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Experiment on Concrete by Adding Steel Fibers and Plastic Waste to Reduce Environmental Issues and Adding Strength to Concrete

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Abstract: Concrete is the most commonly used material for construction in civil engineering. The project involves the proposed concrete which is made up of adding plastic in concrete may help to reuse the plastic as one of the constituent material of concrete.
Due to rapid industrialization the amount of use and decomposition of plastic has increased. If we are able to utilize this waste under proper conditions as addition to concrete it will reduce the plastic waste up to some extent. By adding the steel fibers to the above mix it will increase the compressive strength of the concrete. M40 grade concrete is used in the whole procedure. Here, we used 4 different percentages of plastic waste (i.e., 0.6%, 1.2%, 1.8%, and 2.4%) of weight of cement and by taking quantity of steel fiber as constant (i.e., 2%) of weight of cement, and the aspect ratio of steel fibers is 60. The concrete cube of size 150mm×150mm ×150mm are prepared and tested at 3days, 7days, 14days and 28 days. The resulting data has been analyzed and compared with controlled specimens.

I. INTRODUCTION

The importance of concrete in modern society cannot be underestimated. Look around you and you will find concrete structures every where such as buildings, roads, bridges and dams. There is no escaping the impact concrete mix on your everyday life. It is attractive in many applications because it offers considerable strength at a relatively low cost. Concrete can generally be produced of locally available constituents, can be cast into a wide variety of structural configurations, and requires minimal maintenance during surveys. Workability, strength and durability are the basics of concrete. Amount of useful internal work necessary to overcome internal friction to produce full compaction is called as workability. Size, shape, surface texture and grading of aggregates, water cement ratio, use of admixtures and mix proportions are important factors affecting workability.

Strength is to bear the desired stresses to bear within the permissible factor of safety in expected exposure conditions. The factors influencing strength are: Quality of cement, water cement ratio, grading of aggregates, degree of compaction, efficiency of curing, curing temperature, age at the time of testing, impact and fatigue. In the most of the structures, compressive strength is basically used to resist the compressive strength. Compressive strength is also used as qualitative measure for other properties of hardened concrete. Steel fibers can be defined as discrete, short length of steel having ratio of its aspect ratio in the range of 20 to 100. The steel fibers acts as crack arrestor and it will increase the tensile strength and toughness in concrete. It also reduces the maintenance cost and provides tough and durable surfaces.

Plastic is a synthetic material made from wide range of organic polymers such as polyethylene, PVC, nylon, etc... The plastic waste which we are using is of high density polyethylene. The density of polyethylene is ranges from 930 to 970 kg/m3. Generally, plastic takes more than 450 years to decompose. By the use of plastic waste in construction we can protect the environment and can also reduce the amount of disposal.

This study attempts to give a contribution to the effective use of domestic waste (plastic) in concrete as granules in order to prevent the environmental strains caused by them, also to limit the consumption of natural resources.

II. EXPERIMENTAL INVESTIGATION

In the present experimental investigation plastic waste and steel fibers has been used as addition of cement as an additional ingredients in concrete mixes. The effect of adding different percentiles of plastic waste and constant amount of steel fibers to concrete mixture and their compressive strength were studied. The details of project are as follows:

A. Materials

- Cement
- Fine aggregate (sand)
- Coarse aggregate (gravel)
- Plastic waste (microns)
- Steel Fibers (aspect ratio: 60)
- Water

1) Cement

Ordinary Portland cement available in local market of standard brand was used in the investigation .care has been taken to see that the procurement made from a single batch is stored in airtight containers to prevent it from being affected by the atmospheric and monsoon moisture and humidity. The cement procured was tested for physical requirements in accordance with IS : 81121989.The cement conforms to 43 grade.

Fig 1: Cement

a) Properties of Various Materials used Cement

Portland cements are commonly characterized by their physical properties for quality control purposes. Their physical properties can be used to classify and compare portland cements. The challenge in physical property characterization is to develop physical tests that can satisfactorily characterize key parameters.

b) Physical Properties

- Setting time
- Soundness
- Fineness
- Strength
- Specific gravity

2) Fine Aggregate

The locally available sand is used as fine aggregate in the present investigation .the sand is free from clay, silt and organic impurities. The sand is tested for various properties like specific gravity, bulk density etc., and in accordance with IS 2386-1963. These test results are tabulated in table 3.5 .sieve analysis is carried out and the results and the results are shown in table 3.3 . The fine aggregate conforms to standard specifications . Zone II sand is taken in this experiment. For laboratory conditions sand which is passing through 600micron sieve is taken.

Fig 2: Fine Aggregates

3) Coarse Aggregate

Machine crushed angular granite metal of 20mm nominal size from the local source is used as coarse aggregate .It is free from impurities such as dust, clay particles and organic matter etc. The coarse aggregate is also tested for its various properties. The specific gravity, bulk density and fineness modulus of coarse aggregate were found to be 2.74, 1580kg/m3 and 7.17 respectively .coarse aggregate of size(20mm to 10mm) of angular shape is considered.

Fig 3: Crushed Coarse Aggregates

4) Plastic Waste

High density polyethylene (HDPE) is defined by a density of greater or equal to 0.941 g/cm3.

HDPE has a low degree of branching and thus stronger intermolecular forces and tensile strength. HDPE is a very common plastic. It is used in a variety of applications and thousands of consumer goods are made out of HDPE.

Fig 4: Plastic Waste

5) Steel Fibers

Steel fiber concrete is one of the special concrete that normal concrete mix with discontinuous discrete steel fiber. There are abundant of small- scale fibers are distributed randomly during the concrete mix. The evolution of using steel fibers in the field is to replace and reduce the traditional reinforcement bar in the concrete members. Thus steel fiber tend to increase the tensile strength of the concrete by deflecting micro cracks which develop in the concrete under exterior force and load effects. The lengths of the steel fibers are usually small and short, this is because it wants to avoid inadequate workability of the concrete mixture.

The objective carry this research is to identify the steel fiber that affects the performance of steel fiber concrete which compare with the normal straight steel fibers. The challenge of using the straight steel fiber is the fiber may assemble at one location where they cannot function property which is used as load transfer. Since steel fiber consists of weight, during the mix the fibers will tend to stick to the sides in the rotary mixer, as the final aggregate in the mix. The addition of steel fiber to the concrete is normally can increase the compressive strength and tensile strength into 8% to15%. In additional steel for structural purpose steel fibers should be add as supplements to the reinforcement bars. This is because fibers able to limit the percentage of cracking that due to load. Thus it also can improve the resistance to material deterioration due to fatigue, shrinkage and thermal stresses.

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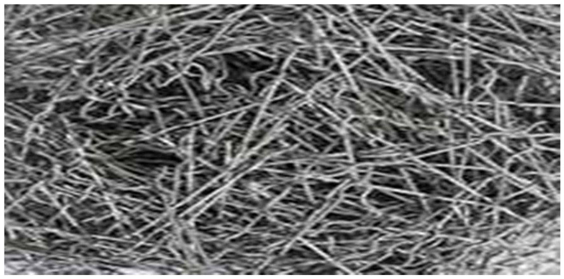

Fig 5: Steel Fibers

6) Water

The locally available portable water accepted for local construction is used in the experimental investigation after testing. The PH value should not be less than 6 .the results and the permissible limits for solids are indicated

Fig 6: Water

III. LITERATURE REVIEWS

1) Use of Recycled Plastic bag waste in the concrete

Youcef Ghernouti, Bahia Rabehi, Brahim Safi and Rabah Chaid

Journal of international scientific publications: Materials, Methods & Technologies ISSN(online): 13147269|Volume-8|2007

The possibility of re-cycling a plastic bag waste material (BBW) that is now produced in large quantities in the formulation of concrete as fine aggregate by substitution of a variable percentage of sand (10, 20, 30 and 40 %). The influence of the PBW on the fresh and hardened states properties of the concrete: workability, bulk density, ultrasonic pulse velocity testing, compressive and flexural strength of the different concretes, has been investigated and analyzed in comparison to the control concrete. The results showed that the use of PBW improves the workability and the density, reduces the compressive strength of concrete containing 10 and 20 % of waste by 10 to 24 % respectively, which have a mechanical strength acceptable for lightweight materials, remains always close to reference concrete (made without PBW). The results of this investigation consolidate the idea of the use of PBW in the field of construction, especially in the formulation of concrete.

2) Use of plastic in concrete to improve its properties

Raghatate Atul M

International Journal of Advanced Engineering Research and Studies (IJAERS) ISSN (online): 2249-8974| Volume-1|Issue-3| June 2012

Plastic bags which are commonly used for packing, carrying vegetables, meat etc creates a serious environmental problem. Plastic bag last in environment up to 1000 years because of plastic bag last so long the number of plastic bag accumulated increases each year. Disposal of large quantity of plastic bag may cause pollution of land, water bodies and air. The proposed concrete which is made up by adding plastic in concrete may help to reuse the plastic bag as one of the constituent's material of concrete, to improve the certain properties of concrete. The properties of concrete containing varying percentages of plastic are 0%, 0.2%, 0.4%, 0.6%, 0.8%, 1% were added and tested for compressive strength and Split tensile strength. For this,Compressive strength of concrete is affected by addition of plastic pieces and it goes on decreasing as the percentage of plastic increases addition of 1 % of plastic in concrete causes about 20% reduction in strength after 28 days curing.

The splitting tensile strength obserarvation shows the improvement of tensile strength of concrete. Up to 0.8 % of plastic improvement of strength recorded after that addition of strength of concrete decreases with addition of plastic. Thus it is conclude that the use plastic can be possible to increase the tensile strength of concrete.

3) An Experimental Study on Strength Behaviour of Cement Concrete with the Use of Plastic Fibre
Raju, Rajiv Chauhan
International Journal of Engineering Research and applications (IJERA) ISSN (online): 2248-9622|March -2014
Concrete is a basic material for all civil works which is made from cement sand and stones. Now a day's collecting sand from natural beds of rivers and aggregates is becoming difficult due to environmental clearances. Replacement of fine aggregate or coarse aggregates in cement concrete with some industrial by-product is highly desirable. Due to its lower cost, it makes an attractive alternative if adequate performance can be obtained. They used polyethylene in fiber form with size 120 mm length and 4 mm width have been replaced by fine aggregate. The fine aggregate was replaced by plastic fiber with 1% by weight. It was observed the compressive strength of cement concrete decreased after the inclusion of plastic fiber. The inclusions of plastic fiber have no significant effect on tensile strength. It has been seen that there is a zilch chemical reaction of plastic fiber with the matrix during the hydration process. This was due to the density difference in fine aggregate and polyethylene. The compressive strength significantly decreased by 50.42% at 28 days. The tensile strength decreased by 8.52% which is nominal as compare to the compressive strength decrement rate.

