

EFFECTS OF METAKAOLIN AND POLYPROPYLENE FIBER IN PERVIOUS CONCRETE

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Civil Engineering

by

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**DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF BUILDING AND ENVIRONMENT**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade “A” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

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BONAFIDE CERTIFICATE

This is to certify that the Project Report is the bonafide work of K.Ashok (Reg. No. 37200901) and M.Jeevanandham (Reg. No. 37200902) who carried out the project entitled "EFFECTS OF METAKAOLIN AND POLYPROPYLENE FIBER IN PERVIOUS CONCRETE" under my supervision from December 2020 TO March 2021.

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DECLARATION

We ASHOK K (Reg. No. 37200901) and JEEVANANDHAM M (Reg. No. 37200902) hereby declare that the Project entitled **“EFFECTS OF MATAKAOLIN AND POLYPROPYLENE FIBER IN PERVIOUS CONCRETE”** done by us under the guidance of MR.C.MANOJ KUMAR M.E, at Sathyabama Institute of Science and Technology, Chennai is submitted in partial fulfilment of the requirement for the award of Bachelor of Engineering Degree in Civil Engineering.

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ABSTRACT

Concrete are composed of cement, coarse aggregate, fine aggregate and water with such suitable proportion for making certain concrete for desired areas.

No-fine concrete, Porous or Pervious cement is a unique sort of cement with high porosity that permits water to enter through it accordingly permitting storm water to at last assimilate once again into the dirt or dissipate and permitting groundwater re-energize. No-fine concrete is acquired by wiping out the fine sand, from the ostensible solid blend. The single-sized coarse totals are encircled and held together by a slim layer of concrete glue invigorating cement. The upside of this kind of cement is lower thickness.

The utilization of pervious solid will lessen the requirements for huge detainment lakes, skimmers, siphons, seepage pipes and other tempest water the board framework, costly water system frameworks can be cut back or even killed. Pervious cement is a strong material, Utilizations of pervious cement should be possible for Sports Pitches, Sub-base, Cycle ways, Parking areas, Carports, Walkways, stopping zones appropriately planned and development will last 20-40 years with next to zero support.

The fundamental point of our undertaking is to contemplate the conduct examination of pervious solid asphalt in Indian street conditions by dissecting the outcomes acquired from different analyses.

KEYWORDS: Pervious concrete, Mix design, strength parameters, permeability.

LIST OF SYMBOLS

A	–	Cross sectional area
B	–	Breadth
l	–	Length
D	–	Dia of bars
d	–	Depth of span
D	–	Effective depth of the beam or slab
f_{ck}	–	Characteristics compressive strength of concrete
f_y	–	Characteristics strength of steel
BM	–	Bending moment

S	–	Spacing of stirrups or standard deviation
V	–	Shear force
W	–	Total load
Z	–	Zone factor
Q	–	Quantity of water

CHAPTER 1

INTRODUCTION

1.1 GENERAL

This is unique kind of cement with a high porousness utilized for solid work applications that permits water from regular sources to go straightforwardly through, along these lines decreasing the running from a site and permitting groundwater re-energize. This part gives a point by point presentation on pervious solid asphalt.

1.2 INTRODUCTION

Concrete is a kind of superabsorbent that allows water to seep through it. It is a novel type of concrete that has the capability of absorbing of water up to 1057gallons of water in the few minute. On an average, one square meter of this pavement concrete surface, can drain 159 gallons in a minute. Pervious concrete absorbs water on its surface area were water clogging and logging. Pervious concrete not only could help flash flooding, this type of concrete keeps the temperature of concrete surface lower in hot weather. This type of concrete allows water freely to drain easily.

The ability to act as a source during periods of high fall Pervious concrete pavements help rapidly in removing of water, preventing the potentially dangerous built-up of standing water This storm water absorbed is filtered through a porous layer, removing petroleum hydro carbons and other pollutants found on the roadway before the water returned to the water table. The utilization of asphalt materials like Bitumen, Asphalt solid seals the dirt surface which limits the downpour water from invasion and characteristic ground re-energize.

Solid expects to reestablish groundwater assets, dirty waterfront waters, re-energize stopping. Complete solid asphalt is the "best administration establishment" (BMP) to gather, spotless and cool tempest water.

1.3 AIM

The Aim is to study the behavioral analysis of pervious concrete pavement in Indian road conditions.

1.4 NEED OF STUDY

In country domains gigantic proportion of storm water are wasted by non drainable areas like Parking bundles, garages, walkways, and streets instead of sprinkling into the earth. This impacts the trademark organic framework and prompts an issue including deterioration, floods, ground water level utilization and defilement of streams. To keep an essential separation from the issues to construct pervious or permeable sort concrete. We should switch Pervious Concrete or Pervious Pavement, a material that offers infiltration of water into the soil, and it can moreover be accumulated and used.

1.5 OBJECTIVES

- To study the strength parameters of nervous solid pavement.
- To test the feasibility of using pervious concrete in rigid pavement.
- To study the permeability of pervious concrete pavement.
- To study the various properties in the porousness and compressive strength.

1.6 SCOPE

- In future it controls storm water
- It reduces runoff when flooded
- It also improves water quality in areas of high dangers of flooding.

1.7 BENEFITS OF PERVIOUS CONCRETE

- Efficient storm water the board
- Environmental the board
- Reduced
- Ease of situation
- Aesthetic request Sustainable
- Low cost
- Eliminates costly drainage systems
- Can be used for erosion control
- Directly recharges ground water
- Reduces surface temperatures

The only downside, it isn't suitable to use in areas with extremely low temperatures, though, because the entire system may destroy when the water beneath it freezes.

CHAPTER 2

REVIEW OF LITERATURE

2.1 GENERAL

The primary objective of pervious concrete pavement is to prevent flash flooding and to increase groundwater level. Permeable cement is a combination of concrete, unique coarse total ,destruction squander and water in reasonable extent. Painstakingly controlled measures of water and cementations materials are used to make a paste that shapes a thick covering around absolute particles without gushing off during blending and putting. Utilizing barely sufficient glue to cover the particles keeps an arrangement of interconnected voids.

2.2 LITERATURE REVIEW

Aleksandra Radlinska et al, “LONG-TERM FIELD PERFORMANCE OF PERVIOUS CONCRETE PAVEMENT” .

This is an open access article disseminated under the Innovative Hall Attribution Permit, which grants unhindered use, conveyance, and generation in any medium, given the first work is appropriately referred to. The work portrayed in this paper gives an assessment of a matured pervious solid asphalt in the Northeastern US to give a superior comprehension of the dependable impacts of situation strategies just as the drawn out field execution of permeable asphalt, explicitly in regions helpless to freezing and defrosting. Numerous examples were taken from the current asphalt and were analyzed regarding porosity and unit weight, compressive and parting elasticity, and the profundity and degree of obstructing.

It was presumed that ill-advised position and restoring prompted lopsided asphalt thickness, unpredictable pore dispersion inside the pervious cement, and profoundly factor strength esteems across the site, just as fixed surfaces that forestalled invasion.

Darshan S. Shah et al, "Past CONCRETE : NEW Time FOR Country Streets Asphalt" Volume 4 Issue 8-August 2013 , Worldwide Diary of Designing Patterns and Innovation (IJETT).

Pervious cement is a moderately new idea for country street asphalt, with increment into the issues in provincial zones identified with the decrease ground water level, agrarian issue. Porous cement has presented in country street as a street asphalt material. Porous concrete as a clearing material has seen reestablished interest because of its capacity to permit water to course through itself to re-energize ground water level and limit stormwater spillover. This prologue to pervious solid asphalts surveys its applications and designing properties, including ecological advantages, primary properties, and sturdiness. In rustic region cost thought is the essential factor which should be remembered. So that in provincial regions expensive stormwater the board rehearses isn't appropriate. Pervious solid asphalt is novel and powerful intends to satisfy developing ecological needs. By catching water and permitting it to saturate the ground. This asphalt innovation makes more proficient land use by disposing of the requirement for maintenance lakes, swell, and other exorbitant stormwater the executives gadgets.

R. Selvaraj et al, "SOME ASPECTS ON PERVIOUS CONCRETE" Volume-3, Issue-1.

Pervious concrete or upgraded porosity concrete has a carefully hole reviewed coarse total stage and next to zero fine totals in order to encourage the development of an interconnected organization of pores in the material. The material is planned with cementitious material substance barely enough to cover the coarse total particles so a design that permits the entry of water at a lot higher rate than ordinary cement. The pervious cement has numerous benefits that improves city climate, re-energizes the ground by downpour water and could be utilized as asphalt for light vehicles, walker pathways, parking areas, likewise it decreases the tire asphalt cooperation clamor and so forth the adequacy of a pervious solid asphalt depends as the inborn penetrability of the mass, and typically this is characterized by the porosity. It has been seen that porosity alone is a lacking pointer of the penetrability of pervious cements, since the porousness relies upon pore sizes, calculation and network too. This paper presents another strategy for deciding the porousness of pervious cement and gives plan system to get ready pervious cement.

Pankaj R. Teware et al (2016), mix proportion of cementitious material In Pervious Concrete” Volume: 1 Issue: 3 August 2016.

The objective of reducing the solid waste disposal problem and economic in cost. The Fly ash and Ground granulated blast furnace slag (METAKAOLIN) are among the solid wastes generated by Thermal power plant and iron manufacturing industry. To overcome from this crisis, fractional supplanting of concrete with Fly debris and Metakaolin can be a financial other option. And the cement is partially replaced with Fly ash and Metakaolin by 10%, 20% up to 30%.

The effect of paste density on properties of pervious concrete by addition of various cementitious admixtures such as Fly ash and Ground Granulated blast furnace Slag ,Metakaolin.

