# Variation of Concrete Strength Using Steel Fibre and Rice Husk Ash

Amir Zahoor Shah

**Abstract:** ***The Study investigates about the effect of various fibres in concrete that helps to determine the optimized concrete strength with respect to various proportions of fibres. The influence of Steel fibre and rice husk explains about the mechanism of bonding strength. In this present study the concrete cube of size 150 x 150 x 150 mm and cylinder of size 150 x 300 mm were casted in order to determine the compressive strength and split tensile strength parameters. The fibres were cleaned and the dust particles were removed by suitable method and later on added to the concrete Mix. Aspect ratio of the fibre is adopted in each stage of concrete mix preparation so that the uniformity of fibre size is maintained. The Concrete specimens were prepared with each calculated ratio of fibres, these fibres strength along with concrete shows the Individual strength results as well as combined form. Steel fibre was using 0%, 1%, 3% and 5% by volume fraction and rice husk ash is replacing by the OPC by the weight at 7%, 12% and 15%. Optimum value of steel fibre is 3% for the compressive strength and for the split tensile strength optimum value is 5 %. And RHA optimum value for replacement is 12 % for both the compressive strength and split tensile strength. Total number of cube casted for compressive strength is 27 and total number casted of cylinder is 27.***

**Keywords:** Steel fibre, Rice husk ash

## 1. Introduction

Concrete is one of the most significant materials which are being utilized now days in development of structures or in case of other constructions. We have numerous sorts of cement yet generally utilized cement is OPC concrete and it consists of fine aggregate, coarse aggregate, concrete and water. Others types of concrete:

- Normal concrete
- High performance concrete
- High strength concrete
- Light weight concrete
- Air entrained concrete
- Self-weight concrete

Concrete have already enough strength but now days we are adding or replacing so many material in concrete only for increasing the strength. Such materials are steel fibre, silica fume and etc. There are so many materials such as silica fume and RHA, by using these material we can increase the surface area so they will absorb more water and by this way we can increase strength or other properties. If we are using the steel fibre for adding the strength in concrete we need to know the size of fibre and also the diameter of the steel fibre. And also, when we use this material in concrete, we have to be very careful that there should not be any ball in concrete when we are adding these materials. And Rice husk is waste material, by burning this material we can get a material that is the RHA which is used now days in concrete for increasing the strength of concrete.

### 1.1 Background

**History behind Development of RHA**

RHA stands for the rice husk ash. It is an agro based waste material. RHA is made by the burning of the rice husk and it is a waste material which is mostly found in the regions of the rice growing. After burning the rice husk we find out a supplementary material which has cementations properties and used as addition material in cement. And by use of this we can increase the concrete strength. After burning the 100kg of rice husk we will get the 20kg rice husk ash.

**Motive behind Development of RHA**

The main motive behind the use of RHA is we can use the waste of rice husk which is obtained after burning rice husk. And one more thing is it's economically.

**Physical properties of RHA**

**Table 1:** Physical properties of RHA

| Particular | Description |
|---|---|
| Color | Grey |
| Particle size | <45 micron |
| Shape | Irregular |
| Odour | Odourless |
| Appearance | Very fine |

**Benefits and Advantages**

- Control pollution
- Use of waste
- Increase the strength

**Steel fibre**

Steel fiber is a material which is additionally utilized in the concrete, that kind of cement is known as the steel fiber reinforced concrete (SFRC). Steel fiber is additionally utilized for expanding the concrete strength and different properties of the concrete. Be that as it may, the properties will be influenced by the size and viewpoint proportion, and furthermore the measurement will be predefined. So we must be cautious with the sizes and different things of the steel fiber. Also, at the hour of including steel fiber into the concrete, we must be cautious in light of the fact that there are countless numbers odds of making the balling by gathering of the steel fiber, so we need to include steel fiber cautiously. The length of the steel fiber is 5cm in this specific investigation.

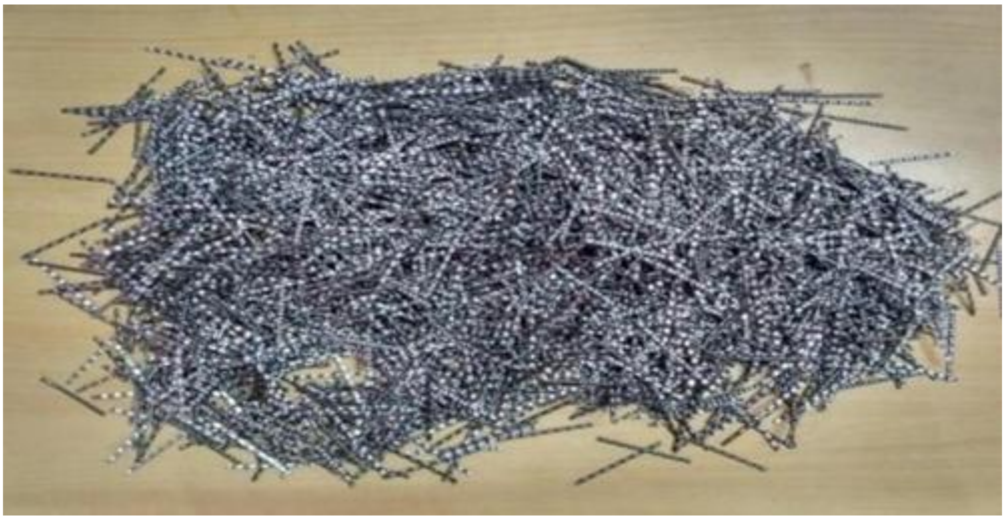


**Figure 1:** Sample of Steel Fibre

**Physical properties of Steel fibre**

**Table 2:** Physical properties of Steel Fibre

| Properties of fibre | Parameter |
|---|---|
| Length | 5cm |
| Color | Silver |
| Shape | Crimpte fiber |

Advantage of using steel fibre is it will increase the Split tensile strength.