4) Properties of Concrete by the Addition of Plastic Solid Waste
M. Muzafar Ahmed, Dr. S. Siddiraju
International journal of science and research (ISJR) ISSN (online): 2319-7064 volume-4|Issue-5|may2015
Concrete is a material which widely used in construction industry. The production of solid wastages is increasing day to day causing serious concerns to the environment. In this study, the recycled plastics are used in the concrete by partial replacement of coarse aggregate in concrete. The main purpose of this study is to investigate the properties of concrete such as workability, compressive as well as tensile strengths in the partial replacement of aggregate. And also thermal characteristics of the concrete are also studied. The results indicate that the use of plastic solid waste in the concrete results the formations of light weight concrete. The properties such as compressive as well as tensile strength are reduced with the addition of varying percentages of plastic waste of 0%, 10%, 20% in concrete. Further the thermal conductivity of concrete is also reduced, when it is mix with concrete. When this plastic used in concrete pavements it can be withstand at high temperature and also reduction in thickness achieved. The effect of water cement ratio on strength development is not predominant in case of plastic concrete.

5) Re-Use of Polyethylene plastic waste in concrete
M. Mahesh, B. Venkat Narsimha Rao, CH. Satya sri
International Journal of Engineering Development and Research (IJEDR) ISSN(online): 2321-9939|Volume-4|Issue-4|2016
The increase in population and the changed lifestyle has resulted in a significant rise in the quantity of plastic waste. This project in particular deals with the possibility of using the waste polyethylene as partial replacement of fine or coarse aggregate in concrete. Concrete with 2%, 4%, 6% pulverized/non pulverized polyethylene material is prepared after doing the mix design. The standard mechanical properties of concrete like compressive strength, split tensile strength are conducted. It is observed that for more percentage addition of plastics i.e 6% in the present case, the 7 day strength has been decreased when compared with conventional concrete. Specific gravity of waste plastic is less than that of fine aggregate, thus self weight of concrete reduces, thus it reduces the weight of the structure/structural component as a whole. Concrete with plastic waste can be used for less important works where concrete is not going to bear more loads.

6) Experimental Investigation on Partial Replacement Of waste plastic in concrete
Arivalagan. S
International Journal of Engineering Sciences & Research Technology (IJESRT) ISSN (online): 2277-9655|November 2016
The use of plastic is increasing day by day, although steps were taken to reduce its consumption. This create substantial garbage every day which is much unhealthy. A healthy and sustainable reuse of plastics offers a host of advantages. The initial questions arising of the bond strength and the heat of hydration regarding plastic aggregate were solved.

As 100% replacement of natural fine aggregate with plastic fine aggregate is not feasible, partial replacement at various percentage are of 5%, 10%, 15%, 20% were examined. The percentage substitution that gave higher compressive strength was used for determining the other properties such as modulus of elasticity, split tensile strength and flexural strength. Higher compressive strength was found with 10% natural fine aggregate replaced concrete. The density of concrete decreased when plastic content increased. Because plastic has more water tightness capacity when compared to natural aggregate this can help in arresting micro cracks. By using recycled waste plastic in concrete can reduce the land fill and environmental issues. This type of aggregate replacement is useful where aggregates are in crisis.

7) Utilization of Waste Plastic in Concrete towards Sustainable Development

Rajat Saxena, Abhishek Jain and Yash Agrawal

International Journal of Engineering Research and Application (IJERA) ISSN (online): 2248-9622|Volume-6|Issue12|December-2016

In the present decade, one of the environmental issues in most regions of world is the existence of large number of bottles made from poly-ethylene terephthalate (PET) and huge quantities of plastic wastes deposited in domestic wastes and landfills. These plastic wastes are adversely effecting the environment and is a topic of serious concern for various concerned authorities. In spite of all efforts made to limit the use of plastic based products, their utility is increasing day by day and thus the amount of plastic waste generated is also increasing day by day. Various attempts were made through experimentation to check the feasibility of plastic waste to be use partially in concrete with respect to various properties of strength, workability, durability and ductility of concrete. Plastic waste has control on the workability property of concrete. Slump value and the compaction factor decreased with the increase in amount of plastic waste in concrete. Concrete produced by using plastic waste has durability properties comparable to that of reference concrete up to certain limits. Use of plastic waste in concrete mix proved exceptionally helpful to produce green sustainable concrete.

8) Use of Plastic Waste in Concrete mix

Mahaveer prasad, Devesh jaswal

International Research Journal of Engineering and Technology (IRJET) ISSN (online): 2395-0056| Volume-4|Issue-2|November 2017

Dumping of plastic waste in environment is considered to be a giant issue due to its very low biodegradability and existence in huge quantities. Present time use of such, industrial and urban wastes from polypropylene (PP) and polyethylene terepthalate (PET) were considered as substitute replacements of part of the conventional aggregates of concrete.

As a result, finding substitute methods of disposing waste by using affable methods are becoming a main research problem. In this research, high density polyethylene waste is added with varying percentages of 0%, 5%, 10% & 13% and mixed with Portland cement to examine the option to make plastic cement, and learn the outcome of replacing sand by fine polyethylene waste with different quantities and percentage on the properties of product. The research was done by using the waste of polyethylene parcels including bottle and food crates and other wastes. As much as 60% of both industrial and urban plastic waste is recycled which carried from various sources. The best compressive strength for product was found in the mixture has 5%, 10% and 13% polyethylene.

9) Utilization of waste plastics as fiber in concrete

A. Ananthi, A. Jay Tamil Eniyan, S. Venkatesh

International Journal of Concrete Technology (IJCT) Volume-3| Issue-1| 2017

The rapid urbanization and industrialization all over the world has resulted in large deposition of plastic waste. Disposal of plastic waste in an environment is considered to being hazard due to its very low biodegradability and presence in large quantities. In order to minimize the problem, the proposed concrete which is made by adding plastics in concrete may help to reuse the plastics and to study the properties of concrete with plastics.

In this project, they used plastic cups as a fiber with mean aspect ratio 158.75 and 26.49. The result proved that the addition of concrete increases the compressive strength and split strength. The compressive strength and split tensile strength increases to maximum when 0.9% of plastic fibers are added to conventional concrete.

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10) Crushed Plastic waste in concrete

Dhaarani D, Shanmuganathan N, Gokila M, Akalya A, Abirami D, Dhilshath Begam J

International Research Journal of Engineering and Technology (IRJET) ISSN (online): 2395-0056|Volume-5|Issue-3|March-2018

Concrete is the most widely used construction material in the world, as well as the largest user of natural resources. Basically it consists of aggregates which are bonded together by cement and water. The major part of concrete besides the cement is the aggregate. Aggregate include sand and crushed stone.

Use of these conventional materials in concrete is likely to reduce the resources unless there is a suitable substitute. Plastic waste materials are often used as a partial replacement of coarse aggregate reducing the cost of construction and help to overcome the deficiencies associated with the use of crushed stones. Also, these materials are identified very harmful to the environment if it is disposal to the land and water.

Hence in this project they aimed to study the effectiveness of Plastics as substitute for coarse aggregate. Aggregate properties viz., specific gravity, water absorption were conducted to ascertain the properties of concrete specimens and has been casted and tested for concrete mix with various percentage of replacement (10%, 20% & 30%) and its viability for replacement were discussed. The compressive strength of Waste Plastic concrete with 10% replacement is 48.84 N/mm^2; it is almost Equal strength of normal concrete 53.14 N/mm^2 on 28th day. The compressive strength of Waste Plastic concrete with 20% replacement, it gives acceptable strength of 45.32 N/mm^2.In the flexural strength test conducted on Waste Plastic concrete, it shows a decrease in strength when compared to the strength of normal concrete.

11) Experimental Study on Steel Fiber Reinforced Concrete for M40 Grade

A. M. Shende, A. M. Pande, M. Gulfam Pathan

International Refereed Journal of Engineering and Science (IRJES) ISSN 2319-183X, (Print) 2319-1821|Volume-1|Issue-1|September2012

Critical investigation for M40 grade of concrete having mix proportion 1: 1.43: 3.04 with water cement ratio 0.35 to study the compressive strength, flexural strength, split tensile strength of steel fiber reinforced concrete containing fibers of 0%, 1%, 2% and 3% volume fraction of hook stain fibers of 50, 60, 67 aspect ratio were used. A result data obtained has been analyzed and compared with a control specimen.

A relationship between aspect ratio Vs compressive strength, aspect ratio Vs flexural strength, aspect ratio Vs split tensile strength represented graphically result data clearly shows percentage increase in 28 days compressive strength, flexural strength and split tensile strength for M40 grade of Concrete. Fibers are generally used as resistance of cracking and strengthening of concrete. Even at 1% of steel fiber content flexural strength of 6.46 N/mm^2 was observed against flexural strength 5.36N/mm^2 at 0% hence increase of 1.1% flexural strength was obtained.

12) Performance of Steel Fiber Reinforced Concrete.

Milind V. Mohod.

International Journal of Engineering and Science (IJES) ISSN (Online): 2278-4721|Volume-1|Issue-12|December 2012.

Cement concrete is the most extensively used construction material in the world. Ordinary Cement possesses a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks leading to brittle failure of concrete. It is now established that one of the important properties of steel fiber reinforced concrete is superior resistance to cracking and crack propagation.

In this paper effect of fibers on the strength of concrete for M30 grade have been studied by varying the percentage of fibers in concrete fiber content were varied by 0.25%, 0.50%, 0.75%, 1%, 1.5%, 2% by volume of cement cubes of size 150X150X150mm to check compressive strength.

All specimens were cured for the period of 3, 7, 28 days before crushing. The results of fiber reinforced concrete for 3 days, 7days, 28days curing with varied percentage of fiber were studied and it has been found that there is significant strength improvement in steel fiber reinforced concrete. The optimum fiber content while studying the compressive strength of cube is found to be 1% and 0.75% for flexural strength of beam. Also it has been observed that with the increase in fiber content up to the optimum value increases the strength of concrete. The slump cone test results revealed that workability gets reduces with the increase in fiber content.

13) Studies On Steel Fiber Reinforced Concrete.

Vasudev R, Dr. B. G. Vishnuram.

International Journal of Scientific and Engineering Research (IJSER) ISSN (Online):2229-5518|Volume-4|Issue-5|May-2013.

Concrete is one of the most versatile building materials concrete is strong under compressive but weak under tension. As such a form of reinforcement is needed.

The most common type of concrete reinforcement is by steel bars the advantage in using concrete include high compressive strength, good fire resistance, high water resistance, low maintenance and long service life. Reinforcement bars, grids, fibers both organic and inorganic as well as composites have been incorporated to strengthen the concrete in tension. Steel fiber reinforced concrete comprises cement, aggregates and steel fibers.