So the physical and mechanical properties of pervious solid will be helpful for the impending utilization of Fly debris and Metakaolin in the development field of pervious solid which will prompt decrease the concrete utilization, ecological issue and environmental benefit.

CH. Harisaipriyanka et al (2017) “Experimental Analysis On High Strength Pervious Concrete” Volume-4, Issue-2, April-2017 .

Pervious Concrete as a clearing material has seen reestablished interest due to its ability to allow water to travel through itself to re-empower groundwater and limit stormwater flood. The utilization of pervious cement has expanded fundamentally over the most recent quite a long while, maybe to a great extent since it is viewed as a harmless to the ecosystem, supportable item. This material drastically decreases ecological debasement and the negative impacts related with never-ending suburbia. No-fines concrete has been utilized as a viable strategy for treating and diminishing negative natural effects. Contrasted with regular concrete, pervious cement has a lower compressive strength, higher porousness, and a lower unit weight, roughly 70% of ordinary cement. To improve the strength we ought to receive reasonable blend design. The fundamental point of the task is to improve the strength qualities of pervious cement by utilizing exceptional fluid kind of water decreasing admixture in mix with gas pedal in pervious cement mix. The examination was attempted by leading various standard solid tests and looking at the attributes of the great strength pervious concrete and traditional solid examples. The tests incorporate compressive strength test, split elasticity test to decide its properties. Shapes and chambers are the examples utilized for the tests and they are readied utilizing fitting blend extents. The decision of choosing appropriate blend extents of pervious solid lead to ideal outcomes. This paper additionally

assesses the reasonableness of pervious cement for different applications like structures, spans and so forth.

S. Koushik et al (2017), “Pervious Concrete Pavement” Volume 8, Issue 4, April 2017.

Water arrives at earth as precipitation. The utilization of asphalt materials like Bitumen, Black-top solid seals the dirt surface which limits the downpour water from penetration and characteristic ground re-energize. The development of impenetrable asphalts starts a chain of occasions which brings about change in metropolitan climate accordingly causing an irregularity in environment. Pervious solid which is alluded as improving permeable solid hole evaluated concrete or no fine concrete is a stage advances limiting metropolitan flooding. The pervious solid blend is readied utilizing totals adjusting to IS-383, concrete, polyvinyl liquor (PVA) and silica smoke, and zeolite as admixture.

Zeolite, silica exhaust is utilized for supplanting concrete in different rates. The concrete glue ties the totals leaving voids, these voids make it workable for downpour water to empty out of asphalt surface. As the water streams down to underground surface re-energizes the groundwater for feasible turn of events. In this task the boundaries like compressive strength, flexural strength, waste states of different blend extents of pervious asphalt layer will be contemplated.

Avinash Patel K et al, (2017) “Study On Porous Concrete With Coarse Aggregate And Fine Aggregate Mix Proportions” Vol. 6 Issue 05, May – 2017.

Permeable cement otherwise called hole evaluated concrete is an extraordinary kind of cement acquired by the combination of Portland concrete, uniform coarse total with or without fine total and water. Permeable cement has an interconnected pore structure that permits unreservedly the section of water to course through. The utilization of Permeable Solid will decrease the requirement for enormous confinement lakes, skimmers, siphons, waste lines and other stormwater the executives frameworks, costly water system frameworks can be scaled down or even dispensed with. Permeable Cement is a strong material; stopping regions appropriately planned and built will last 20-40 years with next to zero support.

SumitLakhmanil et al, , “Study Of Pervious Concrete” Volume: 04 Issue: 06 June -2017.

Pervious cement is an uncommon kind of cement with high porosity utilized for level work application fundamentally that is permit water from precipitation and different sources to go straightforwardly through subsequently diminishing the overflow from the site and permitting groundwater re-energize. Furthermore, in this solid porosity is accomplish by an exceptionally interconnected void substance. Likewise in penetrable or pervious cement has no fine total and has barely enough solidifying glue to coarse total particles while saving the interconnectivity of the voids.porous or pervious cement is generally utilized in stopping zone with traffic, walkways in park and nursery private, green house, ball court, volleyball court.

Principle objective of pervious cement are to help reestablish groundwater supply, Reduce contamination of beach front water, to clear stopping, Recharge ground water table. Diminishes spillover water, Reduces hazard of flooding and dirt wash away.

Hemalatha ,Keerthana et al (2018) , “Study Of Pervious Cement By Utilizing Savvy Materials" Volume: 05 Issue: 01 | Jan-2018.

The investigation center is around the strength examination eco-accommodating pervious cement by substitution of financially savvy materials in pervious cement. The compelling usage of waste reused materials like fly debris, steel slag, elastic chips and silica smoke will by implication lessen climate contamination. The swap for concrete was finished by 8% to 25% of fly debris and silica smolder and for coarse total by 2% to 30% of steel slag and elastic chips.

Utilizing the chose totals the strength of pervious cement is improved monetarily. Fly debris is utilized to build the strength of the solid.

B.V.R.Murthy et al, (2018) “Study On Strength Improvement Of Pervious Concrete” Volume 7, Issue 3 Ver. 4, March 2018.

Pervious Cement Is A Solid Containing Practically zero Fine Total Gives Direct Waste Of Water, Assists with re-energizing Groundwater In Asphalt Applications. The Goal Of This Work Is To Improve Compressive Strength At Which The Strength Accomplishes Better Penetrability. The Plan Blend Is Ready For M25 Comprising Of 53 Evaluation Concrete, Two Unique Sizes Of

Coarse Total Which Are Going Through 25 mm I.S Sifter Size And Held On 16mm I.S Strainer Size As S1 And Totals Going Through 10 Mm And Held On 6mm Named As S2 Were Taken For This Work Waterway Sand And Robo Sand Were Chosen As Fine Total And W/C Proportion Kept up As 0.35 Altogether The Cases.

The Plan Blend Is Created In with Consistent Level Of Coarse Total And Adjusting The Extents Of Coarse Total With Concurrent Expansion Of Rates Of Waterway Sand And Robo Sand In The Solid. From The Trial Results It Is Tracked down That The Compressive Strength And Penetrability Is Acceptable At Adding Of 5% Robo Sand As A Fine Total And Blend Of 80% S1 And 20% S2 As Coarse Total In The Pervious Cement.

2.3 LEASSOS LEARNED

➤ Evaluation of an aged pervious concrete pavement it was closed as ill-advised arrangement and relieving prompted lopsided asphalt thickness, unpredictable pore appropriation inside the pervious cement, and profoundly factor strength esteems across the site, just as fixed surfaces that forestalled penetration.

➤ Pavement innovation makes more productive land use by killing the requirement for maintenance lakes, swell, and other exorbitant tempest water the board gadgets, costly water system frameworks can be scaled back or even wiped out.

- The effect of paste density on properties of pervious concrete increases by addition and fractional supplanting of concrete with Fly debris and Metakaolin can be a financial other option. Furthermore, the concrete is halfway supplanted with Fly debris and METAKAOLIN by 10%, 20% up to 30%.
- Inrequest to improve the strength attributes of pervious cement by utilizing extraordinary fluid kind of water lessening admixture in mix with gas pedal in pervious solid blend.
- Polyvinyl alcohol (PVA) & silica fume, zeolite is utilized for supplanting concrete in different rates. The concrete glue ties the totals leaving voids, these voids make it feasible for downpour water to empty out of asphalt surface.
- Pervious concrete is a solid with high porosity utilized for level work application essentially that is permitwater from precipitation and various sources to go clearly through in like manner decreasing the overflow from the site and allowing groundwater re-invigorate.
- The strength correlation eco-accommodating pervious cement is finished by substitution of savvy materials in pervious cement. The powerful use of waste reused materials like fly debris, steel slag, elastic chips and silica smoke will by implication lessen climate contamination.

- The Compressive Strength and Penetrability Is good by adding Of 5% Robo Sand as a Fine Total And Blend Of 80% S1 And 20% S2 As Coarse Total In The Pervious Cement.

- The adequacy of a pervious strong black-top depends as the inalienable vulnerability of the mass, and conventionally this is described by the porosity. It has been seen that porosity alone is a lacking pointer of the permeability of pervious concretes, since the vulnerability depends upon pore sizes, math and accessibility as well.

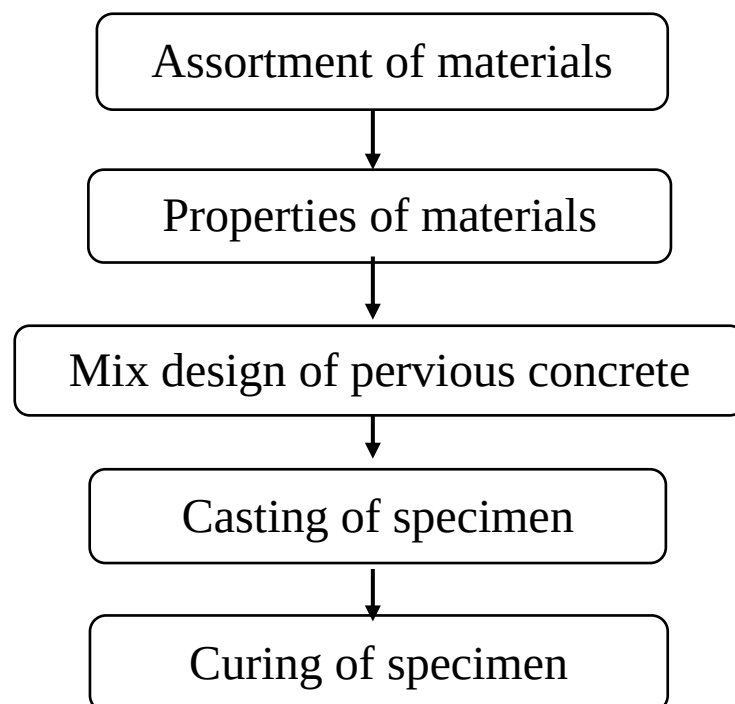
CHAPTER 3

MATERIALS AND METHODOLOGY

3.1 GENERAL

The Methodology is shown in the flowchart and the materials used are explained.