## 1.2 Objective of the Study

The main aim of the present investigation is:

- To convert the rice husk into the RHA by the consuming the rice husk at 6500c temperature for 60 minutes
- To describe the concoction and physical properties of RHA.
- To locate the compressive quality by utilizing the RHA at various rates 7%, 12% and15%.
- To locate the split rigidity by utilizing RHA at various rates 7%, 12% and 15%.
- To locate the compressive strength and split tensile strength by using the steel fibre at different percentages 1%, 3%, 5% and7%.
- The main aim of the research is to control the crack widening with the help of fibers.
- To increase the properties like ductility, flexural strength and compressive strength of the concrete.
- To compare the strength at different percentages after using the RHA and steel fibre in concrete.
- The properties of materials such as fine aggregate, coarse aggregate, cement, and steel fibre that are going to be used in the specimen preparation were determined and the values have been calculated and arranged in tubular form.
- To study the different strength properties of RHA concrete with age in comparison to control concrete.

## 1.3 Scope of the Study

**General**

Construction has played an important role in changing the modern survey rapidly. Innovation in construction is only possible with the development of advanced construction materials. Cementations materials used in construction are the major class materials that have been used in construction for several years. Lately cementations material used were lime or lime with natural pozzolana and in recent times Portland cement is widely being used throughout the world. Despite high demand many countries have shortage of cement. Therefore world is in dire need to find the alternative binder and cement replacement materials and thus it has become a technological interest to develop new concrete materials that are reliable and durable construction material.

Physical and chemical properties of the pozzolanic materials as well as characteristics of Portland cement and pozzolana decide how much amount of Portland cement can be replaced with pozzolanic materials. These include control of the alkali – aggregate reaction, improvement in durability properties, enhancement of resistance against the corrosion of steel in concrete and reduction in the heat of hydration. While 40 to 50% replacement is permitted by many standards, optimum replacement from a strength point of view appears to less than 30%. With this amount of replacement for what can be referred to as good reactive pozzolan, the days compressive strength with at least be comparable than the strength of the unsubstituted Portland cement. For poor pozzolanic materials, the amount of replacement could reduce to 10% to achieve strength equivalence at 28days.

**Scope of the Study**

Many researches are done on utilization of RHA and most these researches are based on improving the physical and mechanical properties of RHA in concrete. Here we are replacing the OPC with RHA. The percentages will be 7%, 12% and 15%. In this study we are focusing on the split tensile strength and compressive strength. In this research work we are going to determine the percentage of replacement of RHA with OPC for the split tensile strength and also for the compressive strength. For finding the compressive strength, we will cast the cube and for find split tensile strength, we will cast the cylinder.

Fibers help in strengthen of the cement matrix and bridge over cracks and help in decreasing the crack width and reducing crack sensitivity of the matrix. Addition of fibers helps in improving the engineering properties of concrete but this is not true for all types of fibers as some fibers have disadvantages like corrosive nature. So we need to investigate which type of fibre can be used to improve the engineering properties of concrete.

### 1.4 Overview of the Report

Contents of this thesis have been organized into the following five chapters:

**Chapter-1 Introduction:** This chapter introduces the topic and objective of this thesis. It further includes a brief overview of the contents of this report.

**Chapter-2 Literature review:** Review of literature related to thesis work has been presented in this chapter.

**Chapter-3 Approach followed:** This chapter discusses the stepwise approach followed to achieve the objective of this work. This also includes the design procedure.

**Chapter-4 Result:** Result of design has been presented in this chapter.

**Chapter-5 Conclusion:** This is the last chapter that summarizes the scheme and outcomes of study.

## 2. Literature Review

**J. DHANALAKSHMI** (2016) has investigated that due to the manufacturing of cement, emission of co2 is increasing in the atmosphere and rice husk ash is also a problem for dispose. So, they find the workability, the split tensile strength and compressive strength. According to them the fine RHA is the best for the replacing the cement because due to fineness surface area will be more and the find the optimum value for replacing the cement is 20%.

**ANANYA SETH, ANIRUDH GOEL** (2014) has investigated the mechanical properties of the concrete by using the expanded poly styrene (EPS) and the RHA. In this research, they replaced the aggregates with the expanded poly styrene (EPS) and OPC with the RHA by weight. They are using the EPS for the decreasing the unit weight and RHA for the increasing workability. Mixture proportioning was done for the strength 65Mpa. In other research they got the 10Mpa but the aim of him was for 25Mpa. With addition of RHA they verified that water absorption will increase. And the compressive strength will also increase but only if we will the less quantity of RHA with the expanded poly styrene (EPS) And they also prefer the small size of particle.

**PATNAIKUNI CHANDAN KUMAR, PALLI MALLESWARA RAO** (2013) has
investigated that by replacing the OPC with the RHA at different percentage 0%, 5%, 7.5%, 10%, 12.5%, 15%, 20% and the size of all the specimen is 100mm* 100mm* 100mm, the optimum percentage for replacement will be 7.5% and I have studied that at a temperature 1000 C normal concrete exhibited zero strength. That shows us concrete cannot withstand 1000 C temperature or above. With replacement of RHA, compressive strength of cement will increase up to the 500 C and above this it will decrease. And for the mixing first all the gradients are mixed in dry condition and then 80% of water is added and rest water will be added later. And because silica is more present in the rice husk ash means workability will be less so they use the super plasticizer dosage for maintain the workability 75mm.