Properties of SFRC in both freshly mixed and hardened state including durability are a consequence of its composite nature. Fibers are usually used in concrete to control cracking due to both plastic shrinkage and drying shrinkage they also reduced permeability of concrete and thus reduce bleeding of water. Steel fibers have a relatively high strength and modulus of elasticity. They are protected from corrosion by the alkaline environment of cementations matrix and their bond to the matrix can be enhanced by mechanical anchorage or surface roughness. The split tensile strength was increased by 20 - 22% of concrete samples with 0.5% fiber content in M20 and M30 grade mixes. From the investigation it was clear that 0.5% fiber content has a pronounced effect on the properties of concrete.

14) Experimental Work on Steel Fiber Reinforced Concrete.

Abdul Ghaffar, Amit S. Charhan, Dr. R. S. Tatwawadi.

International Journal of Engineering Trends and Technology (IJETT) ISSN: 2231 -5381|Volume-9|Issue-15|March-2014.

The objective of the study was to determine and compare the differences in properties of concrete containing without fibers and concrete with fibers. The investigation was carried out using several tests, compressive test and flexural test. Hooked steel fibers were tested to determine the enhancement of mechanical properties of concrete, the workability of concrete significantly reduced as the fiber dosage rate increases.

The maximum percentage increase in compressive strength, flexural strength achieved are 6.15, 7.94 respectively at 30%, 40%, of fiber volume fractions. Durability of concrete is found to increase with inclusion of fibers at higher fiber content the width of crack is found to be less in SFRC than that in plain cement concrete. Critical investigation for M40 grade of concrete having mix proportion 1: 1.43: 3.04 with water cement ratio 0.35 to study the compressive strength, flexural strength, split tensile strength of steel fiber reinforced concrete containing fibers of 0%, 1%, 2%, and 3% volume fraction of hook taint steel fibers of 50, 60 aspect ratio were used. Steel fibers have a relatively high strength and modulus of elasticity. Experimental investigations and analysis of results were conducted to study the compressive and tensile behavior of composite concrete with varying percentage of such fibers added to it. The concrete mix adopted M40 with varying percentages of fibers ranging from 0%, 0.25%, 0.5%, 0.75%, 1%.The results of compressive strength of cubes increases compared to plain concrete.

15) Study of Fiber Reinforced Concrete.

Dr. A. Z. Chitade, Sandeep R. Gaikwad

IOSR Journal of Engineering (IOSRJEN) ISSN (Online): 2250-3021|Volume-25|Issue-1|2015.

In recent years an emerging technology termed Fiber reinforced concrete has become popular in the construction industry. Concrete is a common building material, generally weak in tension, often ridden with cracks due to plastic and drying shrinkage. The introduction of short discrete fibers in to the concrete can be used to counteract and prevent the propagation of cracks. Furthermore incorporation of fibers in concrete results in reduction in the shrinkage and creep deformation of concrete. Application of fiber reinforced concrete is continuously growing in various application fields. FRC is widely used in structures; Due to the property that fiber enhances toughness of concrete. FRC is used on large scale for structural purpose. The fiber is described by a convenient parameter called aspect ratio. A constant fiber volume fraction of 2% was used throughout this investigation. The water cement ratios were varied from 0.30 to 0.65. They have proposed an equation to quantify the effect of fiber on compressive strength of concrete in terms of fiber reinforcing parameter. In their model the compressive strength ranging from 30 to 50 Mpa with fiber volume fraction of 0%, 0.5%, 0.75% and 1% and aspect ratio of 55 and 82 were used. It is observed that the flexural strength increases with increase in the fiber content up to 2%. The maximum increase in this strength i.e. 23.34 at 2.0% fiber content over that of normal content.

16) Experimental Work on Steel Fiber Reinforced Concrete
Avinash joshi, Pradeep reddy, Punith kumar and Pramod hatker
International Journal of Scientific and Engineering Research (IJSER) ISSN (Online): 2229-5518|Volume-7|Issue-10|October 2016.
The various aspects covered are the materials, mix proportioning for M20, M25, M30, M40 grades of concrete. As the concrete is weak in tension, a work has been carried out to investigate the improvement in tensile, shear, flexure and even compressive strength of concrete and also to investigate the cracking strength and reserve strength of concrete and FRC M20, M25, M30, M40 grades of concrete have been added to investigate the compressive strength, tensile strength and shear strength of concrete steel fibers acts as a bridge to retard their cracks propagation and improve several characteristics and properties of concrete fibers are known to significantly affect the workability of concrete. The aspect ratio of (50) and variable in this study were percentage of volume fraction of steel fibers compressive strength, splitting tensile strength and flexural strength of the concrete were determined for the hardened properties. The main purpose is to increase the energy absorption capacity and toughness of the material but also increase in tensile and flexural strength is often the primary objective. A marginal improvement in ultimate strength was observed. The addition of fiber enhanced the ductility significantly.

17) Experimental Studies on Fiber Reinforced Concrete (FRC).
E. Arunakanthi, J. D. Chaitanya Kumar.
International Journal of Civil Engineering and Technology (IJCIET) ISSN (Online) - 0976-6316. |Volume-7|Issue-5|september-2016.
Concrete is one of the most widely recognized development material for the most part delivered by utilizing locally accessible ingredients .The present trend in concrete technology towards increasing the strength and durability of concrete to meet the demands of the modern construction. The main aim of the study is to study the glass fiber and steel fibers in the concrete.FRC has the high tensile strength and fire resistant properties thus reducing the loss of damage during fire accidents. In the present work the strength studies are carried out to compare the glass and steel fiber concrete. The FRC is added 0.5%, 1%, 2% and 3% are added for M20 grade concrete result shows the percentage increases in compressive strength, flexural strength and split tensile strength for 28 days .Flexural behavior of high strength composite incorporating long hook end steel fibers. In this research long hooked steel fibers have been added to mix and compressive strength, flexural strength of concrete have been found out for 7, 14, 28 days. According to various research papers, it has been found that steel fibers give the maximum strength in comparison to glass and fibers. Even at 1% of steel fiber content flexural strength of 6.46 N/mm^2 was observed against flexural strength 5.36N/mm^2 at 0% hence increase of 1.1% flexural strength was obtained.

18) Use of Steel Fiber Reinforced Concrete.
Mohd. Gulfan Pathan, Ajay Swarup
International Journal of Advance Research in Science and Engineering. (IJARSE) Volume-6| Issue-1| December-2017.
Concrete is extensively used material in Construction because of good workability and ability to be moulded to any shape. The concrete shows the brittle behavior and fails to handle tensile loading hence leads to internal micro cracks which are mainly responsible for brittle failure of concrete. Typically steel fibers have equivalent diameters from 0.15mm to 2mm and lengths from 7 to 75mm.Aspect ratio generally range from 20 to 100.concrete mix of M25 grade and crimped steel fibers with aspect ratio 50 are used. The fibers volume fraction is varied from 0.5% to 4.5% at an interval of 0.5% by weight of cement. All the strengths are found to be increasing continuously with increase in fiber volume fraction. Concrete mix of M40 grade of concrete having mix proportion 1:4:3 with water cement ratio 0.35 to study the compressive strength, flexural strength, split tensile strength of steel fibers containing 0%, 1%, 2%, 3% volume fraction of hooks the result shown that steel fiber reinforced concrete increases strength, toughness, ductility and flexural strength of concrete. Concrete containing steel fiber have been shown to have substantially improved resistance to impact and greater ductility of failure in compression, flexure and torsion. It has been extensively used in various civil engineering structures.

19) Awareness of Steel Fiber Reinforced Concrete.
Pramod Kawde, Abhijit warudkhar.
International Journal of Science and Engineering (IJSE). ISSN: 277-9665|Volume-3|Issue-4|January-2017.
Despite the increased awareness of steel fiber reinforced concrete in practice and research, SFRC is yet to find common application in load bearing building structural elements.

In this paper, result are presented on shear test which have been conducted on ten 5m long by 0.3m wide by 0.7m high rectangular simply supported beams with varying transverse and steel fiber reinforcement ratios. It is well known that concrete is characterized by its high compressive strength, yet its brittle made of failure is considered as a drawback of high strength concrete. When it is subjected to impact dynamic loads. Crimped and hooked and steel fiber of length 50mm and an aspect ratio equal to 50 was added to concrete in different proportions 0%, 0.5%, 1.0%, 1.5% with water cement ratio of 0.42. Fibers are generally used as resistance of cracking and strengthening of concrete. According to various research papers, it has been found that steel fibers give the maximum strength in comparison to glass and fibers. Even at 1% of steel fiber content flexural strength of 6.46N/mm^2 was observed against flexural strength 5.36N/mm^2, Hence increase in 1.1% flexural strength was obtained. It can be concluded with addition of steel fibers are a good alternative to traditional concrete, because both its strength, and its behavior in case of fire and improved delaying the appearance and explosive concrete spalling.

20) An Experimental Study on Steel Fiber Reinforced Concrete.
Ankur Yadav, Satish Parihar
International Journal of Science Technology and Engineering (IJSTE) ISSN (Online): 2349-784X|Volume-4|Issue-11|March-2018.
This paper deals with the experiment study for M25 grade of concrete mix proportion 1: 1: 2 with water cement ratio 0.44 to study the compressive strength of steel fiber reinforced concrete containing fibers of 0%, 0.45%, 0.95%, 1.45% and 1.95% volume fraction of hook end steel fibers were used result data obtained has been studied, analyzed and compared with a control specimen (0% fiber). A relationship between compressive strength Vs days represented with the help of tables and graphs. Result data clearly shows percentage increase in compressive strength for M25 grade of concrete in 24 hours, 7, 14, 28 days with respect to the variation in % addition of steel fibers. This research is based on use of steel fiber in structural concrete to enhance the mechanical properties of concrete. The objective of the study was to determine and compare the differences in properties of concrete containing without fibers and concrete with fibers. This investigation was carried out using several tests, compressive test and flexural test. A total of 11 mixes tested to determine the enhancement of mechanical properties of concrete. The workability of concrete significantly reduced as the fiber dosage rate increases.

21) Awareness of Steel Fiber Reinforced Concrete.
Study of Strength Property of concrete Using Waste plastics and Steel fiber Khilesh sarwe
International Journal of Engineering And Science (IJES) ISSN(online):2319-1819|Volume-3|Issue-5|2014
The rapid Urbanization and Industrialization all over the world has resulted in large deposition of Plastic waste. This waste can be utilized under proper condition as content in Concrete. In this paper we study that compressive strength of concrete using waste plastics and also add steel fiber with waste plastics. M-20 grade of concrete having mix proportion 1:1.66:3.33 with water cement ratio 0 .50 to study the compressive strength of concrete using waste plastics and waste plastic + steel fiber. The plastic waste and steel fibers are added to concrete with equal percentages like 0%, 0.2%, 0.4%, 0.6%, 0.8%, 1% . Then the compressive strength of cubes is tested. By adding plastic waste more to the concrete the compressive strength is reduced.