3.2 METHODOLOGY



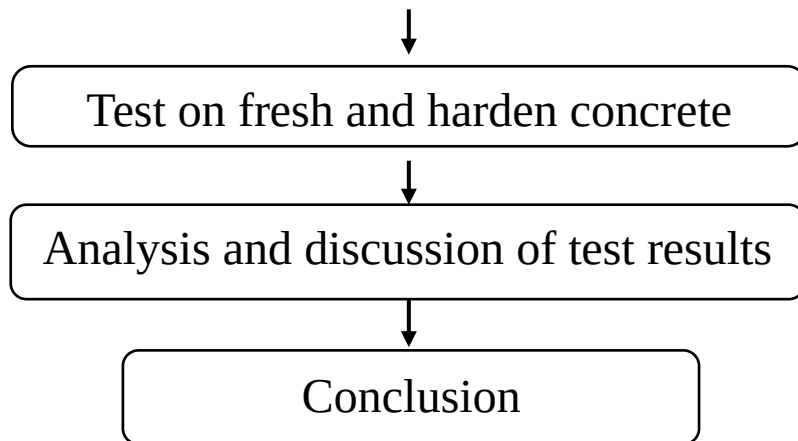


Fig 3.1 Refers to methodology

3.2.1 EXPLANATION OF METHODOLOGY

Collection of materials

The material collection is a collection of materials that are required for targeted concrete mix. It involves in the collection of materials such as cement, coarse aggregates, admixtures, from various sources.

Properties of materials

Materials deals with the various properties of both physical and chemical properties that target in achieving the desired concrete properties.

Mix design for M20 grade concrete

For M20 grade mix design of pervious or no fine concrete is designed using IRC:442017.

Casting of specimen

Casting of specimens is the process of proportioning, mixing and batching of the materials based on its quantity based on proportion of cement, coarse aggregate, admixtures and required volume of water.

Curing of specimen

Concrete curing is basic steps to be followed to protect the loss of moisture for hydration, a curing helps to cool down the concrete which emits large amount of heat in the form of hydration to achieve its ultimate strength.

Testing of fresh and hardened concrete

Fresh and hardened concrete test deals with the experimental on concrete specimen to check its workability, strength, durability etc.

Analysis and discussion of test results

The results obtained from the various test conducted are analyzed and discussed.

3.3 MATERIALS

Materials play an important role in concrete. The properties of various materials are used below.

MATERIALS USED

- CEMENT - Ordinary Portland cement (53 grade)
- COARSE AGGREGATE - 8 to 12mm (angular)
- MINERAL ADMIXTURE - Metakaolin
- CHEMICAL ADMIXTURE - super plasticisers (conplast SP430)
- FIBER - Polypropylene fiber.

3.3.1 CEMENT

Concrete works which well submerged, solidifies rapidly and achieve strength. Concrete contrasts from lime by the property that it doesn't slake however sets slake yet set promptly and gains more strength on setting. The setting force of concrete is more than that is comparable in numerous regards to great quality water driven lime.

The setting and hardening of cement paste is mainly due to hydration and hydrolysis of these compounds.



Fig 3.2 Refers to cement

3.3.2 AGGREGATE

Aggregate should be relatively free of flat and elongated particle smooth and rounded aggregate requires of less of cement paste to flowing concrete

3.3.3 COARSE AGGREGATE

Aggregate is an inert material used for manufacture of mortars and concrete. Good aggregate for construction should be strong enough to bear the strength. Natural aggregate are sand, gravel, rock. According to size, shape and unit its differs, aggregate which pass through 4.75mm sieve are fine aggregate and which does not are coarse aggregate.

Fig 3.3 Refers to coarse aggregate



3.3.4 WATER

Water plays a most important role in construction. Water used curing, mixing, batching, without water concrete can't able to attain its strength. The water is required for course of action of mortar, mixing of solid concrete and for reestablishing work, etc during improvement work. The

quality and measure of water shows the effects in concrete, in concrete water level increases or decreases its losses its strength. Though correct amount of water needed to be maintained in concrete. Formation of honey comb and efflorescence depends on quality of water. PH value of water should be maintained for quality.

3.3.5 MINERAL ADMIXTURES

METAKAOLIN

PROPERTIES OF MINERAL ADMIXTURES

MINERAL ADMIXTURES	METAKAOLIN
SPECIFIC GRAVITY	2.64

TABLE 3.1 Refers to mineral admixtures



Fig 3.4 Refers to mineral admixture

3.3.6 CHEMICAL ADMIXTURE

CONPLAST SP430

Conplast SP430 is a chloride free, superplasticising admixture dependent on chose sulphonatednaphthalene polymers. It is an earthy colored arrangement which quickly scatters in water.

USES

- To give brilliant speed increase of solidarity acquire at early ages and significant expansions in strength at all ages by altogether decreasing water interest in a solid blend.
- Especially reasonable for precast concrete and other high early strength necessities.
- To altogether improve the usefulness of site mixed and precast concrete without extending water interest.
- To give improved solidness by expanding extreme qualities and diminishing solid penetrability.

ADVANTAGES

- Major expansions in strength at early ages without expanded concrete substance are of specific advantage in precast cement, permitting prior stripping times.
- Makes conceivable significant decreases in water: concrete proportion which permit the creation of high strength concrete without exorbitant concrete substance.

- Utilize in progress of streaming strong awards less difficult improvement with quicker setting and compaction and diminished work costs without growing water content.
- Increased functionality levels are kept up for more than with standard sulphonated melamine admixtures.
- Improved union and molecule scattering limits isolation and draining and improves pumpability.
- Chloride free, ok for use in prestressed and built up concrete.

PROPERTIES OF CHEMICAL ADMIXTURES

CHEMICAL ADMIXTURES	SUPER PLASTICISERS (CONPLAST SP430)
SPECIFIC GRAVITY	1.20
DOSAGE LIMIT	0.5% to 2%
CHLORIDE CONTENT	0.2%

TABLE 3.2 Refers to chemical admixtures



Fig 3.5 Refers to Chemical admixture

3.3.7 POLYPROPYLENE CONSTRUCTION FIBER

Polypropylene fiber capacity of solid construction to oppose enduring activity, compound assault, scraped area and other corruption measures during its existence with least support. Albeit concrete have more benefit with respect to. Polypropylene fiber decreases the plastic shrinkage break zone because of their adaptability and capacity to shape. The expansion of 0.1% by volume of fiber is discovered viable in diminishing degree of breaking by factor 5-10. The degree break decrease is relative to fiber content in concrete.

PROPERTIES OF POLYPROPYLENE FIBER

FIBER TYPE	POLYPROPYLENE
------------	---------------

LENGTH mm	12
THICKNESS DIAMETER	7.5 μm
ASPECT RATIO	1600
SPECIFIC GRAVITY	0.90

TABLE 3.3 Refers to properties of polypropylene fiber



Fig 3.6 Refers to polypropylene fiber

CHAPTER 4

EXPERIMENTAL ANALYSIS

4.1 GENERAL

This chapter deals with the mix design, casting, curing, test on fresh and hardened concrete, and analysis of test results.

4.2 TEST ON MATERIALS

4.2.1 TESTING FOR CEMENT

1. FINENESS TEST

The fineness of cement shows the rate of hydration. Fineness of cement gives quick setting and great strength. For every brand cement fineness differs. Particle size should have a maximum size less than about 100micron. The size of the particle size below 3micron found to have affect 28days strength, increases in fineness of cement causes shrinkage in concrete. In commercial concrete fineness of cement should be minimum 7%. Fineness of concrete is tried twoly.

- 1) By sieve
- 2) By air porosity strategy

FINENESS OF CEMENT:

Weight of cement taken = 100gms

Weight of cement retained = 1.5 gms

Percentage of cement retain = $\frac{\text{weight of cement retained}}{\text{total weight of cement}} \times 100$

$$\frac{1.5}{100} \times 100 = 1.5 \%$$

2. STANDARD CONSISTENCY TEST

The standard consistency of concrete is tried utilizing Vicat apparatus, which grants the vicat unclogger to pass to a guide 5 toward 7 mm from the lower part of the vicat form when tried. Methodology to decide the amount of water needed to create a concrete paste of standard consistency. The outside of the stick was leveled on the most elevated place of the shape with a scoop. As of now unclogger was made to contact the outside of the paste and a short time later it was allowed to fall under its own weight.

When plunger needle touches the top of cement in mould, from that depth was noted. If it was from 33- 37mm from the top water percentage was correctly added. In case not means procedure will be followed with different consistency. CONSISTENCY OF CEMENT IS : 32%.

3. SETTING TIME TEST

Setting time of the cement shows the consistency and strength of cement. Setting time has initial and final setting time. Initial setting time has to be 30mins which shows cement has good proportion in raw material. Final setting time should be 10hrs. setting time delay the processes of hydration or hardening. For final setting time completely losses its plasticity.

➤ INITIAL SETTING TIME

When cement is mixed with water, from the moment cement starts to set slowly. So the time period where cement start to lose its plasticity and making it hard. The shape and the non-penetrable plate are washed, cleaned and dried. 400gm of concrete taken plate. The expected of water taken was 0.85 events of water required for standard consistency which was then added to dry cement, and mixed by and large to shape stick. The mixing was done inside 3-5 minutes from the depiction of adding water. At the case of adding water to the solid, the time taken was noted by using stop watch.

