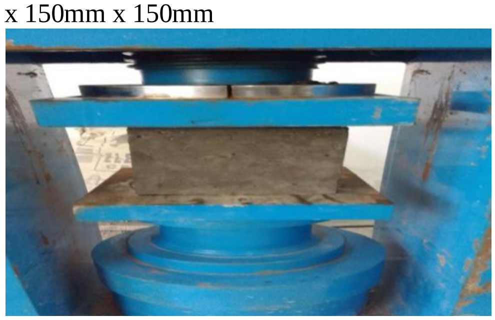

Fig (o): Compression test of cube moulds

Check value of individual cubes in compression testing machine to compressive strength.

Split tensile test: Split tensile test is used to determine the tensile strength of the concrete.

Test procedure:The following test procedure is followed:

- Dimensions of specimen were recorded.

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- The test specimen is placed between the plates of testing machine such that it is exactly at center of circular platen.
- Small initial force is applied to touch the upper plate with the surface of specimen.
- Gradual load is applied on the specimen until failure of specimen occurs and max value of force is recorded.
- Note the values on which load occur.

Tensile strength:T = 2P/Π DL

Where, P = maximum load in Newton applied to the specimen
D = diameter of specimen in mm i.e. 150mm

L = length of the specimen in mm i.e 300mm

Fig(p):Testing of cylinder moulds

Flexural strength test: During the testing, the beam specimens of size 150mm x150mm x700mm were used. Specimens were dried in open air after 7, 14, 28 days of curing and subjected to flexural strength test under flexural testing machine.

Flexural strength is determined by given equation:
Modulus of rupture = PL / Bd^2

Where P= maximum load at which specimen fails.
l= length of specimen.
B=width of specimen.
d= depth of specimen.

Fig (q): Flexure strength testing of beam moulds

VI. RESULTS

- **Tests on specimens**: All the cast specimens were de-moulded after 24 hours and were placed in curing tank for a period of 7 to 28 days. The specimens were taken for testing such as compression test, split tensile strength test and flexure test. Three numbers of specimens in each were tested and the average value is calculated.

Test Resultof cubes:

a) Compressive strength test

Table : Result of Compressive strength of concrete(cubes)

S.NO.	Grade of concrete	Percentage of threaded plastic bottles fibers	Avg. compressive strength of cubes after 7 days(N/mm^2)	Avg. compressive strength of cubes after 14 days(N/mm^2)	Avg. compressive strength of cubes after 28 days(N/mm^2)
1	M25	0	26.67	27.56	30.89
2	M25	5%	27.56	28.88	29.78
3	M25	10%	30.67	29.56	32.01
4	M25	15%	32.01	30.66	26.66

The graph shown illustrates the variation of the compressive strength of specimens with different percentage of threaded plastic PET fibers.

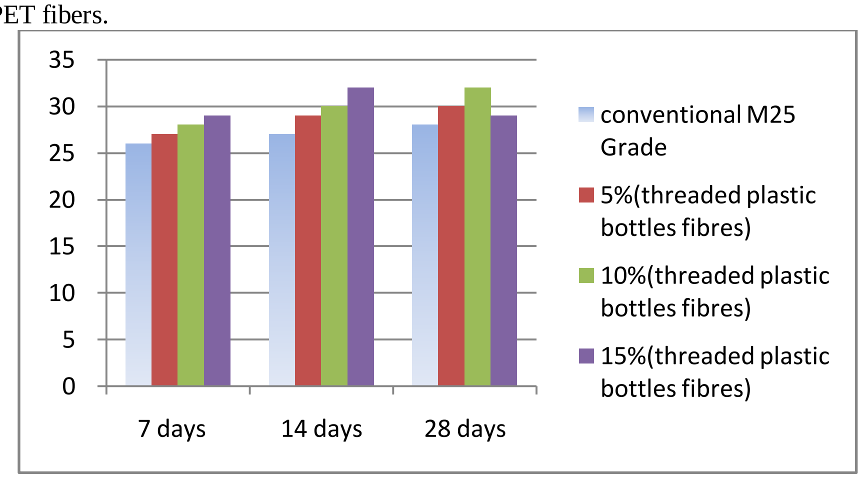

Fig (u): Compression test of concrete cubes

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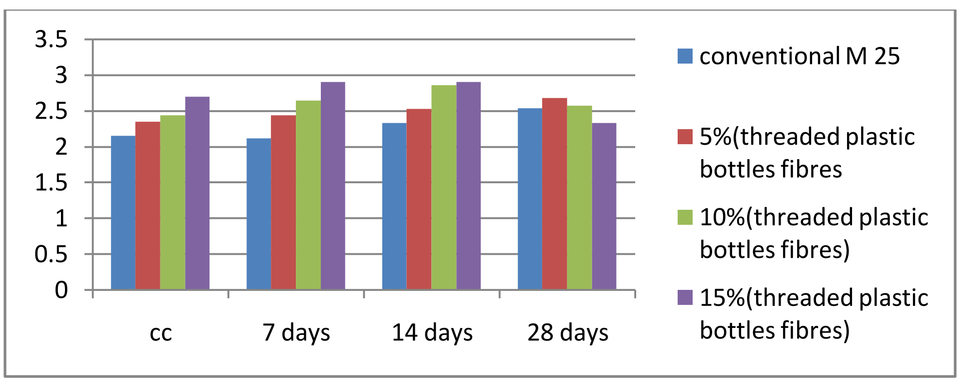
b) Split tensile strength