IV. PLANNING AND COSTING

A. Planning

Planning is a fundamental and challenging activity in the management and execution of construction projects.
1) It involves the choice of technology, the definition of work tasks, the estimation of the required resources.
2) A good construction plan is the basis for developing the budget and the schedule for work. ✓ Developing the construction plan is a critical task in the management of construction.
3) It may also be necessary to make organizational decisions about the relationships between project participants and even which organizations to include in a project.
4) For example, the extent to which sub-contractors will be used on a project is often determined during construction planning.

Project scheduling and project monitoring:
a) *Strategic Planning:* It involves the high- level selection of the project objectives.
b) *Operational Planning:* It involves the detailed planning require to meet the strategic objectives.
c) *Scheduling:* Detailed operational plan on a time scale set by the strategic objectives.

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B. Costing

1) Cost estimating is an iterative process that uses a variety of estimating techniques to determine the total cost of completing a project.
2) Once you have created satisfactory estimates, you can finalize and approve the project budget.
3) Cost managers typically release budgeted amounts in stages according to the level.

C. Quality Assurance

1) Quality assurance can be defined as" part of quality.management focused on fulfilling quality requirements".
2) Quality assurance is for entire life cycle.
3) The main aim to prevent the defects and focus on the process used to make the product.
4) Everyone involved in the developing a product are responsible for the quality assurance.

Quality Control

Quality control can be defined as "part of quality management focused on fulfilling quality requirements".

a) Reduction of scrap and rework.
b) Quality caution at all levels.
c) To check the variation during manufacturing.
d) To improve the poor- quality product reaching to costumer.

D. Experiments Conducted in Quality Control lab

1) *Determination of Fineness of cement*

a) The main aim of this experiment is to determine the number of cement particles larger than 90µm.. and the apparatus used for this experiment are Weighing balance, sieve set
b) Take a sample of cement and rub the cement with the hands. The test sample should be free of lumps
c) Now take 100 g of cement (W_1).
d) Pour 100 g of cement in 90 µm sieve and close with the lid.
e) Now shake the sieve with the hands by agitating the sieve in planetary and linear movements in 15 minutes.
f) Next, weight the residue retained on the 90 µm(W_2).
g) Then calculate the percentage of weight of cement retained on sieve (Wt). ➢ Repeat the above experiment with different samples of cement.

Formula

Percentage of Fineness of cement (W_t) = $(W_1 - W_2)/W_1 \times 100$

Fig 7: Fineness of Cement using 90µmm sieve

2) *Determination of Consistency of Cement Paste*

a) The main of this experiment is to determine the quantity of water required producing a cement paste of standard consistency. The apparatus used for this experiment are Weighing balance, vicat apparatus with plunger, graduated glass, measuring jar and gauging trowel.
b) Take 300gms of cement. Sample passing through the IS 90 microns sieve and add certain quantity of water and make it a paste.
c) Keep the vicat mould over glass plate and completely fill the mould with the paste smooth of the surface to the level with the top of the mould. To expel the air if any, the mould might be shaken slightly
d) Now place the mould at vicat apparatus. Release the plunger to penetrate into the paste.
e) Wait for some time till the plunger comes to rest and note the vicat reading.
f) Repeat the above procedure until the vicat reading is between 5-7 mm and the respective water cement ratio 25%.

Fig 8: Vicat Apparatus

3) *Initial & Final Setting Time Of Cement*

a) The main of this experiment is to determine the initial and final setting times of the given cement. The apparatus used for this experiment are Vicat apparatus, Vicat needles, vicat mould, measuring jar, weighing balance, glass plate, trowel and stop watch.
b) Prepare the cement paste, taking 300gm.
c) Keep the vicat mould over the glass plate and completely fill the mould with paste.
d) Replace the plunger of vicat apparatus with the standard needle of 1mm square.
e) If the vicat reading is 0.5mm stop the stop watch .The total time elapsed is the initial setting time.
f) The total time taken from the instant water added to the dry cement to final set stage.

Fig 9: Vicat Apparatus

4) *Soundness of Cement*

a) The main of this experiment is to determine the specific gravity and soundness of cement.The apparatus used for this experiment are Weighing balance, Stopwatch, Specific gravity bottle, Glass plate, Trowel, Tray, Measuring jar, Water bath with electric heating arrangement, Le-chatelier apparatus.
b) Before conducting the test lightly oil the apparatus such as Le-Chatelier mould, Glass plates.
c) Take required amount of cement 200 gm. Prepare a cement paste by adding 0.78 times of water required for standard consistency. Mix the cement paste well by using trowel.
d) Now place the lightly oiled Le-Chatelier mould on the glass panel.
e) Fill the mould with the prepared cement paste up to the top. While placing the cement hold the mould edges gently together. Now place another glass plate on the top and put weight on it.
f) Submerge the whole assembly into the water pot at a room temperature and keep it undisturbed for 24hrs.
g) Now remove the whole assembly from water and measure the distance between the mould edges, note the distances as L_1. The measuring pointer should indicate to the nearest 0.5 mm.
h) Submerge the mould again into the water and bring it to the boiling point and cool down it to room temperature. Now again measure the mould edges distance as L_2.

Formula:

Soundness of cement = $L_1 - L_2$

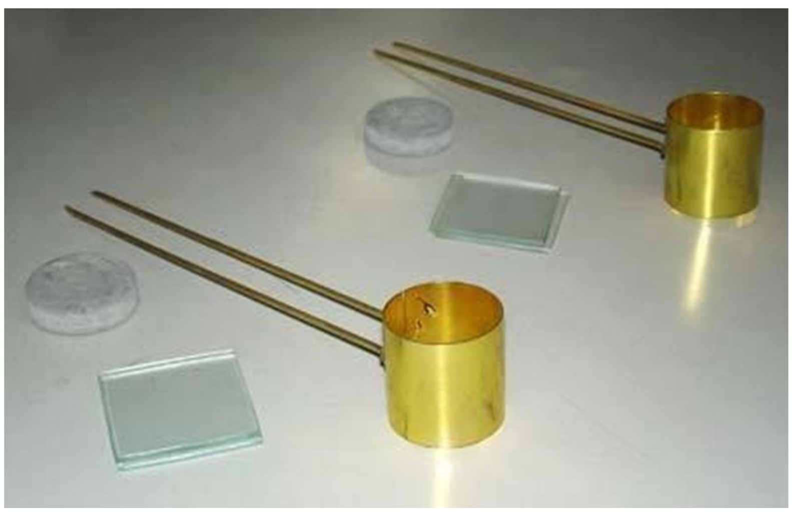

Fig 10: Le-Chatlier Apparatus

5) *Specific Gravity of Cement*

a) The main of this experiment is to determine the specific gravity of cement. The apparatus used for this experiment are Specific Gravity Bottle of 100ml capacity, Weighing Balance, Kerosene.
b) Measure the weight of empty flask (W_1). The flask should be totally dry and free of liquid.
c) Fill half of the flask with the cement (about 50gm) and measure the weight of its stopper (W_2).
d) Then fill the flask with the kerosene up to top level of the flask.
e) Mix cement and kerosene properly to remove air bubble from it. Weigh the flask with cement and kerosene (W_3).
f) Now empty the flask and again fill it with the kerosene up to top of the flask.
   Weigh the flask (W_4).

Formula:

$$\text{Specific Gravity } (S_g) = \frac{(W_2 - W_1)}{(W_2 - W_1) - (W_3 - W_4) \times 0.79}$$

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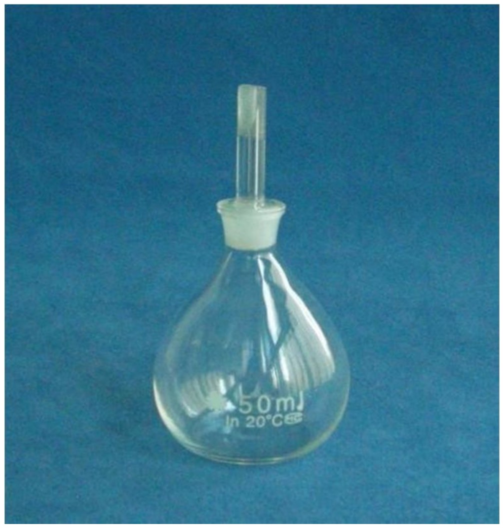

Fig 10: specific gravity bottle

6) *Determination of Sieve Analysis of Aggregate*

a) The main of this experiment is to determine the particle size distribution of fine and coarse aggregates. The apparatus used for this experiment are Weighing balance, IS sieves (63mm, 40mm, 20mm, 12.5mm, 10mm, 4.75mm, 2.36mm, 1.18 mm,300 microns, 150 microns, 75 microns)

b) Take a representative air-dried sample by quartering method or by a sample driver. Record its weight before sieving. Sieve the samples successively on the sieves for which the site distribution to the analyzed, starting from the largest.

c) Shake each sieve separately on a clean tray until two minutes. The sieving shall do forward, backward, circular, clockwise, anticlockwise with frequent jarring.

d) Lumps of fine materials present can be broken by gentle pressure by hand.

e) Weight the material retained on each sieve and record them.

f) The cumulative mass of the aggregate fraction shall be calculated and percentage of passing in each sieve shall then be reported.

Maximum size of aggregates	Minimum weight of sample to be taken (gm)
63mm	50,000
50mm	35,000
40mm	15,000
25mm	5,000
20mm	1,000
12.5mm	2000
10mm	500
4.75mm	200
2.36mm	100

ISsieve designation	Grading Zone1	Grading Zone 2	Grading Zone3	Grading Zone 4
10mm 4.75mm 2.36mm 1.18mm 600microns 300microns 150microns	100 90 - 100 60 - 95 30 - 70 15 - 34 5 - 20 0 – 10	100 90 - 100 75 - 100 55 - 90 35 - 59 8 - 30 0 - 10	100 90 - 100 85 - 100 75 - 100 60 - 79 12 - 40 0 - 10	100 95 - 100 95 - 100 90 - 100 80 - 100 15 - 50 0 - 15

Fig 11: Sieve Set for Coarse Aggregates

Fig 12: Sieve Set for Fine Aggregates

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7) *Determination of Specific Gravity of Fine aggregate*

a) The main of this experiment is to determine the specific gravity of fine aggregate. The apparatus used for this experiment are Pycnometer, weighing machine, sieve sets.
b) Specific gravity of fine aggregate is defined as the ratio of weight of aggregate to the weight of equal volume of water. The specific gravity of an aggregate is considered to be a measure of strength or quality of the material.
c) A clean, dry pycnometer is taken and its empty weight is determined (W_1).
d) About 1000 g of clean sample is taken into the pycnometer, and it is weighed (W_2). Water at 27ºc is filled up in the pycnometer with aggregate sample, to just immerse sample.
e) Immediately after immersion the entrapped air is removed from the sample by shaking pyncometer, placing a finger on the hole at the top of the sealed pyncometer.
f) Now the pyncometer is completely filled up with water till the hole at the top, and after conforming that there is no more entrapped air in it, it is weighed(W_3).
g) The contents of the pyncometer are discharged, and it is cleaned.
h) Water is filled up to the top of the pyncometer, without any entrapped air. It is then weighed.
i) For mineral filler, specific gravity bottle is used and the material is filled up to one third of the capacity of bottle. The rest of the process of determining specific gravity is similar to the one described for aggregate finer than 6.3 mm.