The vicat shape was set on plate and was loaded up with the readied concrete glue and the outside of glue in level with the form by utilizing a scoop. By shaking the shape air particles gets eliminated. Needle was gradually goes down to contact the outside of the concrete glue were the perusing are noted. Needle immediately delivered it enter into the glue. Were needle quits, perusing are noted. The strategy of delivering the needle

was rehashed at each 30sec, until the perusing of the record scale shows $5 \pm .5\text{mm}$ from lower part of the form. The time was noted down. The time that passed between the second when water previously added to the concrete and the second at which the needle of 1mm 2 areas neglected to penetrate the test block at $5 \pm .5\text{mm}$ from lower part of the form was the underlying setting season of concrete.

➤ FINALSETTING TIME

The needle was delivered rapidly permitting it to infiltrate into the glue. At the point when the needle stops, the perusing on the record deal was noted. The strategy of delivering the needle was rehashed at like clockwork until the perusing on the record scale shows $5 \pm .5\text{mm}$ from the lower part of the form. The delivering the needle was proceeded at each 2min till the needle establishes on connection with the test block.

TABLE4.1 SETTING TIME:

TIME (MIN)	INITIAL SETTING TIME	FINAL SETTING TIME
9	82	420



Fig 4.1 Refers to setting time test

4. SPECIFIC GRAVITY OF CEMENT

- 100gm of concrete is gauged.
- 990ml of lamp fuel is filled in a particular gravity bottle.
- The concrete sample is set in a particular gravity bottle till the level of the lamp fuel arrives at 100ml imprint.
- The amount of concrete bound in the jug is determined. At that point the particular gravity of concrete is discovered by utilizing by following response.
- Specific gravity of concrete = weight of concrete load of lamp oil of equivalent volume of concrete.

SPECIFIC GRAVITY OF CEMENT:-

Empty weight of specific gravity bottle

$$W_1 = 49\text{gms}$$

Weight of specific gravity bottle and water	$W_2 = 149\text{gms}$
Weight of specific gravity bottle and kerosene	$W_3 = 129.9\text{gms}$
Weight of specific gravity bottle and kerosene and cement	$W_4 = 167\text{gms}$
Weight of cement taken	$W_5 = 50\text{gms}$

$$\text{Specific gravity of cement} = \left(\frac{W_5(W_3 - W_1)}{[W_5 + W_3 - W_4][W_2 - W_1]} \right)$$

$$= \left[\frac{50(129.9 - 49)}{(50 + 129.9 - 16) \times (149 - 49)} \right]$$

$$= 3.135.$$

Fig 4.2 Refers to specific gravity test



TABLE 4.2 Refers to test on cements

TEST ON CEMENTS	TEST RESULTS	LIMITS (IS 269-2015 CODES)
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SPECIFIC GRAVITY TEST	3.135	-
FINENESS TEST (Blaine's Air permeability)	325 Sq.m/kg	225 Sq.m/kg
CONSISTENCY	32%	-
INITIAL SETTING TIME	82 min	Minimum 30 min
FINAL SETTING TIME	420 min	Maximum 600 min
COMPRESSIVE STRENGTH	56.85 MPa	Minimum 53 MPa
SOUNDNESS	2 mm	Maximum 10 mm

4.2.2 TEST FOR COARSE AGGREGATE

1. SPECIFIC GRAVITY TEST FOR AGGREGATE

Indian standard detail IS 2386(PART III) of 1963 gives different techniques to discover the particular gravity of various size of totals. An example of totals under 2kg is taken. It is altogether washed to eliminate the better molecule and residue sticking to the totals.

It is then positioned in a wire box and water temperature are kept up. They are kept in water for a time of 24 hours. At that point its was completely weighted in water, at that point it was completely taken out from the containerwhat's more, put on dry surface to dried. The full scale is moved second dry surface and further dried. The unfilled bushel again absorbed water, staggered on different events and weighted in water. By then the

accumulated is weighted in air. By then complete is kept in the barbecue at the temperatures of 100 to 1000c and kept up at this temperature for 24hours.

SPECIFIC GRAVITY OF COARSE AGGREGATE

Weight of empty bottle	$W_1 = 0.52 \text{ kg}$
Weight of bottle + coarse aggregate	$W_2 = 1.702 \text{ kg}$
Weight of bottle + coarse aggregate+ water	$W_3 = 2.250 \text{ kg}$
Weight of bottle + water	$W_4 = 1.517 \text{ kg}$
Specific gravity of coarse aggregate	$= \left(\frac{(W_2 - W_1)}{(W_4 - W_1) - (W_3 - W_2)} \right)$ $= \frac{(1.702 - 0.52)}{(1.517 - 0.52) - (2.250 - 1.702)}$ $= 2.632.$

Fig 4.3 Refers to specific gravity test for coarse aggregate



2. WATER ABSORPTION

This test to know the water maintenance of coarse sums as indicated by IS: 2386 (Part III) – 1963. Test in any event 2000g should be used Strategy to pick water support of Totals. i) The model all around washed to clear out better particles and dust, depleted and from there on arranged in the wire bushel and inundated in refined water at a temperature some spot in the extent of 22 and 32 C. ii) After splashing, the air ought to be taken out by lifting the holder and permitting it to drop on various events in 25 seconds. It was totally stay lowered in water for a time of 24 + ½ hrs starting there. iii) The bushel and wholes should then be shed from the water, permitted to debilitate a couple of moments, clamminess. The totals ought to be spread on the following surface and acquainted with the air away from direct light till it has all of the stores of being totally surface-dry. The totals ought to be estimated (Weight 'A'). iv) The totals should then be set in a broiler at a temperature of 100 to 110 C for 24hrs. It should then be taken out from the barbecue, cooled and estimated (Weight 'B'). Condition utilized is Water support = $[(A - B)/B] \times 100\%$. Two such tests ought to be done and the individual and mean outcomes ought to be addressed.

$$A=2022 \text{ g}$$

$$B= 2000 \text{ g}$$

$$\text{Water absorption} = [(A - B)/B] \times 100\%.$$

$$= [(2022-2000)/2000] \times 1000$$

$$\text{WATER ABSORPTION} = 1.1.$$

BULK DENSITY OF COARSE AGGREGATES

Mass thickness of sums is the mass of sums expected to fill the compartment of a unit volume after aggregates are bundled subject to volume. It depends upon the squeezing of all out for instance, Either estimatedly squeezed sums or on the other hand well thick compacted entireties. On the off chance that, tolerating the particular gravity of material is known, it relies on the shape and size of particles. It is considering the way that, if the entirety of the particles are of same size than crushing should be possible up to an exceptionally restricted degree. On the off chance that the expansion of additional unassuming particles is conceivable inside the voids of more prominent particles than these more modest particles improve the mass thickness of the stuffed material. State of the particles in like way influence thoroughly, in light of the fact that closeness particles relies on the state of totals. Expecting an affirmation resembles: A coarse totals with higher mass thickness, it induces moderately not many of the voids can be filled by utilizing fine entireties and concrete. For testing, English Norm (BS 812) has shown the level of compaction. These are;

(i) Take the substantialness of void measure (W) (ii) Fill the activity with sums test for around 33% height and cap similarly with 25 strokes of the changed completion of the pressing shaft (iii) Add an equivalent measure of absolute as second layer and pack it consistently with 25 strokes. (iv) Fill the activity with a third layer of total up to over after and load it with 25 strokes. (v) Strike off the flood all out using the pressing post as a

straight edge. (vi) Take the weight (w1). (vii) Void the activity and fill it again to over spilling through a burrowing apparatus, the all out being delivered from a height not outperforming 5 cm over the most elevated place of the activity.

BULK DENSITY OF COARSE AGGREGATES

Volume of container = 3 liters

Container weight = 3.56 kg

Roded bulk density = 4.84 kg

Loose bulk density = 4.16 kg

Density of roded aggregate $\frac{4.84}{3} = 1.613 \text{ kg/lit}$

Density of loose aggregate $\frac{4.16}{3} = 1.386 \text{ kg/lit}$

Density of the aggregate = $1968 \approx 2000$.



Fig 4.4 Refers to bulk density test

TEST ON COARSE AGGREGATE	TEST RESULTS	LIMITS
SPECIFIC GRAVITY TEST	2.632	-
WATER ABSORPTION TEST	1.1	2%
BULK DENSITY TEST	2000	-

TABLE 4.3 Refers to test on coarse aggregate

4.3 MIX DESIGN

The route toward picking suitable properties of concrete and choosing their general entireties with the objective of making a strong material, strength, robustness. The proportioning of component of concrete is addressed by the important introduction of concrete in 2 states, specifically the plastic and the cemented states. If the plastic concrete isn't helpful, it can't be true to form put and compacted. The property of convenience, in this way, is the destiny of essential importance.

The control solid combination was included portland concrete, water, coarse total and fine total Concrete mix setup is described as the legitimate assurance and proportioning of constituents to convey a strong with pre-portrayed qualities in the new and solidified states. As a rule, concrete blends are planned to accomplish a characterized functionality, strength and toughness.

The selection and proportioning of materials depend on:

- The structural requirements of the concrete
- The environment to which the structure will be exposed
- Production, transport, placement, compaction and finishing
- The characteristics of the available raw materials

The solid blend has been planned according to IS 10262 - 2009. The predetermined solid evaluation includes the practical determination of relative extents of concrete, fine total, coarse total and water. In spite of the fact that consistence regarding 'trademark strength' is the fundamental rules for acknowledgment, it is verifiable that solid should likewise have wanted

functionality in the new state and impermeability and sturdiness in solidified state.

4.3.1 INDIAN STANDARD CONCRETE MIX PROPORTIONING FOR PERVIOUS CONCRETE

For design of pervious concrete IS 12727 (1989) NO-FINE IN SITU CEMENT CONCRETE-CODE method is used.