Table: Result of split tensile strength of cylinder moulds

S.NO.	Grade of concrete	Percentage of threaded plastic bottles	Avg. tensile strength of cylinder after 7 days(N/mm^2)	Avg. tensile strength of cylinder after 14 days(N/mm^2)	Avg. tensile strength of cylinder after 28 days (N/mm^2)
1	M25	0	2.15	2.35	2.44
2	M25	5%	2.12	2.44	2.64
3	M25	10%	2.33	2.53	2.86
4	M25	15%	2.54	2.68	2.77



The graph shown above illustrates the variation of the split tensile strength of specimens with different percentage of threaded plastic PET fibres.

Fig (v): Split tensile strength of cylinder mould

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c) Flexure strength test

Ability of the concrete to resist its bending is determined by its flexural strength. It is also an indirect method to determine tensile strength of concrete. Specimen of size $100\times100\times700mm^3$ is used in this test.

Flexural strength is determined by given equation:

$$\text{Modulus of rupture} = Pl/\ Bd^2$$

Table 9: Flexural strength test

S.NO.	Grade of concrete	Percentage of threaded plastic bottles	Avg. flexure strength of beams after 7 days(N/mm^2)	Avg. flexure strength of beams after 14days(N/mm^2)	Avg. flexure strength of beams after 28days(N/mm^2)
1	M25	0	4.3	4.7	4.9
2	M25	5%	4.21	4.5	4.3
3	M25	10%	4.65	4.77	5.3
4	M25	15%	4.3	4.44	4.68

The graph shown above illustrates the variation of the flexure strength of specimens with different percentage of threaded plastic PET fibres.

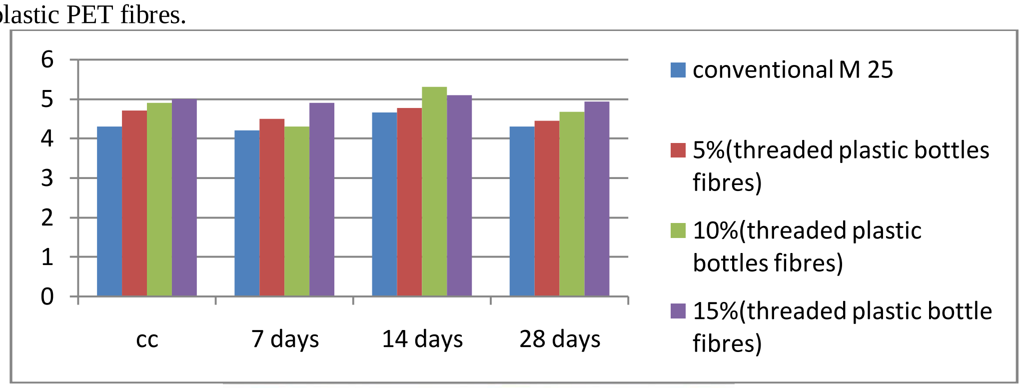

Fig (w): Flexure strength test of beam moulds

VII. CONCLUSION

1. The concrete with PET fibers reduced the weight of concrete and thus if mortar with plastic fibres can be made into light weight concrete based on unit weight.
2. It was observed that the compressive strength increased with threaded plastic PET bottle fibres . Hence threaded plastic bottles are very useful as a micro level reinforcement.
3. It was observed that the split tensile strength increased also increased with PET bottle fibres . Hence, more threaded like plastic fibres used will be reasonable with high split tensile strength compared to the other specimens casted and tested.

4. It was observed that the flexural strength increased while plastic fibers used as a micro level reinforcement to gain strength in the concrete moulds.
5. Hence, the plastic bottles in the form of threaded structure will be very useful and also reduced the cost because plastic bottles are locally available i.e. in the garbage , scrap site, dumpster diving site, in the factory also etc.

VIII. FUTURE SCOPE

Further study should be conducted to support the values determined as the compressive strength of these concrete masonry units. In addition, expanding the variety of bottle types used in the masonry units is suggested. Mixing the various types of plastic bottles in the same masonry unit is also suggested to determine if affects compressive strength. Other variables to study further include, but are not limited to, the number of plastic bottles per masonry unit, the height of the plastic bottles, whether the bottles have lids, and the orientation of the bottle (lid side up or down). Further study should also include testing different categories of the masonry unit besides compressive strength. Testing should include thermal conductivity of the masonry unit. Does the addition of plastic bags inside the plastic bottle increase resistance to heat change? Further analysis of shear loading and cyclic loading on the masonry units is suggested to analyse the masonry unit for seismic loading.

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