Fig 13: pyncometer

8) *Determination of Specific gravity of coarse Aggregate*

a) The main aim of this experiment is to determine the specific gravity for the coarse aggregates. The apparatus used for this experiment are Wire basket, weighing balance, thermostatically controlled oven, container filling water and suspending the basket, two absorbent clothes.
b) About 2 kg of aggregate sample is taken, washed to remove fines and then placed in wire baskets. The wire basket is then immersed in water, which is at a temperature of 22ºc to 33ºc.
c) Immediately after immersion the entrapped air is removed from the sample by lifting the basket 25 mm above base of the tank and allowing it to drop, 25 times at a rate of about one drop per second.
d) The basket, with aggregate are kept completely immersed in water for a period 24±0.5 hr. The basket and aggregate are weighed while suspended in water, which is at a temperature of 22ºc to 32ºc.
e) The basket and aggregates are removed from water and dried with dry absorbent cloth. The surface dried aggregates are also weighed.
f) The aggregate is placed in shallow tray and heated to about 110ºc in the oven for 24 hrs. later, it is cooled in an air tight container and weighed.

Fig 14: Wire bucket

Flow tests of Self Compacting Concrete

9) Slump Flow Test

a) The main aim of this experiment is to determine the of flow rate of self-compacting concrete by using slump flow test. The apparatus used for this experiment are Slump cone, Base plate, measuring scale, measuring tape.

b) Place the cone on a steel place at 210mm diameter marking.

c) Pour the sample into slump cone without compaction.

d) Strike surplus material and lift within the 30 seconds.

e) Measure the time from start of lift to time when first touches the 500mm diameter mark.

f) .Measure largest diameter in two directions at 90 degrees to nearest 10mm.

g) Take average to obtain slump flow to nearest 10mm.

Fig 16: Slump Cone

10) Compaction Factor Test

a) The aim of this experiment is to determine the Workability of concrete to which slump test is not suitable. The apparatus used for this experiment are Conical hoppers for top & bottom, cylinder, Trowels, Hand scoop, Steel Rod for compaction, weighing machine.

b) Prepare a concrete mix for testing workability. Weigh the quantity of cement, sand, aggregate and water correctly. Mix thoroughly. Use this freshly prepared concrete for the test.

c) Place the sample of concrete in the upper hopper up to the brim.

d) The trap-door is opened so that the concrete falls into the lower hopper.

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e) The trap-door of the lower hopper is opened and the concrete is allowed to fall into the cylinder.
f) The excess concrete remaining above the top level of the cylinder is then cut off with the help of plane blades.
g) The concrete in the cylinder is weighed. This is known as weight of partially compacted concrete.
h) The cylinder is filled with a fresh sample of concrete and vibrated to obtain full compaction. The concrete in the cylinder is weighed again. This weight is known as the weight of fully compacted concrete.

Fig 17: compaction factor test

11) Determination of Compressive strength of Cubes
a) The main aim of this experiment is to determine the compressive strength of the concrete cubes after 3,7,28 days of curing. The apparatus used for this experiment are Compressive testing machine, cube moulds, tamping rod, measuring cylinder, weighing balance.
b) Mix the cement and fine aggregate until the mixture is thoroughly blended and is of uniform color.
c) Add the coarse aggregate and mix with cement and fine aggregate until the coarse aggregate is uniformly distributed throughout the batch.
d) Add water and mix it until the concrete appears to be homogeneous and of the desired consistency.

e) Clean the mounds and apply oil
f) Fill the concrete in the molds in layers.
g) Compact each layer with not less than 35 strokes per layer using a tamping rod (steel bar 16mm diameter and 60cm long, bullet pointed at lower end) ➢ Level the top surface and smoothen it with a trowel.

Fig 19: Cubes after applying grease

Fig 20: Cubes after Filled with concrete

h) The test specimens are stored in moist air for 24 hours and after this period the specimens are marked and removed from the molds and kept submerged in clear fresh water until taken out prior to test.

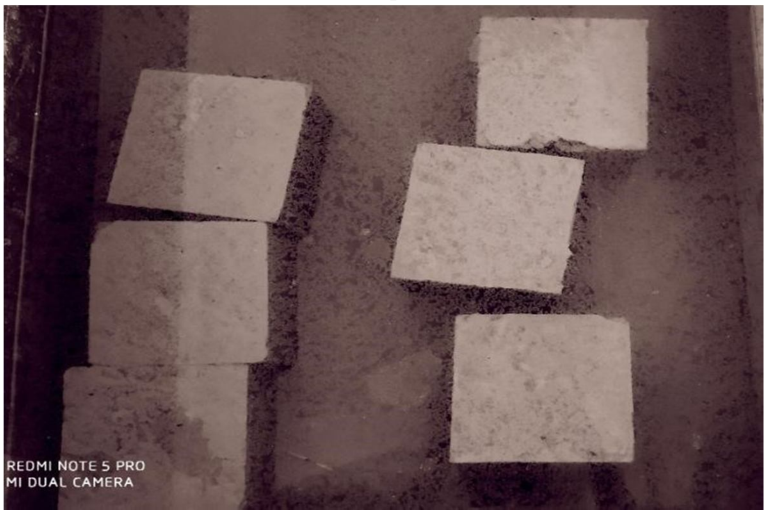


Fig 21: Cubes in Curing Tank

i) Remove the specimen from water after specified curing time and wipe out excess water from the surface.
j) Clean the bearing surface of the testing machine.
k) Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.
l) Align the specimen centrally on the base plate of the machine. Rotate the movable portion gently by hand so that it touches the top surface of the specimen.
m) Apply the load gradually without shock and continuously at the rate of 140 kg/cm2/minute till the specimen fails.
n) Record the maximum load and note any unusual features in the type of failure.

Fig 22: Compression Testing Machine

V. MIX DESIGN

A. Conventional Concrete Mix Design Procedure

1) Data For Mix Design

a) The following basic data are required to be specified for design of a concrete mix:
b) Characteristic compressive strength(that is , below which only specified proportion of test results are allowed to fall)of concrete at 28days (fck) ➢ Degree of workability desired.
c) Limitations on the water-cement ratio and the minimum cement content to ensure adequate durability (IS:456.1978)
d) Type and maximum size of aggregate to be used.
e) Standard deviation (s) of compressive strength of concrete.

2) Target Mean Strength For Mix Design

In order that not more than the specified proportion of test results is likely to fall below the characteristic strength, the concrete mix has to be designed for somewhat higher target average compressive strength (fck). The margin over the characteristic strength depends upon the quality control (expressed by the standard deviation) and the accepted proportion of results of strength tests below the characteristic strength (fck), given by the relation

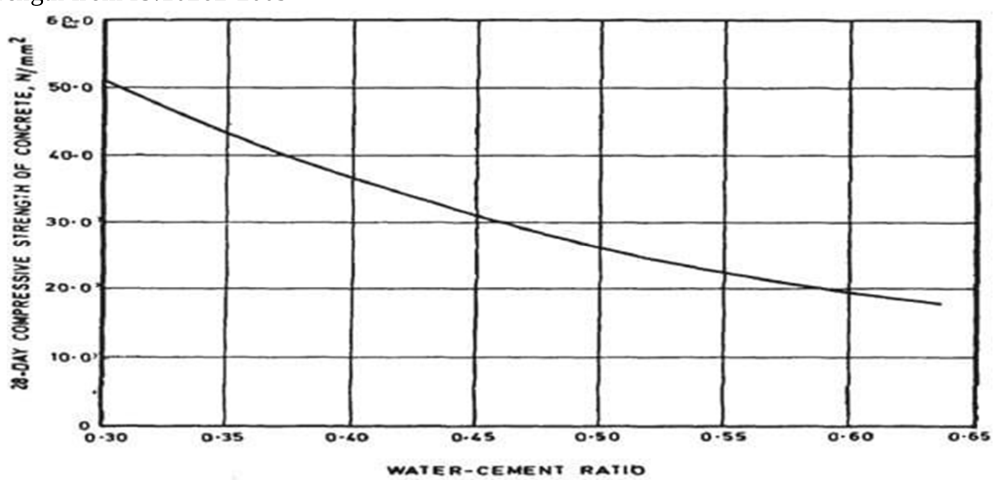
Fck = fck + ts
Where,
Fck = target average compressive strength at 28 days,
Fck = characteristic compressive strength at 28 days,
S= standard deviation
T=tolerance factor
NOTE: According to IS: 456- 1978*and IS: 1343- 1980, the characteristic strength is defined as that value below which not more than 5% (1 in 20) results are expected to fall in such case the above equation will be reduced to:
Fck = fck + 1.65 * s

The standard deviations are

Grade of cement	Standard deviation
M10 - M15	3.5 Mpa
M20 - M25	4.0 Mpa
M30 - M50	5.0 Mpa

3) Selection Of Water –Cement Ratio

Since different cements and aggregates of different maximum size, grading surface texture, shape and other characteristics may produce concretes of different compressive strength for the same free water-cement ratio , the relationship between strength and free water-cement ratio should preferably be established for materials actually to be used .in the absence of such data , the preliminary free water cement ratio (by mass) corresponding to the target strength at 28 days may be selected from the water-cement ratio to 28 day compressive strength from IS:10262-2009



4) Estimation Of Air Content

Approximate amount of entrapped air to be expected in normal concrete is given in the following table.

Table: Entrapped air percentage of concrete

Normal maximum size of aggregate (mm)	Entrapped air percentage of volume of concrete
10	3.0
20	2.0
30	1.0

5) Selection Of Water Content And Fine To Total Aggregate Ratio

For the desired workability, the quantity of mixing water per unit volume of concrete and the ratio of fine aggregate to total aggregate by absolute volume are to be estimated from the tables below.

Estimate water content and sand contents for concrete grades up to M35/above M35

Ms.a(mm)	W Kg/m^3	P= f_{agg} vol (%of total)
10	208	40
20	186	35
40	165	30
10	200	28
20	180	25

Maximum water content per 1m3 of concrete = 186 liters (for 25mm – 50mm slump range and for 20 mm aggregates and sand confirming to zone II.