Calculation

Grade for proportioning	:	M20
Type of Cement	:	OPC 53 grade confirming to IS 12269
Nominal size of aggregate	:	10 mm
Minimum Cement content	:	350 kg/m ³
Cement aggregate ratio	:	1:3
Maximum water cement Ratio	:	0.30
Workability	:	210 mm (slump)
Exposure condition	:	Severe
Method of concrete placing	:	Pumping
Degree of supervision	:	Good
Type of aggregate	:	angular aggregate
Maximum Cement content	:	350 kg/m ³

DATA FOR MATERIALS

Cement used	=	OPC 53 grade confirming to IS 8112
Specific gravity of cement	=	3.15
Specific gravity of		
Coarse aggregate	=	2.632
Water absorption of		
Coarse aggregate	=	0.89
Free moisture of		
Coarse aggregate	=	Nil
Cement aggregate ratio	=	1:3

MIX CALCULATIONS

Volume of cube	=	3.375×10^{-3}
Volume of beam	=	15.75×10^{-3}
Volume of concrete	=	bulk density $\times$ volume of cube
For cube		
	=	$2000 \times 3.375 \times 10^{-3} = 6.75 \text{ kg}$
Volume of concrete	=	bulk density $\times$ volume of cube
For beam		
	=	$2000 \times 15.75 \times 10^{-3} = 6.75 \text{ kg}$
$\frac{6.75}{4}$	=	1.687
Cement content	=	$1.687 \times 1 = 1.687$
Cement	=	$1.687 \times 1.2 = 2.0 \text{ kg}$
Water content	=	$2.0 \times 0.30 = 0.6 \text{ lit}$
Aggregate	=	$1.687 \times 3 = 5.06 \text{ kg}$

MIX PROPORTION

Cement = 350 kg/m^3

(Cement aggregate

Ratio) = 1:3

Cement = 1

Water cement ratio = 0.30

(For one cube)

Cement = 2.0 kg

Water = 0.6 lit

Coarse aggregate = 5.06 kg

COMPONENTS	RATIO
CEMENT	1
CEMENT-AGGREGATE RATIO	1:3
WATER-CEMENT RATIO	0.30

TABLE 4.4 Refers to mix proportion for pervious concrete

MIX DESIGN FOR PARTIAL REPLACEMENT OF METAKAOLIN IN CEMENT WITH ADDITIONAL 0.5% OF POLYPROPYLENE FIBER

For design of pervious concrete IS code method is used.

Calculation

Grade for proportioning	:	M20
Type of Cement	:	OPC 53 grade confirming to IS 12269
Type of mineral admixture	:	Ground granulated blast-furnace slag
Nominal size of aggregate	:	10 mm
Minimum Cement content	:	350 kg/m ³
Cement aggregate ratio	:	1:2.5
Maximum water cement Ratio	:	0.30
Workability	:	210 mm (slump)
Exposure condition	:	Severe
Method of concrete placing	:	Pumping
Degree of supervision	:	Good
Type of aggregate	:	angular aggregate
Maximum Cement content	:	350 kg/m ³

DATA FOR MATERIALS

Cement used	=	OPC 53 grade confirming to IS 8112
Specific gravity of cement	=	3.15
Admixtures used	=	ground granulated blast-furnace slag
Specific gravity of METAKAOLIN	=	2.45

Specific gravity of		
Coarse aggregate	=	2.632
Water absorption of		
coarse aggregate	=	0.89
Free moisture of		
coarse aggregate	=	Nil
cement aggregate ratio	=	1:2.5

MIX CALCULATIONS

$$\text{volume of cube} = 3.375 \times 10^{-3}$$

$$\text{Volume of beam} = 15.75 \times 10^{-3}$$

$$\text{Volume of concrete} = \text{bulk density} \times \text{volume of cube}$$

For cube

$$= 2000 \times 3.375 \times 10^{-3} = 6.75 \text{ kg}$$

$$\text{Volume of concrete} = \text{bulk density} \times \text{volume of cube}$$

For beam

$$= 2000 \times 15.75 \times 10^{-3} = 6.75 \text{ kg}$$

$$\frac{6.75}{3.5} = 1.928$$

$$\text{Cement content} = 1.928 \times 1 = 1.928$$

$$\text{Cement 50\%} = 0.964 \times 1.2 = 1.156 \text{ kg}$$

$$\text{METAKAOLIN 50\%} = 0.964 \times 1.2 = 1.156 \text{ kg}$$

$$\text{Water content} = 2.0 \times 0.30 = 0.6 \text{ lit}$$

$$\text{Aggregate} = 1.928 \times 2.5 = 4.82 \text{ kg}$$

MIX PROPORTION

Cement = 350 kg/m^3
 (Cement aggregate
 Ratio) = 1:2.5
 Cement = 50%
 METAKAOLIN = 50%
 Water cement ratio = 0.30
 (For one cube)
 Cement = 1.15 kg
 METAKAOLIN = 1.15 kg
 Water = 0.6 lit
 Coarse aggregate = 4.82 kg
 Polypropylene = 0.5%

COMPONENTS	RATIO
CEMENT	50%
CEMENT-AGGREGATE RATIO	1:2.5
WATER-CEMENT RATIO	0.30
METAKAOLIN	50%
POLYPROPYLENE FIBER	0.5%

TABBLE 4.5 Refers to mix design for partial replacement of metakaolin in cement

MIX DESIGN USING IRC:44-2017 (GUIDELINES FOR CEMENT
CONCRETE MIX DESIGN FOR PAVEMENTS)
(FOR M20 GRADE WITH A PERCOLATION RATE OF 350mm/min)

Grade for proportioning : M20
Type of Cement : OPC 53 grade confirming to IS:269
Maximum Nominal size of
Aggregate: 10 mm (9.5mm)
Minimum percolation rate : 350mm/min
Maximum water cement
Ratio : 0.38
Type of aggregate : angular aggregate

TEST DATA FOR MATERIALS

Cement used = OPC 53 grade confirming to IS:269
Specific gravity
1. cement = 3.15
2. coarse aggregate = 2.70
Water absorption of Coarse
Aggregate = 0.5%
Free moisture of

Coarse aggregate	=	Nil (Absorbed moisture also nil)
Fine aggregate	=	confirming to grading zone II as per IS:383

TARGETED STRENGTH FOR MIX PROPORTION

$$f_{lck} = f_{ck} + 1.65s$$

Where,

f_{lck} = Target average strength of compressive strength at 28 days.

f_{ck} = Characteristic compressive strength at 28 days.

s = Standard deviation

From table 18, of IRC44: 2017, Standard deviation,

$$s = 2.5 \text{ N/mm}^2$$

$$\text{Targeted strength, } f_{lck} = 20 + 1.65 \times 2.5 = 14.13 \text{ N/mm}^2$$

SELECTION OF WATER-CEMENT RATIO

The regular water concrete proportion v/s compressive strength relationship for typical cement doesn't make a difference to pervious cement.

Let us take water cement ratio = 0.38 for first trial.

VOID CONTENT

From table 19, void content = 25% for percolation rate of 350 mm/min

From table 20, void content = 23% for compressive strength of 14.13 N/mm²

Let us take an average value of 24% to satisfy the requirement of percolation rate and compressive strength.

PASTE VOLUME (V_p), CEMENT CONTENT (C) AND WATER CONTENT (W)

From table 21, paste volume= 11% for 24% voids content for well compacted pervious concrete.

Paste volume= 18% for 24% voids content for lightly compacted pervious concrete.

Paste volume, V_p = cement volume + water volume

$$V_p = (c/3.15 \times 1000 \text{ kg/m}^3) + w/1000 \text{ kg/m}^3$$

Substituting $w = (w/cm) c$,

$$V_p = c/(3.15 \times 1000 \text{ kg/m}^3) + [(w/cm) c/1000] \text{ kg/m}^3$$

$$c = [(V_p / (0.315 + w/cm))] \times 1000 \text{ kg/m}^3$$

1. For well compacted pervious concrete,

$$c = [0.11 / (0.35 + 0.38)] \times 1000 \text{ kg/m}^3 = 158 \text{ kg/m}^3$$

For lightly compacted pervious concrete, $w = (w/cm)$

$$c = (0.38 \times 158) \text{ kg/m}^3 = 60 \text{ kg/m}^3$$

2. For lightly compacted pervious concrete,

$$c = [0.18 / (0.315 + 0.38)] \times 1000 \text{ kg/m}^3 = 258.9 \text{ kg/m}^3$$

$$w = (w/cm)c = (0.38 \times 258.9) \text{ kg/m}^3 = 128.4 \text{ kg/m}^3$$

CALCULATION OF COARSE AGGREGATE PROPERTION

For well compacted pervious concrete

$$\text{Volume of concrete} = 1 \text{ m}^3$$

$$\text{Void content} = 24\%$$

$$\text{Paste volume} = 11\%$$

$$\text{Volume of aggregate} = 1 - (0.24 + 0.11) = 0.65 \text{ m}^3$$

$$\begin{aligned} \text{Mass of coarse aggregate} &= d \times \text{volume of coarse aggregate} \times \text{Specific} \\ &\quad \text{Gravity of coarse aggregate} \times 1000 \\ &= 0.65 \times 2.70 \times 1000 \\ &= 1755 \text{ kg/m}^3 \end{aligned}$$

For lightly compacted pervious concrete

$$\text{Volume of concrete} = 1 \text{ m}^3$$

$$\text{Void content} = 24\%$$

$$\text{Paste volume} = 18\%$$

$$\text{Volume of aggregate} = 1 - (0.24 + 0.18) = 0.58 \text{ m}^3$$

$$\begin{aligned} \text{Mass of coarse aggregate} &= d \times \text{volume of coarse aggregate} \times \text{Specific} \\ &\quad \text{Gravity of coarse aggregate} \times 1000 \\ &= 0.58 \times 2.70 \times 1000 \\ &= 1566 \text{ kg/m}^3 \end{aligned}$$