**MAURICE E. EPHRAIM, GODWIN A. AKEKE** (2012) has examined the RHA is supplanting with the OPC at the diverse rate 10%, 20%, 25%.specific gravity found by them was 1.55 and the mix proportion was the 1:1.5:3.they done the curing for 7 days, 14 days, 21 days, 28 days. As indicated by them in view of silica the functionality will be less so they include some measurements of super plasticizer for keeping up the usefulness. The ideal incentive for the supplanting of RHA with the OPC is the 10%. At 7, 14, 21, 28 days the compressive strength will be more for 10% yet when they expanded the amount of RHA to 20% and 25%, strength was decreasing individually.

**S. D. NAGRALE, PANKAJ RR. MODAK** (2012) has examined about the rice husk usage. As indicated by this paper rice husk is the one of the material which is created more in India. By this rice husk India produce the 20 million ton RHA. Serious issue with rice husk is dumping, so they were attempting to supplant it with OPC with this RHA for looking of the quality variety. Level of substitution is the 15-25% and as indicated by them the consuming temperature ought to be 600 C, in such a case that it ought to be over the 700 C so will create the glasslike silica which is far less receptive. Also, in the end they have seen the compressive quality is expanding, however the ideal rate is17%.

**RAVANDE KISHORE, V. BHIKSHMA** (2011) has explored that for increment in compressive strength 10% will be the ideal rate for the RHA for supplanting the OPC. They attempted the three distinct rates for 5%, 10%, 15%.according to him because of moderately popularity for water, the RHA concrete created lower compressive quality. And furthermore, the water request will increase with expanding the amount of the RHA. In the event of split tensile strength, the quality will diminish with because of increasing the amount of RHA. For compressive strength, they make the cube and for the split tensile strength they make the cylinder.

**NOOR SHUHADA MOHAMMAD** (2011) has investigated about the RHA in the case of fine grained mortar. They were using the OPC for replacement of RHA and for investigation they were using the XRF to know the content of silica present in this material, they were testing for the different 0%, 10%, 20%, 30%. In this paper they were finding the flexural strength and compressive strength. The optimum percentage for replacement was the 20%.Prism was using for the flexural strength and the size of prism was 40mm*40mm*160mm. And they find the optimum percentage is 20% because for 7 days the strength was the 4.37N/mm$^2$ and for the 28 days the strength was the 6.66 N/mm$^2$. For maintain the workability they were using the super plasticizer 1% by the weight.

**GHASSAN ABOOD HABEEB** (2009) has examined about utilizing the normal molecule size of rice husk debris impact on the mechanical properties and drying shrinkage properties. Privately created rice husk debris size is 31.3, 18.3 and 11.5 micrometer. They are supplanting the conventional Portland concrete with the rice husk debris by the weight and the rate was 20%.

The new properties of cement were that there was no dying, no isolation and droop go was the 210-230mm. This shows there will advancements of strength at different stages, Means the compressive quality will build step by step. Flexural quality will likewise increase and the quality was higher for the better RHA due to the expanded pozzolanic response and the pressing capacity of rice husk debris fine particles. Split tensile strength has been upgraded by including the RHA in the concrete.

**Steel Fibre**

**JING JU LU (**2017) has explored about the flexural durability and assessment technique for steel fiber fortification in lightweight total cement. However, at the principal stage they discover the thickness, functionality and the compressive quality and furthermore also they discover the microstructure of SFLWC by utilizing filtering electron magnifying lens. The ideal level of 2% of steel fiber was proposed dependent on how much the fiber improved the durability of plain light weight concrete (LWC). Length was 38mm, measurement was 0.7mm and the angle proportion was the 54. For the most extreme burden the limit of machine was the 2000KN. As per the end the steel fiber will diminish the usefulness and upgrade the compressive quality and furthermore improve the post breaking pliability of light weight concrete (LWC).

**G.M. CHEN, H. YANG** (2016) has examined about the break conduct of steel fiber fortified reused total cement after introduction to raised temperature. The steel fiber was the 0%, 0.5%, 1%, and 1.5% and the introduction temperature was 200 C, 400C and 600 C has researched. In the outcome the steel fiber defers the inception of breaks and furthermore upgrades the crack vitality. The profundity, tallness and length of example were the 100mm, 100mm, and 515 mm individually. That is totally founded on three-point scored beam test. The crack vitality has been upgrading after introduction to high temperature up to 600 C. Furthermore, the ideal estimation of steel fiber is 1% by volume for crack vitality.

**DEEPA A SINHA** (2014) has investigated about the characteristic properties of steel fibre reinforce concrete with varying a percentage of steel fibre. They were using the steel fibre by the volume fraction in concrete and the different percentages was the 0.5%, 0.75%, 1%, 1.25%, 1.50%, 1.75%, 2.0%. The optimum percentage was the 1% for adding in the concrete by the volume fraction. The grade was the M30, proportioning for this grade is 1:1.86:2.41. According to this paper if we will increase the percentage of steel fibre in concrete, compressive strength will also increase. For 7 days it will increase 11% and for 28 days it will increase 6%. Similar trends are observed for the tensile strength. They found that after adding the 1% steel fibre result in 42% and 32% increase in 7 days and 28 days tensile strength respectively.

**N. SHIREESHA** (2014) has investigated about the mechanical properties of SFRC. The quantity of steel fibre was the 0.5%, 1% and 1.5% by the volume fraction. They were using the hooked end steel fibre. The compressive strength was higher for 1.5%, by adding the steel fibre in concrete compressive strength increases by 8% to 21% for 7 days and 6% to 12% for 28 days and the split tensile was also the higher at the 1.5%.the split tensile strength also increased from 14% to 36% for 7 days and 15% to 39% for 28days.