6) Calculation Of Cement Content

The cement content per unit volume of concrete may be calculated from the free water cement ratio and the quantity of water per unit volume of concrete. The cement content so calculated shall be checked against the minimum cement content for requirements of durability and the greater of the two values adopted.

7) Calculation Of Aggregate Content

With the quantities of water and cement per unit volume of concrete and the ratio of fine to total aggregate already determined, the total aggregate content per unit volume of concrete may be calculated from the following equations:

$$V = \left(W + C/S_C + 1/P \; f_a/S_{fa} \right) \times 1/1000 \qquad V = W + C/S_c + \left(1/1\text{-}p \; C_a/S_c \right) \times 1/1000$$

V=absolute volume of fresh concrete = (1-2%)=1-(2/100)=0.98

W=mass of water in kgs for 1m^3 of concrete

C=mass of cement in kgs for 1m^3 of concrete

Sc=specific gravity of cement

P= ratio of fine aggregate to total aggregate by absolute volume

Sfa= specific gravity of fine aggregate

Sca= specific gravity of coarse aggregate

Fa= total mass of fine aggregate in kgs for 1m^3 of concrete.

Ca = total mass of coarse aggregate in kgs for 1 m^3 of concrete.

VI. PREPARATION OF SPECIMEN

A. Sieving of Fine Aggregate and Coarse Aggregate

A sieve analysis is a practice or procedure used to assess the particle size distribution of granular material by allowing the material to pass through a series of sieves of progressively smaller mesh size and weighing the amount of material that is stopped by each sieve as a fraction of the whole mass.

Fineness modulus is an index used to know the mean size of practical in the total quantity of aggregate fineness modulus is to grade the given aggregate for most economical mix and workability with less consumption of cement.

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B. Weighing of Materials

The materials are weighed by using electrical weighing machine with maximum capacity 50 kgs the accuracy of electrical weighing machine used is 0.1 kg.

C. Mixing

When mixing concrete by hand, you should combine cement, sand, and coarse aggregate in the proper ratio. The measured quantity of sand is spread evenly. The required quantity of cement is dumped on the sand and spread evenly. The sand and cement is then mixed intimately with spade turning the mixture over and over again until it is of even color through out and free from streaks. Finally, ensure the mixture is evenly put together and work fast to prevent formation of dry lines.

Fig 23: Mixing of concrete with addition of steel fibers & plastic waste

D. Casting of Cubes

Number of cubes to be casted is decided by quantity of concrete to be used in the batch.

Minimum 6 cubes are casted. Cubes should be casted within 30 minutes if admixture is not used. Cubes are cleaned and lightly oiled. It is filled in three layers with 15 mm diameter rod with 25 blows each otherwise cube is vibrated on vibrating table. It is reminded that the third layer quantity concrete is filled in such a way that after compaction no concrete is excess in cube and just leveled by trowel. The concrete to be filled from bucket is mixed first but no selective filling in cube is allowed. Excess water in cube after filling is not taken but after sometimes little bit concrete is added and leveled sample of concrete are collected and filled in cube to cover whole batch of concrete. Cube date and grade is marked on cube after initial or final set by paint. After 24 hrs of filling and remain in shade under wet cloth/jute bag, concrete cube are kept in water. Water is changed to reduce temperature and available fresh water having good oxygen value.

Fig 24: oiling of cubes before casting

Fig 25: casting of cubes

E. Demoulding Of Test Cubes

Test cubes should be demoulded between 16 and 24 hrs after they have been made. If after this period of time the concrete has not achieved sufficient strength to enable demoulding without damaging the cube then the demoulding should be delayed for a further 24 hrs. When removing the concrete cube from the mould, take the mould a part completely. Take care not to damage the cube because, if any cracking is caused, the compressive strength may be reduced.

After demoulding, each cube should be marked with a leasable identification on the top or bottom using a water proof crayon or ink. The mould must be thoroughly cleaned after demoulding the cube. Ensure that grease or dirt does not collect between the faces of the flanges, otherwise the two halves will not fit together properly and there will be leakage through the joint and an irregularly shaped cube may result.

F. Curing Test Cubes

Cubes must be cured before there tested. Unless required for test at24hrs the cube should be placed immediately after demoulding in the curing tank or mist room.

The curing temperature of the water in the curing tank should be maintained at 27ºc to 30ºc. if curing is in mist room, the relative humidity should be maintained at no less than 95%. Curing should be continued as long as possible up to the time of testing.

In order to provide adequate circulation of water, adequate space should be provided between the cubes, and the side of curing tank. If the surface of the cubes are moist at all times.

Fig 26: placing cubes for curing in curing Tank

G. Testing Of Specimens

Concrete is used mostly for structural purposes such as foundations, columns, beams and floors and therefore must be capable in taking the loads that will be applied. one of the methods checking its fit for purpose is to carry out a concrete cube test which measures compressible cube strength of the concrete and relates directly to the required design strength specified by the designer a time schedule for testing of specimens is maintained to ensure the proper testing on the due date and time the cast specimens are tested as per standard procedure IS-516-1959. The test results are tabulated carefully.

H. Compression Testing Machine

The compression testing machine (micropressor based) used for testing the cube specimens is of standard make the capacity of testing machine is 200KN. The machine has facility to control the rate of loading with a control valve. The plates are cleaned before the testing of the cubes.

After the required period of curing, the cube specimens are removed from curing tank and cleaned to wipe off the surface water. It is placed on machine such that the load is placed centrally. The smooth surface of specimen is placed on the bearing surfaces. The top plate is bought in contact with the specimen by rotating the handle.

Fig 27: placing specimen for compression value

VII. DESGIN MIX FOR M40 GRADE CONCRETE

A. Design Stipulations For Proportioning

1) Grade designation : M40
2) Type of cement : OPC 43 grade confirming to IS
3) Maximum nominal size of aggregates : 20mm
4) Degree of workability factor : 50mm (slump)& (25-50mm slump (0.8-0.9 c.f)
5) Exposure condition : Very severe
6) Degree of supervision : Good
7) Type of aggregate : Angular aggregate
8) Materials added in cement : Plastic waste (HDPE), Steel fibers

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B. Test Data For Materials

1) Cement used : OPC 43 grade confirming to
2) Specific gravity of cement : 3.15
3) Specific gravity of coarse aggregate : 2.76
4) Specific gravity of fine aggregate : 2.79
5) Water absorption coarse aggregate : 0.5 percent
6) Water absorption fine aggregate : 1.0 percent
7) Free (surface) moisture coarse aggregate : Nil (absorbed moisture also nil)
8) Free (surface) moisture fine aggregate : 2%
9) Absorbed moisture of coarse aggregate : Nil
10) Absorbed moisture of fine aggregate :1%
11) Sieve Analysis : conforming to size 20mm of Coarse aggregate (20mm-10mm)
12) Fine aggregate : conforming to Zone II of

C. Target Strength For Mix Proportioning

Fck = fck + ts

Where

Fck = Target average compressive strength at 28 days,

Fck = Characteristic compressive strength at 28 days,

S= Standard deviation

T=tolerence factor

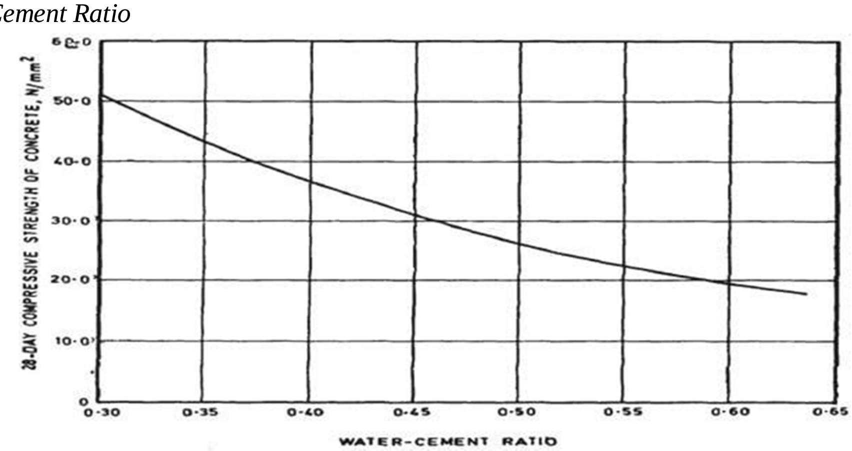
The standard deviations are

Grade of cement	Standard Deviation
M10	M15: 3.5 Mpa
M20	M25: 4.0 Mpa
M30	M50: 5.0 Mpa

From above Table standard deviation, s = 5 N/mm^2

Therefore target strength FCK = 35+ 1.65 x 5 = 48.25 N/mm^2 =49N/mm^2

D. Selection Of Water Cement Ratio



From above graph of IS: 456-2000,

Fck = 49.00Mpa & 43 grade OPC

Maximum water cement ratio = 0.41

Based on experience adopt water cement ratio as 0.41

0.41 < 0.45(specified durability conditions, hence ok

E. Selection Of Water Content

Estimate water content & sand contents for concrete grades up to m35up M35/ above M35

Ms.a(mm)	W Kg/m^3	P= f_{agg} vol (%of total)
10	208	40
20	186	35
40	165	30
10	200	28
20	180	25

Maximum water content per 1m3 of concrete = 186 liters (for 25mm – 50mm slump range and for 20 mm aggregates and sand confirming to zone II)

Estimate water content & sand contents for concrete grades up to M35 above M35 (Adjustments)

Change in condition	Adjustment of water content %	Adjustment of % sand in total aggregates
For decrease in water/cement ratio by (0.6-0.41) / (0.05*1.0)	0	-3.8
Increase in compaction factor (0.9-0.8) / (0.1*3)	+3	0
For sand confirming to zone II	0	0
Total	+3	-3.8

Sand content as % of aggregate by absolute volume = 35%

Required sand content = 35-3.8 = 31.2%

Require water content = 186 + ((3/100) × 186) = 186+5.58 = 191.61 Kg/m^3

F. Calculation Of Cement Content

Water cement ratio = 0.4

Cement content = 400 kg/m^3

From Table 5 of IS: 456, minimum cement content for severe exposure condition = 320 kg/m^3

400 kg/m3 > 320 kg/m^3.