MIX PROPORTIONS BASED ON AGGREGATE IN SSD CONDITION

For well compacted pervious concrete

$$\text{Cement} = 158 \text{ kg/m}^3$$

$$\text{Water} = 60 \text{ kg/m}^3$$

$$\text{Coarse Aggregate} = 1755 \text{ kg/m}^3$$

$$\text{Water cement ratio} = 0.38$$

For lightly compacted pervious concrete

$$\text{Cement} = 258.9 \text{ kg/m}^3$$

Water = 98.4 kg/m³
Coarse aggregate = 1566 kg/m³
Water-cement ratio = 0.38

MIX DESIGN USING IRC:44-2017 (GUIDELINES FOR CEMENT
CONCRETE MIX DESIGN FOR PAVEMENTS)
(FOR M20 GRADE WITH A PERCOLATION RATE OF 150mm/min)

Grade for proportioning : M20
Type of Cement : OPC 53 grade confirming to IS:269
Type of mineral admixture : METAKAOLIN
Maximum Nominal size of
Aggregate: 10 mm (9.5mm)
Minimum percolation rate : 150mm/min
Maximum water cement
Ratio : 0.38
Type of aggregate : angular aggregate

TEST DATA FOR MATERIALS

Cement used = OPC 53 grade confirming to IS:269

Specific gravity

3. cement = 3.15

4. coarse aggregate = 2.70

Water absorption of Coarse

Aggregate = 0.5%

Admixtures used = METAKAOLIN

Specific gravity of METAKAOLIN = 2.45

Free moisture of

Coarse aggregate = Nil (Absorbed moisture also nill)

Fine aggregate = confirming to grading zone II as per
IS:383

TARGETED STRENGTH FOR MIX PROPORTION

$$f_{lck} = f_{ck} + 1.65s$$

Where,

f_{lck} = Target average strength of compressive strength at 28 days.

f_{ck} = Characteristic compressive strength at 28 days.

s = Standard deviation

From table 18, of IRC44: 2017, Standard deviation,

$$s = 2.5 \text{ N/m}^2$$

$$\text{Targeted strength, } f_{lck} = 20 + 1.65 \times 2.5 = 24.12 \text{ N/m}^2$$

SELECTION OF WATER-CEMENT RATIO

The regular water concrete proportion v/s compressive strength relationship for typical cement doesn't make a difference to pervious cement.

Let us take water cement ratio = 0.38 for first trial.

VOID CONTENT

From table 19, void content = 20% for percolation rate of 150 mm/min

From table 20, void content = 15% for compressive strength of 24.12 N/mm²

Let us take an average value of 17.5% to satisfy the requirement of percolation rate and compressive strength.

PASTE VOLUME (V_p), CEMENT CONTENT (C) AND WATER CONTENT (W)

From table 21, paste volume= 16.5% for 17.5% voids content for well compacted pervious concrete.

Paste volume= 23.5% for 17.5% voids content for lightly compacted pervious concrete.

Paste volume, $V_p = \text{cement volume} + \text{water volume}$

$$V_p = (c/3.15 \times 1000 \text{ kg/m}^3) + w/1000 \text{ kg/m}^3$$

Substituting $w = (w/cm) c$,

$$V_p = c/(3.15 \times 1000 \text{ kg/m}^3) + [(w/cm)c/1000] \text{ kg/m}^3$$

$$c = [V_p/(0.315 + w/cm)] \times 1000 \text{ kg/m}^3$$

3. For well compacted pervious concrete,

$$c = [0.165/(0.315 + 0.38)] \times 1000 \text{ kg/m}^3 = 237.4 \text{ kg/m}^3$$

$$w = (w/cm)c = (0.38 \times 237.4) \text{ kg/m}^3 = 90.21 \text{ kg/m}^3$$

4. For lightly compacted pervious concrete,

$$c = [0.235/(0.315 + 0.38)] \times 1000 \text{ kg/m}^3 = 338.1 \text{ kg/m}^3$$

$$w = (w/cm)c = (0.38 \times 338.1) \text{ kg/m}^3 = 128.4 \text{ kg/m}^3$$

CALCULATION OF COARSE AGGREGATE PROPERTION

For well compacted pervious concrete

$$\text{Volume of concrete} = 1 \text{ m}^3$$

$$\text{Void content} = 17.5\%$$

$$\text{Paste volume} = 16.5\%$$

$$\text{Volume of aggregate} = 1 - (0.175 + 0.165) = 0.66 \text{ m}^3$$

$$\begin{aligned} \text{Mass of coarse aggregate} &= d \times \text{volume of coarse aggregate} \times \text{Specific} \\ &\quad \text{Gravity of coarse aggregate} \times 1000 \\ &= 0.66 \times 2.70 \times 1000 \\ &= 1782 \text{ kg/m}^3 \end{aligned}$$

For lightly compacted pervious concrete

$$\text{Volume of concrete} = 1 \text{ m}^3$$

$$\text{Void content} = 17.5\%$$

$$\text{Paste volume} = 23.5\%$$

$$\text{Volume of aggregate} = 1 - (0.175 + 0.235) = 0.59 \text{ m}^3$$

$$\begin{aligned} \text{Mass of coarse aggregate} &= d \times \text{volume of coarse aggregate} \times \text{Specific} \\ &\quad \text{Gravity of coarse aggregate} \times 1000 \\ &= 0.59 \times 2.70 \times 1000 \\ &= 1593 \text{ kg/m}^3 \end{aligned}$$

MIX PROPORTIONS BASED ON AGGREGATE IN SSD CONDITION

For well compacted pervious concrete

$$\text{Cement} = 237.4 \text{ kg/m}^3$$

$$\text{Water} = 90.21 \text{ kg/m}^3$$

Coarse Aggregate = 1782 kg/m^3

Water cement ratio = 0.38

For lightly compacted pervious concrete

Cement = 338.1 kg/m^3

Water = 128.4 kg/m^3

Coarse aggregate = 1593 kg/m^3

Water-cement ratio = 0.38

CASTING AND CURING OF CONCRETE

Pervious concrete under Indian standards codes for ordinary pervious concrete, of ratio 1:3 (cement aggregate ratio) with no fine aggregate. Total of 9 cubes and 9 beams, 3 cubes and 3 beams for each 7, 14, and 28 days testing is casted after de-moulding the concrete, curing process is done (curing in water) and cured.

No fine concrete with polypropylene fiber for concrete with polypropylene fiber, of ratio 1:2.5 (cement aggregate ratio) with no fine and 0.5% of additional polypropylene fiber. Total of 9 cubes and 9 beams, 3 cubes and 3 beams for each 7, 14, and 28 days testing is casted after de-moulding the concrete, curing process is done (curing in water) and cured.

Pervious concrete under Indian road congress codes: pervious concrete under IRC:44-2017, for M10 and M20 grades with a percolation rate of 350 mm/min and 150 mm/min, a total of 18 cubes are casted for each grade. 3 cubes for each 7, 14, and 28 days testing along with 9 cubes for each test such as ultrasonic, rebound hammer, and permeability test. After de-moulding the concrete, curing process is done (curing in water) and cured.

Fig 4.5 Refers to the moulds of beam and prism



Fig 4.6 Refers to casting the beam



Fig 4.7 Refer to after curing of concrete

4.4 TESTON CONCRETE

4.4.1 FRESH CONCRETE

The test conducted for fresh concrete are as follows

➤ SLUMP CONE TEST

SLUMP CONE TEST:

The slump cone test is carried out as per IS code. The workability for all the concrete mix made for carrying out various tests measured. The workability of concrete mixes prepared for different percentage of replacement of rubber waste with aggregate is evaluated and recorded in the Table.

The apparatus for testing the slump test consists of metal mould of

Bottom diameter : 20 cm

Top diameter : 10 cm

Height: 30 cm

TABLE 4.6 SHOWING RECOMMENDED SLUMPS FOR SLUMP CONE TEST

Slump in cm	Workability	Uses
2 – 4	Very low	Concrete used for road construction
4 – 5	Low	Concrete for piers, slabs, walls, etc.
5 – 10	Medium	Concrete for normal RCC work
10 – 17.2	High	Concrete for congested reinforcement where vibration is not possible.

Slump cone value= 210 mm (collapse).



Fig 4.8 Refers to slump cone test

4.4.2 HARDEND CONCRETE:

The tests conducted for hardened concrete are as follows

- COMPRESSIVE STRENGTH TEST
- FLEXURAL STRENGTH TEST
- PERMEABILITY TEST OF CONCRETE

5.1 COMPRESSIVE STRENGTH TEST:

The compressive strength of cement is given regarding the trademark compressive strength of 150mm size solid shapes tried at 7 and 28 days (fck). By this Single test one appointed authority that cementing has been done appropriately or not. Concrete compressive strength for general development changes from 15MPa to 30MPa and higher in business and modern constructions

$$f = P / A \text{ N/mm}^2$$

where,

P = Load at which the specimen fails in Newton.

A = Area over which the load is applied in mm²

f = Compressive stress in N/mm²

Fig 5.1 Refers to compressive strength test



Fig 5.2 Refers to compression testing machine



5.2 FLEXURAL STRENGTH TEST:

The bar examples were tried for flexural strength toward the finish of 28 days. The examples were tried following expulsion water, while they were still in wet condition. The measurements and weight every example were noted prior to testing.

Surface bearing supports and stacking rollers was cleaned off. The model was then situated on the rollers so will be applied to the upper for the most part surface as cast in the shape along two lines isolated 13.3cm isolated. The model was intentionally agreed with the rotate of the stacking contraption. The store was applied without daze and extending continually. The store was

extended until the model failed and the most limit trouble applied to the model was recorded. Exceptional breaks were recorded.