**A.M. SHENDE, A.M. PANDE** (2012) has investigated about the steel fibre adding in the concrete with the different quantity of steel fibre. They were adding the steel fibre in concrete by the different volume fraction. The percentage was 0%, 1%, 2% and 3%. I have studied the effect of steel fibre on the strength (compressive strength, split tensile strength, flexural strength) of concrete. The grade was the M40, proportioning for this grade is 1:1.43:3.04. I have also learn the compressive strength will increase up to the 11 to 24% after adding the steel fibre, flexural strength will increase up to the 12 to 49% after adding the steel fibre, split tensile strength will increase up to 3 to 41% after adding the steel fibre in concrete.

**M.L. BERNDT** (2010) has investigated the strength and the permeability of steel fibre reinforced grouts. They were using the 13mm round steel fibre and the diameter is 0.16 mm. Grouts were added 0.5% and 1% by the volume fraction. They found that the steel fibre is beneficial for short and long term tensile strength.

**K. HOLSCHEMACHER** (2010) has investigated about the effect of the steel fibre on mechanical properties of high strength concrete. One of the most advantages of using the steel fibre is hindrance of micro cracks development or delay in micro cracks. They were using the three types of fibres, two were the straight with end hooks with different fibres and one corrugated were used. They were also using the 2 bars of 6 dia and another was the 12 dia.

**P.S. SONG** (2004) has investigated about the high concrete strength with the steel fibre. The steel fibre were added in concrete at the volume fraction of 0.5%, 1%, 1.5% and 2%.The compressive strength reached at maximum after adding the 1.5% steel fibre in concrete and the improvement was in strength 15.3% over the HSC and for split tensile strength the maximum value was about 3% of steel fibre and also for the modulus of rupture.

## 3. Methodology

My all the thesis work is experimental work. Here I am using cement, fine aggregate and coarse aggregate. And the size of aggregate will be the 10mm and 20mm. Mix these ingredients thoroughly. Three supplementary material Rice husk ash, coconut fibre and steel fibre are added to concrete. Mix design is grade M20. And then casting of cylinder and cube is done for determining tensile strength and compressive strength. Number of the cubes is 27 for testing of the compressive strength and as well as cylinder number is 27 cylinder for testing of tensile strength. In whole casting the total quantity of cement will be 52.704kg, Fine aggregate Quantity is 79.056kg and the total quantity of coarse aggregate 158.184kg. First of all we have to be done all experimental work on materials.

- Fineness test
- Soundness test
- Consistency test
- Initial setting time
- Final Setting time
- Specific gravity test Experiment of the Aggregates:-
- Sieve analysis test
- Specific gravity test of aggregates
- Water absorption test of aggregates Experiments of the Sand:-
- Sieve analysis test
- Specific gravity test

### 3.1 Material used

**3.1.1 Rice Husk Ash:** Rice Husk Ash is obtained by burning the rice husk in air in an uncontrolled burning process. The temperature was in the range of 400-600$^0$C and the color is grey.RHA particle size is less than the75micronmeter.

**Table 3.1:** Physical properties of RHA

| S.No | Particular | Description |
|---|---|---|
| 1 | Colour | Grey |
| 2 | Particle size | <45 micron |
| 3 | Shape | Irregular |
| 4 | Odour | Odourless |
| 5 | Appearance | Very fine |

**Table 3.2:** Chemical properties of RHA

| S. No | Particular | Description |
|---|---|---|
| 1 | Silicon dioxide | 86.94% |
| 2 | Aluminum oxide | 0.2% |
| 3 | Iron oxide | 0.3-2.2% |
| 4 | Calcium oxide | 0.2-0.6% |
| 5 | Magnesium oxide | 0.1-0.8% |

#### 3.1.2 Cement

OPC of 43 grades is used in this study and the composition and properties of this cement are in accordance with ISO. Cement is a binding material that binds different construction materials and has adhesive and cohesive properties. Or in other words cement is a binding material that gives strength to construction elements. The main chemical components of OPC are:

- Silica
- Calcium
- Alumina
- Iron

**Table 3.3:** Basic Composition of Cement

| S.No. | Contents | Percentages |
|---|---|---|
| 1 | Cao | 60-67 |
| 2 | $Sio_2$ | 17-25 |
| 3 | $Al_2o_3$ | 3.3-8 |
| 4 | $Fe_2o$ | 6.0 |
| 5 | Mgo | 0.5-0.40 |
| 6 | Alkalis | 0.3-3.5 |

Characteristics of OPC 43grade:

1) Durable
2) Corrosion resistant
3) heat of hydration is low
4) Volume stability
5) Enormous compressive strength

Composition of Cement is the Lime, alumina, silica, calcium sulphate and the others also.

**Table 3.4:** Material presence in cement

| Materials | Percentage (%) |
|---|---|
| Lime | 62-67% |
| Silica | 17-25% |
| Alumina | 3-8% |
| Calcium sulphate | 3-4% |
| Iron oxide | 3-4% |
| Sulphur | 1-2% |

In cement the Lime or calcium oxide will imparts strength and also the soundness to the cement. Silica will also increase the strength and it also increases the setting time. Alumina also imparts the quick setting property of the cement and in excess there will be some weakness in cement and here calcium sulphate will help to increase the initial setting time and iron oxide will provide the colour.