Hence OK

G. Proportion Of Volume Of Coarse Aggregate And Fine Aggregate Content

As per IS: 1026, CI. NO. 3.5.1)

V = [W+(C/Sc) + (1/p) . (fa / Sfa)]*(1/1000)

V = [W+(C/Sc) + {1/ (1-p)} . (ca / Sca)] * (1/1000)

Where,

V = Absolute volume of fresh concrete

W = Mass of water

S = Standard deviation

C = Mass of cement

Sc = Specific Gravity of cement
P = Ratio of fine aggregate to total aggregates by absolute volume
(fa), (ca) = Total mass of fine aggregates and coarse aggregates per m3 of concrete Sfa, Sca = Specific Gravity of saturated surface dry fine aggregate and coarse aggregate respectively
As per Table No 3, IS- 10262, for 20mm maximum size entrapped air is 2%
Assume Fine aggregate by total % of volume of total aggregates = 36.5%
0.98 = [160 + (400/3.15) + (1/0.365) (ca/2.76)](1/1000)
ca = 1168.37 kg
Say ca = 1168 kg
Hence Mix Design per m3

MIX DESIGN FOR M40 GRADE
Trail mix results
Mix proportions:
Cement = 400 kg
Water = 160 kg
Fine Aggregate = 660 kg Coarse Aggregate = 1168 kg
Mix proportion:

C: FA: CA: W/C: 1: 1.65: 2.92: 0.40

Table: 1 MIX Proportions.

S.No	Materials	Cement (Kg)	Sand (Kg)	Coarse Aggregates (Kg)	Water (Kg)
1.	Weight of materials for $1m^3$ of concrete.	400	660	1168	160
2.	Mix proportions by weight.	1	1.65	2.92	0.40
3.	Weight of materials for $3.375x10^{-3}m^3$(1 cube) of concrete.	1.350	2.227	3.942	0.540
4.	Weight of materials for 16 cube of concrete.	21.60	35.632	63.072	8.64

Materials required after addition of Plastic waste with different percentiles for 16 cubes.

S.No	%Plastic waste.	0%	0.6%	1.2%	1.8%	2.4%	Total contents.
1.	Cement (Kg)	21.60	21.60	21.60	21.60	21.60	108
2.	Fine aggregates (Kg)	35.632	35.632	35.632	35.632	35.632	178.16
3.	Coarse aggregates (Kg)	63.072	63.072	63.072	63.072	63.072	315.36
4.	Water content (Kg)	8.64	8.64	8.64	8.64	8.64	43.2
5.	Plastic waste (Kg)	0	0.129	0.259	0.388	0.518	1.294
6.	Steel fibers (Kg)	0	0.432	0.432	0.432	0.432	2.16

Tabulation of Casting and Testing days of Cubes

S.No	Percentage of plastic waste	Casting	3 Days	7 Days	14 Days	28 Days
1.	0%	26-12-2019	29-12-2019	02-01-2020	09-01-2020	23-01-2020
2.	0.6%	02-01-2020	06-01-2020	10-01-2020	17-01-2020	31-01-2020
3.	1.2%	04-01-2020	08-01-2020	12-01-2020	19-01-2020	02-02-2020
4.	1.8%	05-01-2020	09-01-2020	12-01-2020	20-01-2020	03-02-2020
5.	2.4%	07-01-2020	11-01-2020	15-01-2020	25-01-2020	08-02-2020

Description

- M_0 - 0% of plastic waste and steel fibers are added to concrete.
- M_1 - 0.6% of plastic waste and 2% of steel fibers are added to concrete.
- M_{2-} 1.2% of plastic waste and 2% of steel fibers are added to concrete.
- M_3 -1.8% of plastic waste and 2% of steel fibers are added to concrete.
- M_4 -2.4% of plastic waste and 2% of steel fibers are added to concrete.

VIII. STRENGTH TABLES

Compressive strength of cube in 3 days curing in water

S.No	Percentage of steel fibers	Percentage of plastic waste	Compressive strength in Mpa
1.	2%	0%	27.07
2.	2%	0.6%	15.75
3.	2%	1.2%	20.01
4.	2%	1.8%	22.04
5.	2%	2.4%	18.29

Compressive strength of cube in 7 days curing in water

S.No	Percentage of steel fibers	Percentage of plastic waste	Compressive strength in Mpa
1.	2%	0%	28.90
2.	2%	0.6%	18.18
3.	2%	1.2%	21.19
4.	2%	1.8%	24.76
5.	2%	2.4%	22.57

Compressive strength of cube in 14 days curing in water

S.No	Percentage of steel fibers	Percentage of plastic waste	Compressive strength in Mpa
1.	2%	0%	35.85
2.	2%	0.6%	19.84
3.	2%	1.2%	22.01
4.	2%	1.8%	28.06
5.	2%	2.4%	26.02

Compressive strength of cube in 28 days curing in water

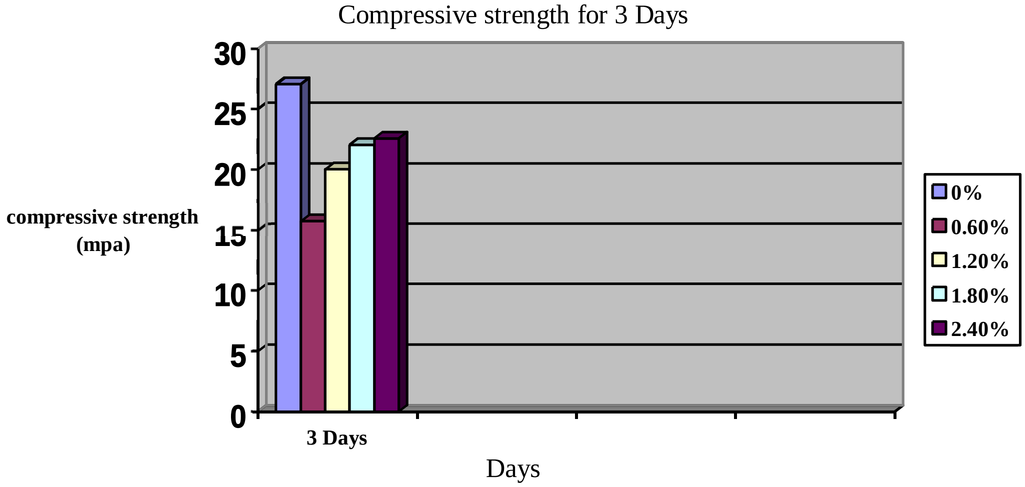
S.No	Percentage of steel fibers	Percentage of plastic waste	Compressive strength in Mpa
1.	2%	0%	47.36
2.	2%	0.6%	20.67
3.	2%	1.2%	25.26
4.	2%	1.8%	33.16
5.	2%	2.4%	30.05

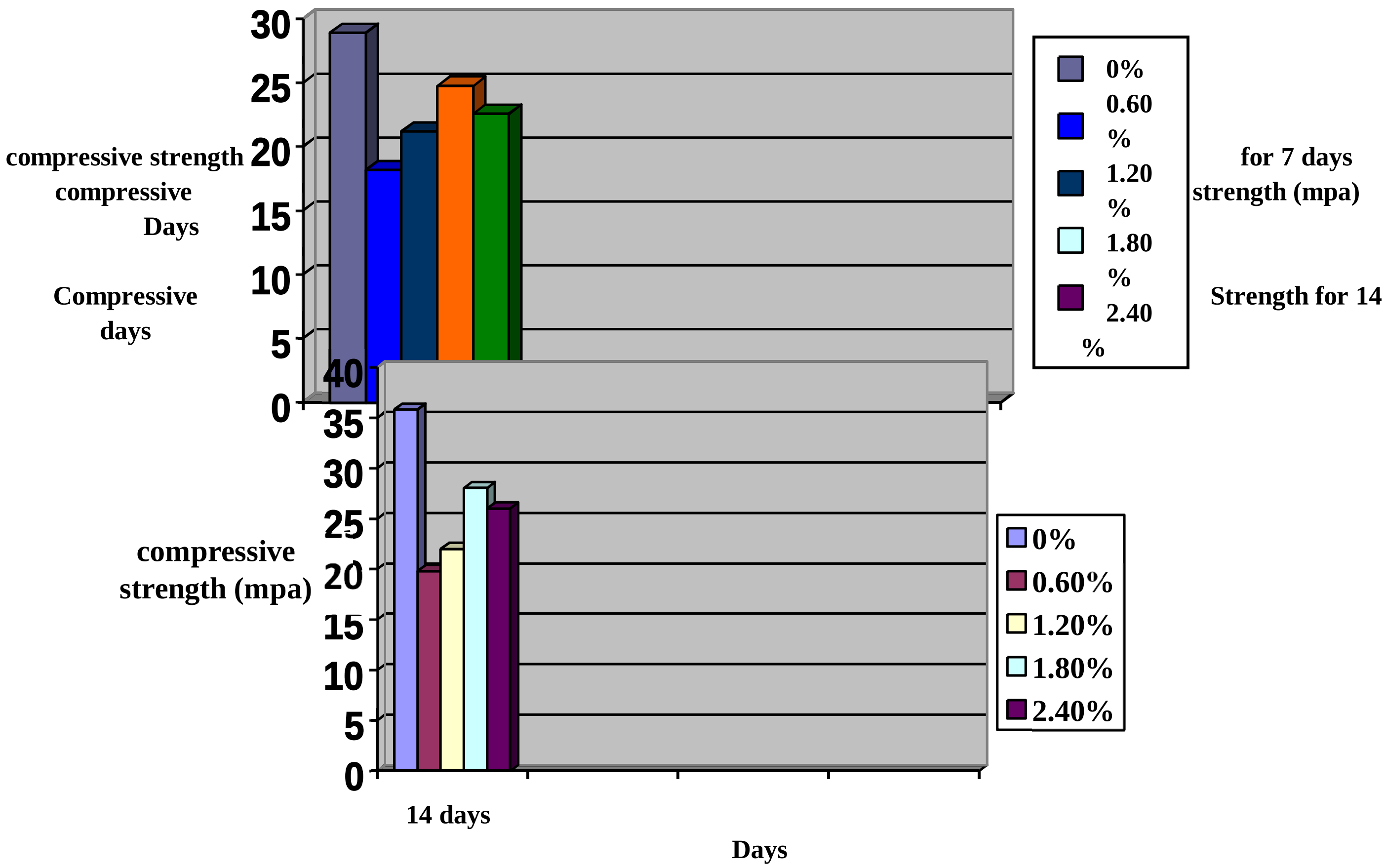
Tabulation of compressive strength results of different % of plastic waste.