The specimen sizes are 10cm x 10cm x 50cm.

$$\text{Flexural Strength} = Pl / (b \times d^2)$$

Where,

P = Maximum load in kN applied to the specimen

b = Breadth of the specimen in mm

d = Depth of the specimen in mm

l = Effective span



Fig 5.3 Refers to flexural testing machine



Fig 5.4 Refers to the maximum load is applied to the specimen was recorded

SUMMARY:

The test examinations depended on the outcomes got from different strength qualities tests led at the appointed time. At last the reasonableness of the piece elastic with incomplete substitution of coarse total in M30 concrete was considered.

NUMBER OF SPECIMENS

TABLE 5.1 Refers to number of specimen

MATERIALS	No. OF SPECIMENS FOR TEST		
	COMPRESSION	PERMEABILITY	FLEXURE

	(cube)			(cube)			(prism)
DAYS	7	28		7	28	7	28
0% replacement of METAKAOLIN in cement and 0% polypropylene fiber	3	3		3	3	3	3
0% replacement of METAKAOLIN in cement + 0.5% polypropylene fiber	3	3		3	3	3	3

RESULTS AND DISCUSSION

GENERAL

This chapter deals with all the results obtained.

COMPRESSIVE STRENGTH: (FOR IS-12727 (1989) METHOD)

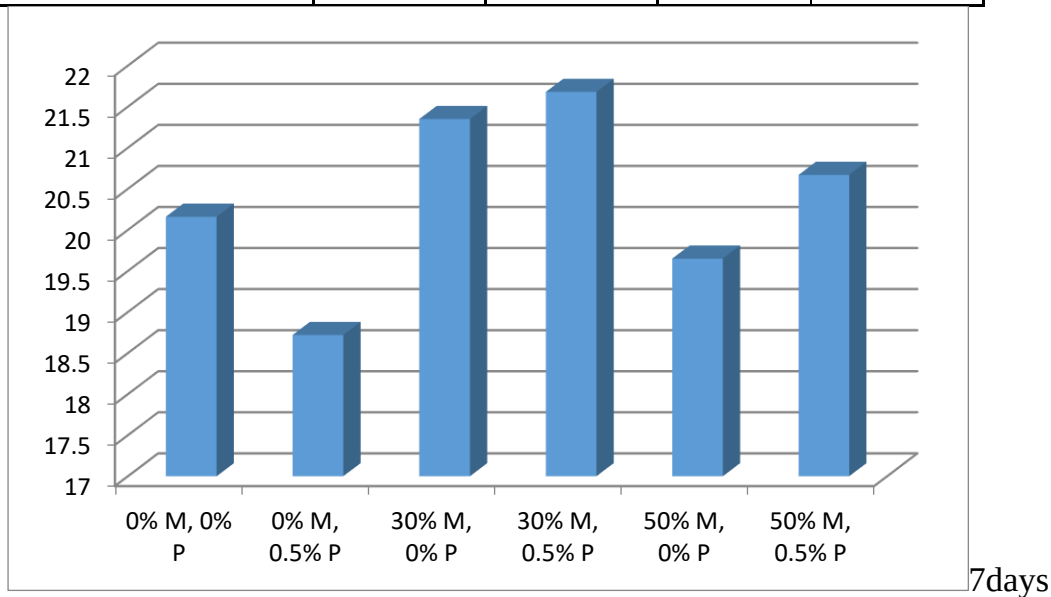
The mean compressive strength of concrete as per IS-12727 were determined at the age of 7 days and 28 days were reported in Table.

COMPRESSIVE STRENGTH: (FOR IS-12727 (1989) METHOD)

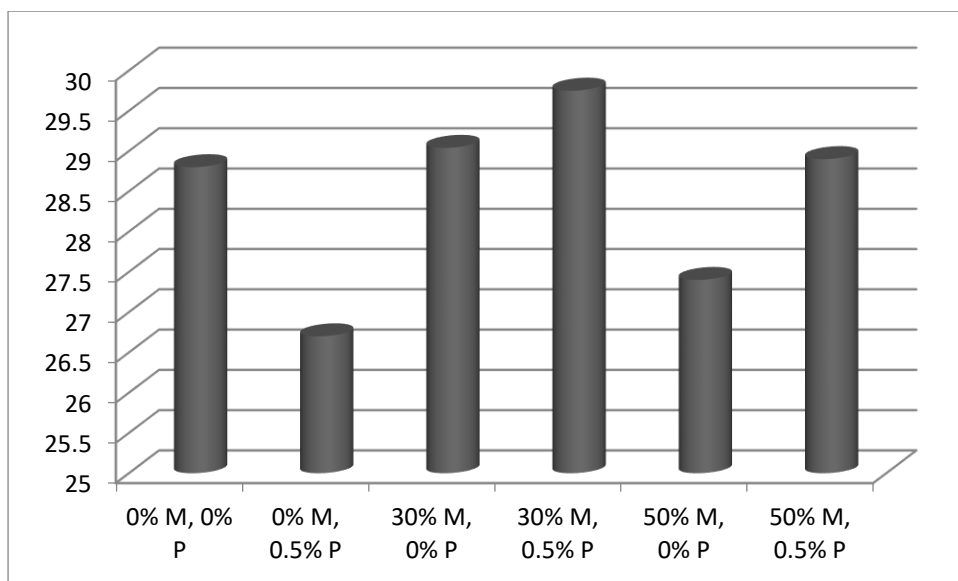
The mean compressive strength of concrete as per IS-12727 were determined at the age of 7 days and 28 days were reported in Table 5.2

MATERIAL	7 DAYS		28 DAYS	
	ultimate load KN	Peak stress N/mm ²	ultimate load KN	Peak stress N/mm ²
0% replacement of METAKAOLIN in cement and 0%	453.8	20.16	648.2	28.8

polypropylene fiber				
0% replacement of METAKAOLIN in cement + 0.5% polypropylene fiber	421.2	18.72	601.7	26.7
30% replacement of METAKAOLIN in cement and 0% polypropylene fiber	480.4	21.35	669.4	29.04
30% replacement of METAKAOLIN in cement + 0.5% of polypropylene fiber	487.4	21.68	653.4	29.75
50% replacement of METAKAOLIN in cement and 0% polypropylene fiber	453.50	19.65	654.3	27.40
50% replacement of METAKAOLIN in cement + 0.5% of polypropylene fiber	461.33	20.67	647.1	28.9



28days



COMPRESSIVE STRENGTH RESULTS FOR IRC:44 CODE METHOD

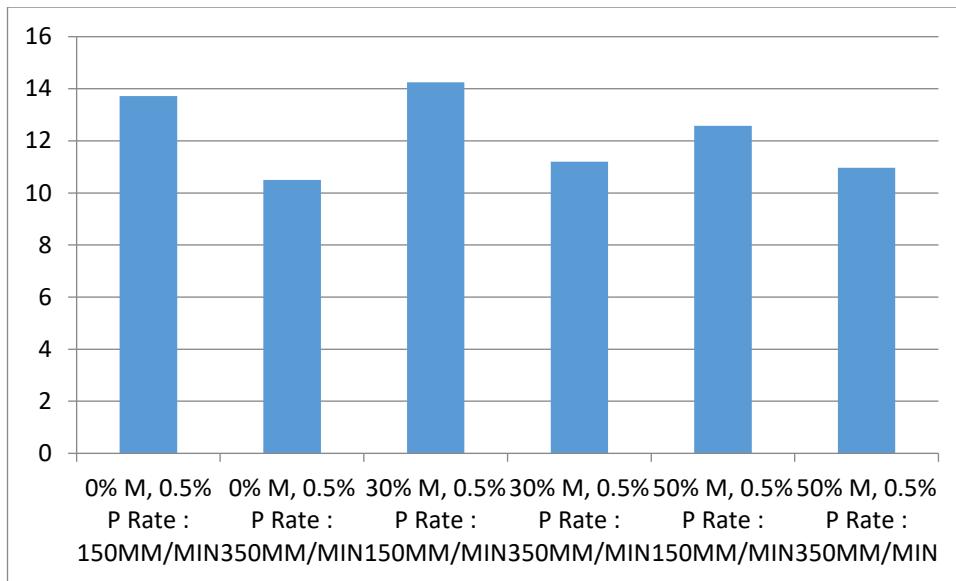
The mean compressive strength of 150mm concrete cubes for M20 grade, using GGBS as partial replacement for cement as per IRC: 44 were determined at the age of 7 days and 28 days were reported in Table 5.3

TABLE 5.3

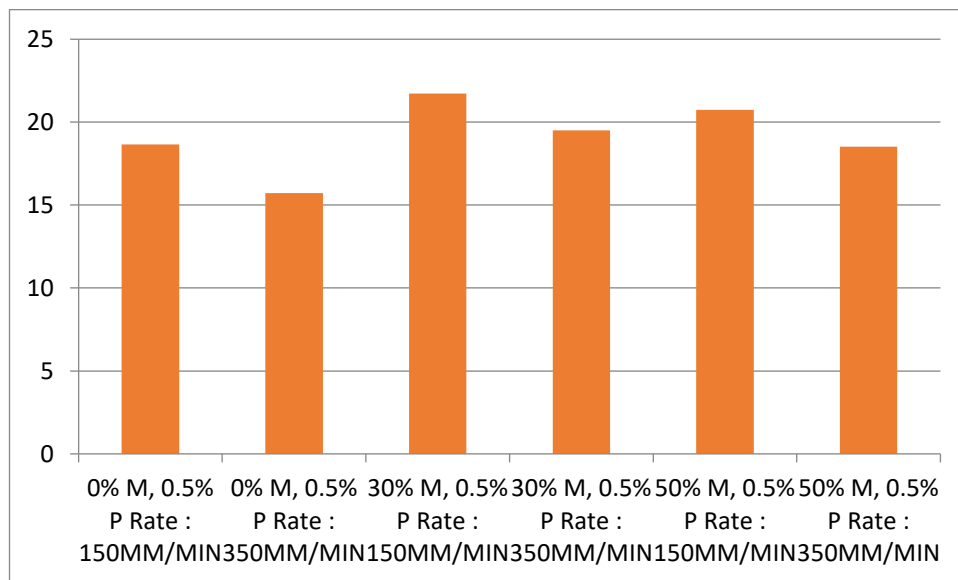
MATERIAL	7 DAYS		28 DAYS	
	Peak load KN	Peak stress N/mm ²	Peak load KN	Peak stress N/mm ²
0% Metakaolin and 0.5% polypropylene, Minimum percolation rate:150mm/min	308.7	13.72	419.6	18.65
0% GGBS and 0.5% polypropylene, Minimum percolation rate:350mm/min	236	10.50	353.7	15.72