**Physical properties of cement**:

**Table 3.5:** Physical properties of cement

| Properties | Description |
|---|---|
| Colour | Grey |
| Specific gravity | 3.15 |
| Size | 2-50 micrometer |
| Shape | Angular shape |

#### 3.1.3 Concrete

Concrete is one of the most important and widely used construction materials on earth. It's strong, durable, fire resistant, and can be made to fit any size or shape. It's mainly composed of three components cement, water and aggregates (fine and coarse aggregates).

**Characteristics of Good Concrete**

1) Workability
2) Freedom from segregation
3) Freedom from bleeding
4) Strength
5) Durability
6) Appearance

#### 3.1.4 Aggregates

The inert mineral materials such as sand, gravel, etc used for manufacture of concrete are known as aggregates.

Requirements of good aggregates
1) It should be sufficiently strong.
2) It should be hard.
3) It should have rough surface.
4) It should be in spherical or cubical in shape.

**Classification of Aggregates**
1) Coarse aggregates
2) Fine aggregates

**Coarse Aggregate:** Coarse aggregates are those aggregate which pass through 75mm sieve and retain on 4.75mm.
**Fine Aggregates:** Fine aggregates are those aggregates which pass through 4.75mm IS sieve and retain 75 micron IS sieve.

### 3.1.5 Steel Fibre
Steel fibre is a material which is also used in the concrete, that type of concrete is known as the steel fibre reinforcement concrete (SFRC). Steel fibre is used to increase the strength of concrete and other properties of the concrete. But the properties will also be affected by the size and aspect ratio, and also the diameter will be predefined. So we have to very careful with the sizes and other things of the steel fibre. And also at the time of adding the steel fibre into the concrete we have to be very careful because there are so many chances of making the balling by the gathering of the steel fibre, so we have to add steel fibre very carefully.

**Table 3.6:** Physical properties of Steel Fibre

| Sr. N | Properties of fibre | Parameter |
|---|---|---|
| 1 | Length | 5cm |
| 2 | Colour | Silver |
| 3 | Shape | Crimple fibre |

## 3.2 Experiments of cement:-We have different types of experiments

### 3.2.1 Fineness test
Procedure:
- First we have to be take sample weight of cement of100gm.
- Then we will use the sieve of 90micron.
- Sieve will be used by us for 20minute.
- Then we will weigh the retained sample.
- In final the weight of retaining cement should be less than the 10% of weight.

**Table 3.7:** Quantity of sample

| Material | Quantity |
|---|---|
| Total weight of sample | 100gm |
| Weight retained | 5gm |
| Percentage wt retained | <10% |

### 3.2.2 Consistency test
To find the initial setting time, final setting time, soundness and strength of the cement a parameter known as consistency has to be used. For finding the consistency we will use the “VICAT’S PLUNGER”. The Diameter of the needle is 10mm and the height will be the 50mm.This apparatus is used to “find the water content require to produce the cement paste” of standard consistency.

Procedure:-
- First we will take the cement sample of 250kg.
- Then we add in this 28% water for first trial.
- Remove all the air voids from present in the sample.
- Then release the plunger and then measure the depth of perimeter from the bottom.

**Figure 2:** Figure of Cement

**Table 3.8:** Paste when the sample is 250g Material Quantity

| Material | Water | Quantity |
|---|---|---|
| 28% of 250gm | 70ml | 24mm |
| 30% of 250gm | 75ml | 19mm |
| 32% of 250gm | 80ml | 12mm |
| 34% of 250gm | 85ml | 8mm |

Hence the consistency is 34%.

### 3.2.3 Initial setting time
Initial setting time is the measure of time from the instant water is added to the cement up to the instant its starts losing its plasticity.

Procedure:-
- Take the sample of cement500gm.
- Then find the consistency it’s up to the 33mm to 35mm from the top.

**Figure 3:** Vicat Apparatus

**Table 3.9:** Initial setting time

| Time(10 min gap) | Penetration(From bottom) |
|---|---|
| 0-10 | 3mm |
| 10-20 | 4.5mm |
| 20-30 | 6mm |

Hence the initial setting time is 30 minute.

### 3.2.4 Specific gravity test
Procedure:-
- First weight the empty flask.
- Then weight flask when cement is added in it.

- Then weight of flask, cement and water.
- Then weight flask and water

In tabular form:

**Table 3.10:** Quantity of material

| Perimeter | Name | Weight |
|---|---|---|
| W1 | Wt. of flask | 111gm |
| W2 | Wt. of flask cement | 161gm |
| W3 | Flask + cement + water | 400gm |
| W4 | Flask + water | 358.5gm |

Calculation:
Calculation is given in below image for specific gravity:-
Specific gravity= (w2-w1)/ ((w2-w3)-(w2-w4)*.87)
=(161-111)/((161-111)-(400-358.5)*.87)
=3.125/cc

### 3.2.5 Fine Aggregate

Fine aggregate is the one of the important part of the concrete. The best example of fine aggregate is sand and we can get it from the marine and also from the land.

**Physical properties of sand:**

**Table 3.11:** Physical properties of sand

| Name | Properties |
|---|---|
| Size | 0.0625mm to 0.004mm |
| Shape | Granular |
| Specific gravity | 2.60 to 2.80 |

We have so many test of sand.

### 3.2.6 Specific gravity test

Procedure:
- First take the weight of pycnometer.
- Then take the weight of sand pycnometer and water.
- Then take the weight of pycnometer and water.
- Then take the weight of sand from oven after 24 hours.

**Table 3.12:** Reading of specific gravity test

| Perimeter | Name | Weight |
|---|---|---|
| W' | Wt. of pycnometer | 645gm |
| W | Pycnometer + sand + water | 1845.8gm |
| W1 | Pycnometer + water | 1500gm |
| W2 | After 24hr | 545gm |

**Calculation:**
Specific gravity= (W2)/ (W2-(W-W1))
= (545)/ (545-(1845.8-1500))
=2.63gm/cc

### 3.3 Fine Aggregate

Fine aggregate is the one of the important part of the concrete. The best example of fine aggregate is sand and we can get it from the marine and also from the land.