S.No	Percentage of plastic waste	Percentage of steel fibers	Compressive strength at 3days Mpa	Compressive strength at 7days Mpa	Compressive strength at 14days Mpa	Compressive strength at 28days Mpa
1.	0%	0%	27.07	28.90	35.85	47.36
2.	0.6%	2%	15.75	18.18	19.84	20.67
3.	1.2%	2%	20.01	21.19	22.01	25.26
4.	1.8%	2%	22.04	24.76	28.06	33.16
5.	2.4%	2%	18.29	22.57	26.02	30.05

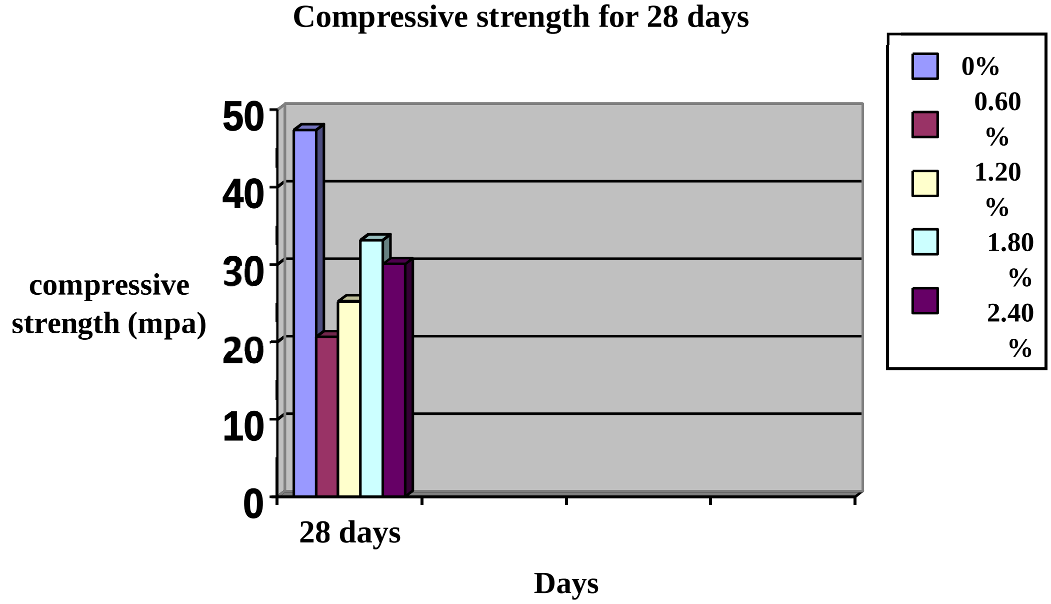
IX. GRAPHICAL REPRESENTATION

Compressive strength for 3 Days





Compressive strength for 28 days



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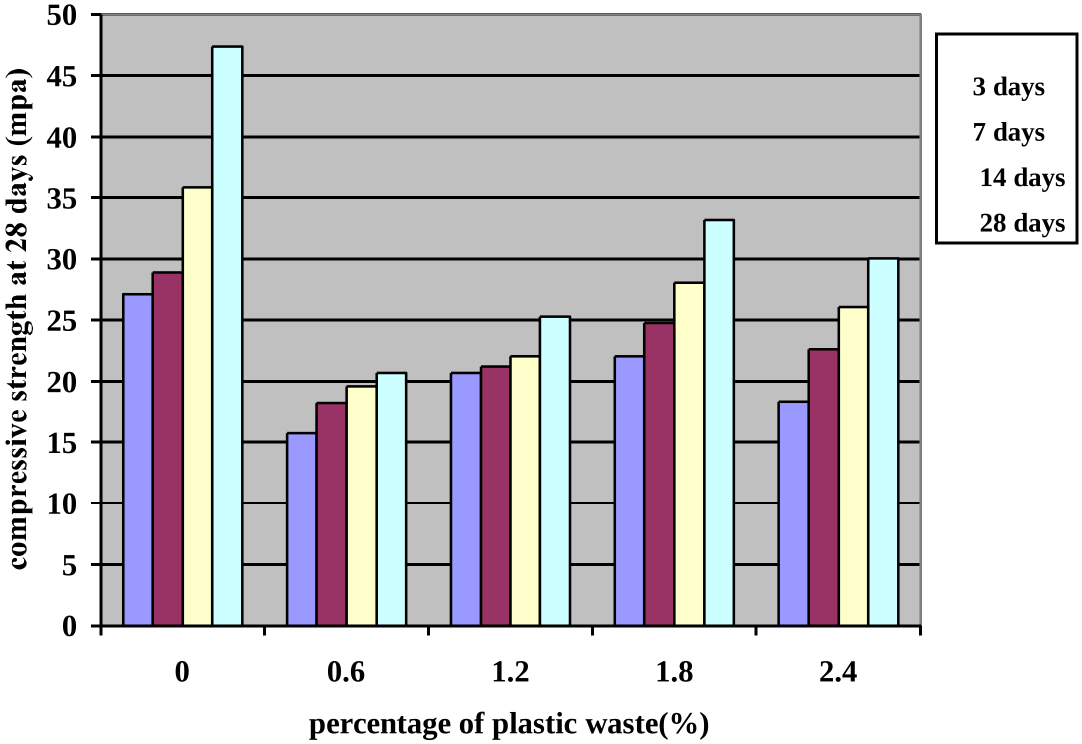
Compressive Strength varying with plastic waste percentages



X. CONCLUSIONS

Based on the results the following calculations are made:

1) The compressive strength of concrete after 3days is reduced by 11.32%, 7.06%, 5.03% and 8.78% by adding 0.6%, 1.2%, 1.8%, 2.4% of plastic waste respectively to plain concrete mix.
2) The compressive strength of concrete after 7 days is reduced by 10.72%, 7.71%, 4.14% and 6.33% by adding 0.6%, 1.2%, 1.8%, 2.4% of plastic waste respectively to plain concrete mix.
3) The compressive strength of concrete after 14 days is reduced by 16.01%, 13.84%, 7.79% and 9.83% by adding 0.6%, 1.2%, 1.8%, 2.4% of plastic waste respectively to plain concrete mix.
4) The compressive strength of concrete after 28 days is reduced by 26.69%, 22.10%, 14.20% and 17.31% by adding 0.6%, 1.2%, 1.8%, 2.4% of plastic waste respectively to plain concrete mix.
5) By adding 1.8% of plastic waste to concrete is suitable for adding plastic waste to concrete. More than 1.8% of plastic waste the compressive strength is reduced.

A. List Of Is Codes

1) I.S. 12269-1989---Specification for grade ordinary Portland cement
2) I.S. 383-1970 ---Specification for Coarse & Fine Aggregate from Natural Sources for
3) Concrete
4) I.S.456-2000---Indian Standard Plain & Reinforced Concrete Code of Practice
5) I.S. 516-1959---Methods of test for strength of concrete
6) I.S. 2386-1963---Methods of Test for Aggregates of Concrete (all parts) 6. I.S. 3085-1965---Methods of Test for Permeability of Cement & Concrete
7) I.S. 13270-2013---Indian Standard Specification for Steel fibers.
8) I.S. 10262-1982---Recommended guide lines for concrete mix design
9) I.S. 4031-1988---Methods for physical tests for hydraulic Cements :(PT2) Part 2 Determination of fineness by specific surface by Blaine's air permeability method
10) I.S. 4031-1988---Methods for physical tests for hydraulic cements: (PT5) Part 5 Determination of initial and final setting times.

11) I.S. 4031-1988---Methods for physical tests for hydraulic cements: (PT3) Part 3 Determination of soundness
12) I.S. 1199-1959---Methods of sampling and analysis of concrete
13) I.S.5512-1983---Specifications for flow table for use in tests of hydraulic cements & Pozzolanaic materials
14) 5514-1969---Apparatus used in "Le Chatelier" test.
15) 5513-1966---Vicat Apparatus.

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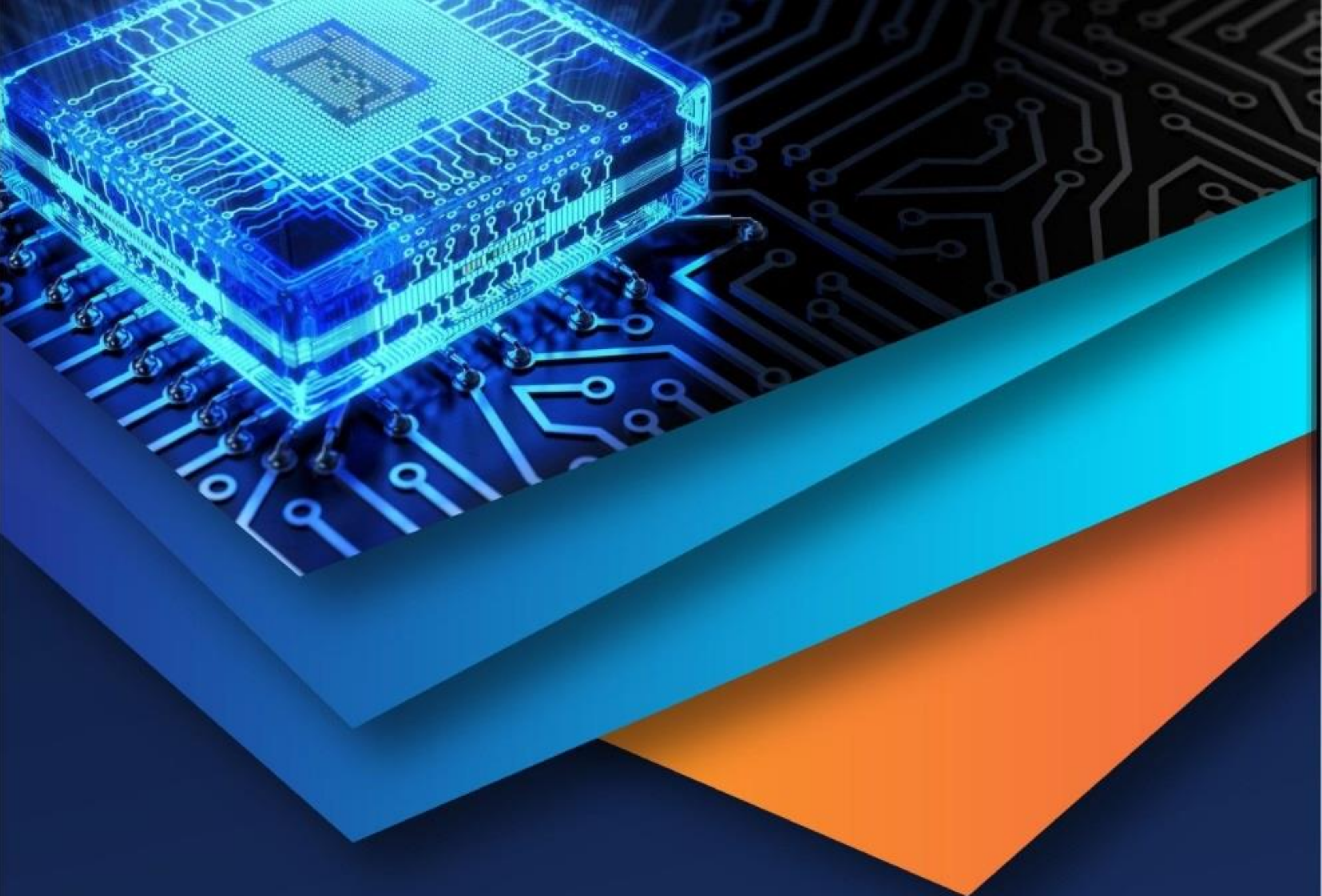

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