30% Metakaolin and 0.5% polypropylene, Minimum percolation rate:150mm/min	320.6	14.25	488.9	21.73
30% Metakaolin and 0.5% polypropylene, minimum percolation rate:350mm/min	252	11.20	438.7	19.50
50% Metakaolin and 0.5% polypropylene, Minimum percolation rate:150mm/min	317	12.58	466.8	20.75
50% Metakaolin and 0.5% polypropylene, minimum percolation rate:350mm/min	242	10.97	416.7	18.52

7days



28days



FLEXURAL STRENGTH TEST:

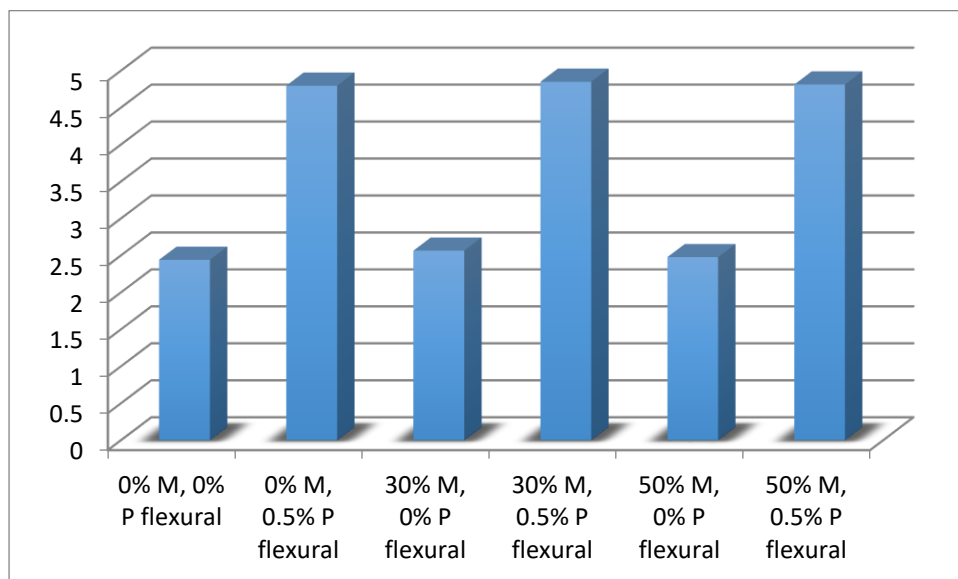
The flexural strength of concrete beam of M20 grade, were determined at the age of 7 days and 28 days. The flexural strength of concrete with additional polypropylene construction fiber gives double the strength than the 0% replacement of polypropylene fiber concrete.

TABLE 5.4 Refers to flexural strength of concrete

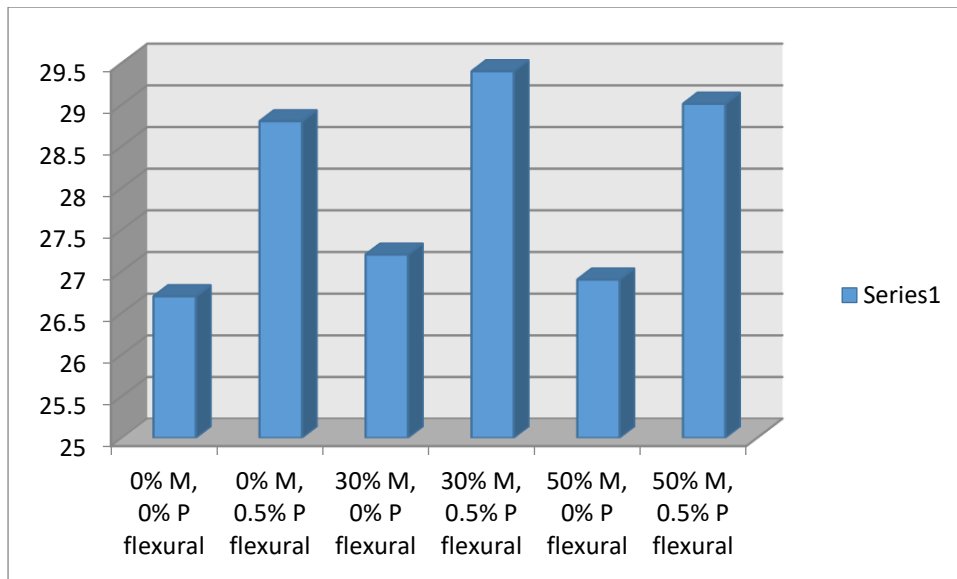
MATERIAL	7 DAYS		28 DAYS	
	ultimate load KN	Peak stress N/mm ²	ultimate load KN	Peak stress N/mm ²
0% replacement of Metakaolin in cement and 0% polypropylene fiber	1.4	2.441	2.5	26.7

0% replacement of Metakaolin in cement + 0.5% polypropylene fiber	2.7	4.796	2.9	28.8
30% replacement of Metakaolin in cement and 0% polypropylene fiber	1.5	2.565	3.1	27.2
30% replacement of Metakaolin in cement + 0.5% of polypropylene fiber	2.75	4.850	3.5	29.4
50% replacement of Metakaolin in cement and 0% polypropylene fiber	1.4	2.477	2.5	26.9
50% replacement of Metakaolin in cement + 0.5% of polypropylene fiber	2.75	4.812	3.3	29.01

7days



28days

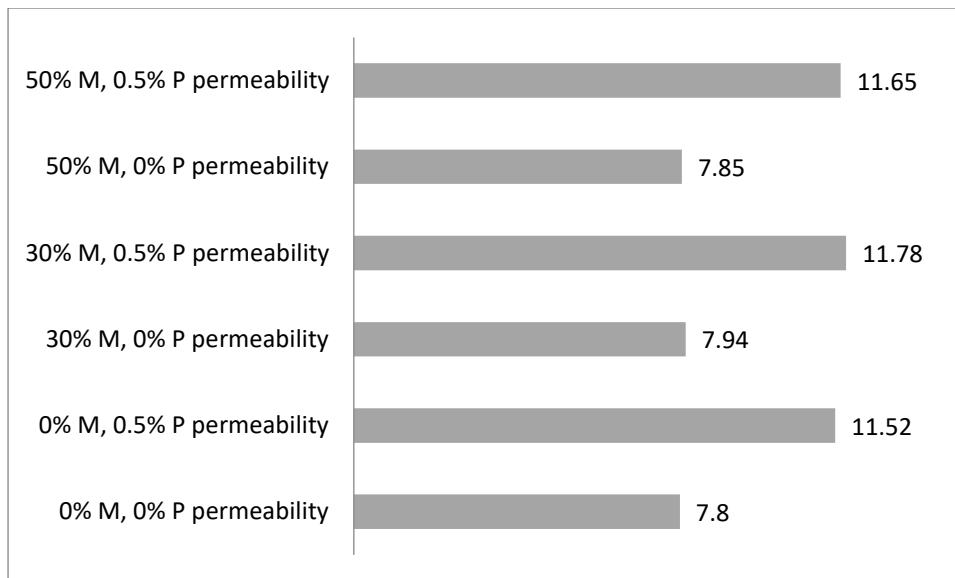


PERMEABILITY TEST

MATERIALS	CO-EFFICIENT OF PERMIABILITY VALUE (m/s)
0% replacement of Metakaolin in cement and 0% polypropylene fiber	7.8
0% replacement of Metakaolin in cement + 0.5% of polypropylene fiber	11.52
30% replacement of Metakaolin in cement	7.94
30% replacement of Metakaolin in cement + 0.5% of polypropylene fiber	11.78

50% replacement of Metakaolin in cement	7.85
50% replacement of Metakaolin in cement + 0.5% of polypropylene fiber	11.65

TABLE 5.5 Refers to permeability test of concrete



CHAPTER 6

6.1 CONCLUSION

The accompanying ends are drawn from the investigation on Metakaolin, they are appropriate for the scope of boundaries and materials utilized in this examination. It tends to be utilized in the substitution of concrete. It is seen that there is a strength increment with expansion 30% metakaolin 0.5 % Polyporylenefiber, M20 grade concrete.

A quantifiable expansion in solidness of the solid Metakaolin has been noticed. The trial concentrate altogether uncovered a superior execution of the solid as for strength, Toughness and nature of the solid.

The particular gravity for Metakaolin powder is 2.65. though for concrete is 3.15. The water retention for coarse total is 0.3 percent.

The compressive strength of 30% Metakaolin, 0.5% Polypropylene substitution in M20 grade concrete is 21.3% higher than regular cement.

The Flexural strength of 30% Metakaolin 0.5 % Polypropylene substitution in M20grade concrete is 29.4% higher than customary cement.

Notwithstanding, more examination considers are being made on the Metakaolin and polypropylene fiber is vital for the viable application.

Future Examinations: Examination on conduct of cement in primary applications. Weariness obstruction of cement can be contemplated. Uses of these solid in Underground constructions might be investigated

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