**Physical properties of sand**

**Table 3.13:** Physical properties of sand

| Name | Properties |
|---|---|
| Size | 0.0625mm to 0.004mm |
| Shape | Granular |
| Specific gravity | 2.60 o 2.80 |

### 3.3.1 Specific gravity test

Procedure:
- First take the weight of pycnometer.
- Then take the weight of sand pycnometer and water.
- Then take the weight of pycnometer and water.
- Then take the weight of sand from oven after 24 hours

**Table 3.14:** Reading of specific gravity test

| Perimeter | Name | Weight |
|---|---|---|
| W' | Wt. of pycnometer | 645gm |
| W | Pycnometer + sand + water | 1845.8gm |
| W1 | Pycnometer + water | 1500gm |
| W2 | After 24hr | 545gm |

Calculation
Specific gravity= (W2)/ (W2-(W-W1))
= (545)/ (545-(1845.8-1500))
=2.63gm/cc

### 3.3.2 Sieve test

Procedure:-
- First we will take the sample of sand.
- Then we will arrange the sieve according to the series.
- Then we will calculate the weight of retained sand.
- Then Percentage of cumulative sand retained.

**Table 3.15:** Material Quantity for sieve test

| Sieve size | Wt retained in gm | % retained | Cumulative wt. retained | Cumulative % of sand retained |
|---|---|---|---|---|
| 4.75 | 1 | 0.06 | - | - |
| 2.36 | 1 | 0.06 | 1 | 0.06 |
| 1.18 | 15 | 0.80 | 2 | 0.12 |
| 600 micron meter | 1 | 0.06 | 17 | 0.92 |
| 300 micron meter | 1 | 0.06 | 18 | 0.98 |
| 180micr | 640 | 32 | 19 | 1.04 |
| 90 micron meter | 850 | 42.5 | 659 | 33.04 |
| 75 micron meter | 490 | 24.5 | 1509 | 75.54 |
| | | | 1999 | 100.04 |
| | | | | 211.74 |

Calculations
Fineness modulus=211.74/100=2.46
So in result the sand is very fine.

### 3.4 Coarse Aggregate

Coarse aggregate are basically used in the field of construction these are mainly used in concrete to provide the better binding with the cement. Here the coarse aggregate are of sizes: 10mm and 20mm.

**Physical properties of coarse aggregate**

**Table 3.16:** Physical properties of Coarse aggregate

| Name | Properties |
|---|---|
| Size | <40mm |
| Shape | Irregular |

**Experiments of coarse aggregate**

### 3.4.1 Specific gravity test and water absorption test:-

Procedure:-

- First we will calculate the weight of basket in water
- Then Weight of basket, aggregate in water.
- Then wt. of aggregate after 24hrs

**Table 3.17:** Materials for water absorption test.

| Perimeter | Weight | Quantity |
|---|---|---|
| W1 | Basket aggregate in water | 3250gm |
| W2 | Basket in air/water | 850gm |
| W3 | Wt. before oven dry | 3984gm |
| W4 | After 24hrs | 3981.5gm |

Calculation
Specific gravity=W3/ (W4-(W1-W2))
=3984/ (3981.5-(3250-850))
=2.66gm/cc

Water absorption=100(W3-W4)/W3
=100(3984-3981.5)/3981.5
= .61%

## 4. Results and Discussion

### 4.1 Mix Design for M20GRADE

**Materials for proportioning:**

- Grade of concrete:M25
- Types of cement: OPC 43Grade
- Maximum size of coarse aggregate:20mm
- Maximum cement content:450kg/mt$^3$
- Types of aggregate: crushed

Test data for material: all data is based on the results which were done in laboratory

- Specific gravity of cement=3.125
- Specific gravity of coarse aggregate=2.66
- Specific gravity of fine aggregate=2.638
- Water absorption of CA=0.61%
- Water absorption of FA=0.81%
- Fineness modulus of CA=2.662
- Fineness modulus of FA=2.46
- Consistency of cement=34%
- Soundness of cement=0.3
- Initial setting time=49.33min
- Final setting time=610min

**1) Target strength for mix design**
$F_{ck}$ =$f_{ck}$+ (t *s)
Where $F_{ck}$ is target average compressive strength at 28 days and $f_{ck}$is the characteristic at 28 days. s is standard deviation and t is a statistic variable depending upon the accepted proportion of low results and the no. of tests.

$F_{ck}$= 20+ (1.65*4.6) = 27.59N/mm$^2$

**2) Selection of water cement ratio**
W/C ratio for corresponding $F_{ck}$ value =0.48

**3) Air content:**
For maximum size of 20 mm aggregates the entrapped air 2% of the volume of concrete.

**4) Water content and fine to total aggregate ratio**
For nominal maximum size of 20 mm aggregates and concrete grade of M20 the water and sand content are obtained 186 kg/m$^3$ and 35% of total aggregate volume respectively.

**5) Adjustments of values in water content and sand percentages**
No corrections are required since aggregates used are not rounded and there is no increase or decrease in w/c ratio compaction factor.

**6) Determination of cement content**
W/C ratio= 0.48
Water content = 186 kg/m$^3$
Cement content =387.5 kg/m$^3$

**7) Check for minimum and maximum cement content**
The calculated cement content of 387.5 is adequate as per IS: 456:1978

**8) Determination of coarse and fine aggregate content**
Fine aggregate:
0.98= (186+387.5/3.125 + (1/0.35)*($f_a$/2.638))*(1/1000) = 618.611 kg
Coarse aggregate:
0.98= (186+ (387.5/3.125) + (1/ (1-0.35))*($C_a$/2.66)*(1/1000) = 1158.43kg

**9) Total quantities of ingredients and mix proportions**

**Table 4.1:** Quantities of ingredients and mix proportions

| Cement | Fine aggregate | Coarse aggregate | water |
|---|---|---|---|
| 387.5 (kg) | 618.611 (kg) | 1158.43 (kg) | 186 (kg) |
| 1 | 1.597 | 2.99 | 0.48 |

### 4.2 Workability and density of concrete

Workability can be defined as the ease with which we can handle the concrete i.e how easily concrete can be transported, placed and compacted without any segregation. We have three methods to determine the workability of concrete.

- Slump test
- Compaction factor test
- Vee-bee consistometer test

The slump test determines the workability of concrete.
Mould which is used for the slump test, the upper diameter is 10cm, below diameter is 20cm and the height is 30cm.

Slump values at different percentages of steel fibre:

**Table 4.2:** Slump value for steel fibre

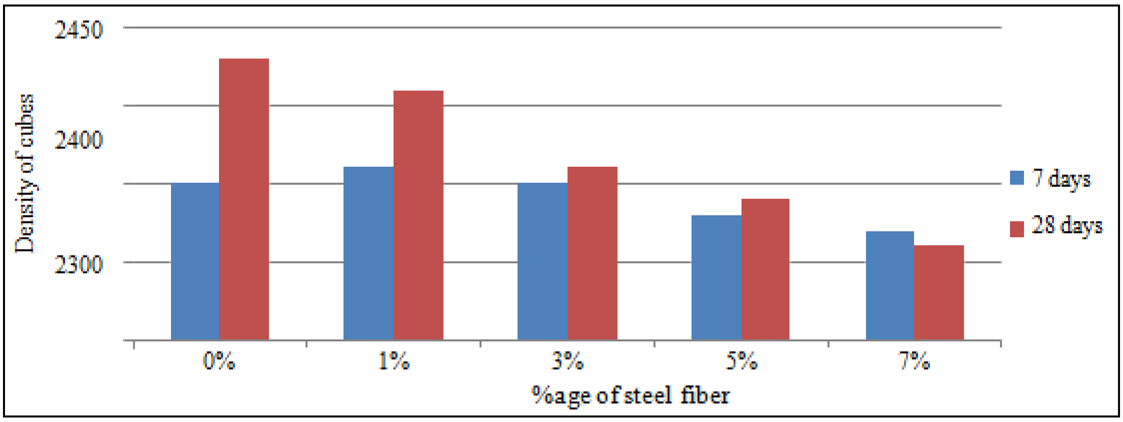
| Serial no | W/c ratio | % Steel Fibre | Slump value |
|---|---|---|---|
| 1 | 0.48 | 0 %(control) | 103 |
| 2 | 0.48 | 1 % | 98 |
| 3 | 0.48 | 3 % | 95 |
| 4 | 0.48 | 5 % | 91 |
| 5 | 0.48 | 7 % | 88 |

Density of concrete: - Using cube size is

150mm*150mm*150mm. For finding the density first we have to be take weight of cube:

**Table 4.3:** Density of cubes by using steel fibre

| Serial no | % of steel fibre | Density (7 days kg/mt$^3$) | Density (28 days kg/mt$^3$) |
|---|---|---|---|
| 1 | 0 % | 2350 | 2430 |
| 2 | 1 % | 2360 | 2410 |
| 3 | 3 % | 2350 | 2360 |
| 4 | 5 % | 2340 | 2340 |
| 5 | 7 % | 2320 | 2310 |

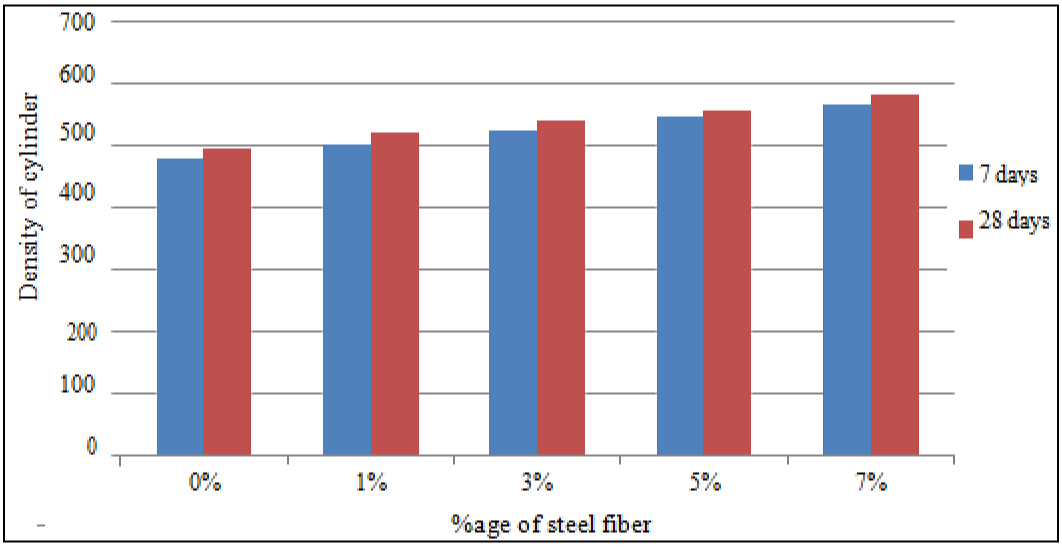



**Graph 4.1:** of density for cube

Cylinder size is 300mm* 150 mm

**Table 4.4:** for density of cylinder

| Serial no. | % of steel | Density after 7 days(kg/mt$^3$) | Density after 28 days(kg/mt$^3$) |
|---|---|---|---|
| 1 | 0 % | 480 | 495 |
| 2 | 1 % | 500 | 520 |
| 3 | 3 % | 525 | 540 |
| 4 | 5 % | 545 | 555 |
| 5 | 7 % | 565 | 580 |

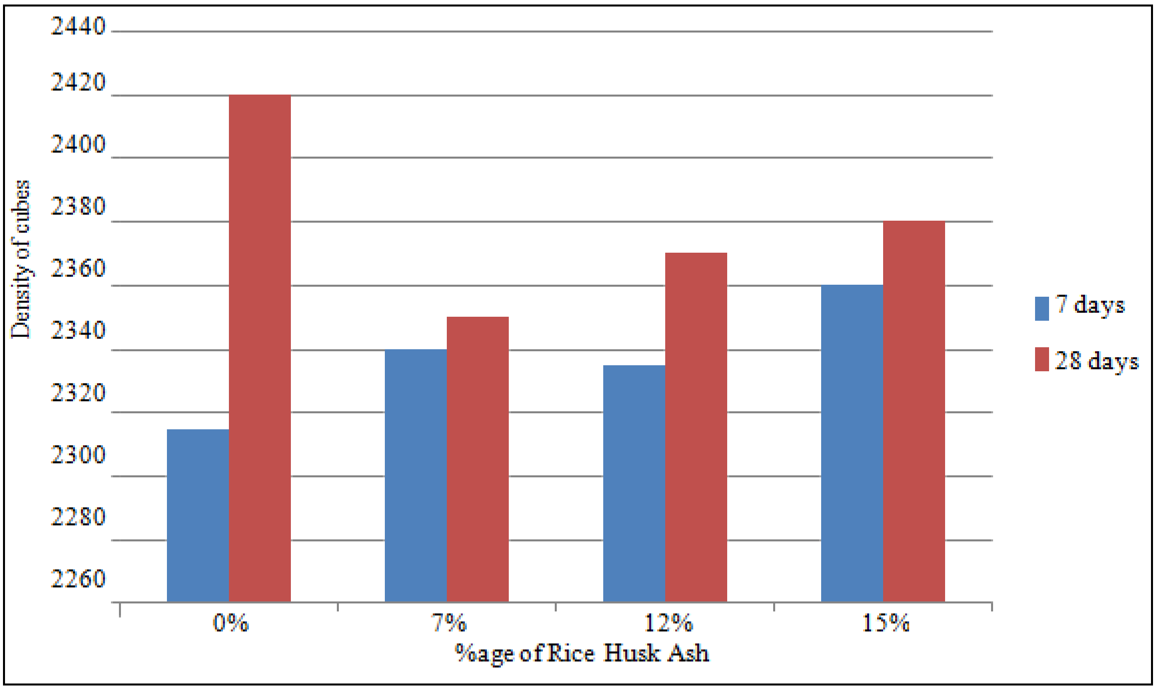



**Graph 4.2:** of density of cylinder

Density of cubes after using the Rice Husk Ash:-Cube size 150mm*150mm*150mm

**Table 4.5:** Density of cubes by using RHA

| Serial no. | % of RHA | Density after 7 days(kg/mt$^3$) | Density after 28 days(kg/mt$^3$) |
|---|---|---|---|
| 1 | 0 % | 2315 | 2420 |
| 2 | 7 % | 2340 | 2350 |
| 3 | 12 % | 2355 | 2370 |
| 4 | 15 % | 2360 | 2380 |

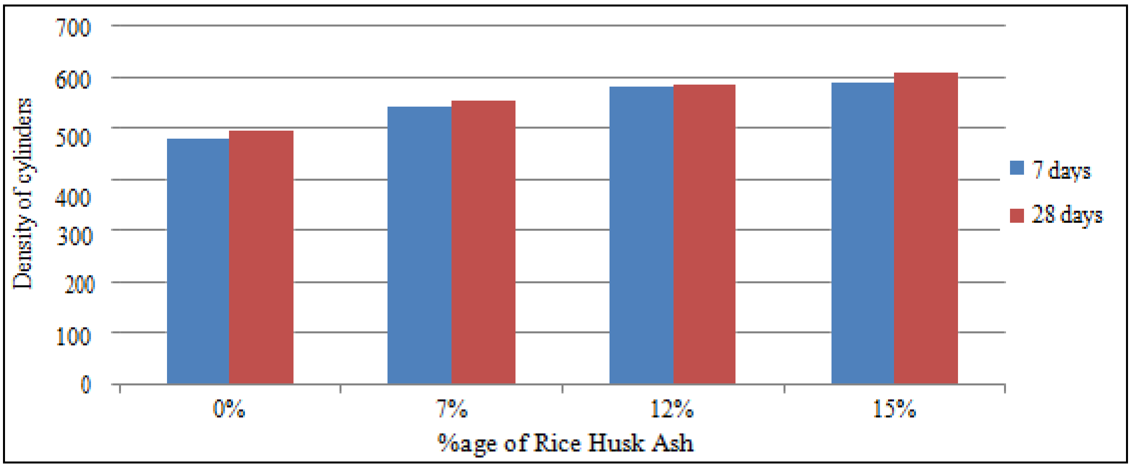



**Graph 4.3:** Density of cubes

Cylinder size is 300mm*150mm

**Table 4.6:** Density for cylinder by using RHA

| Serial no. | % of RHA | Density after 7 days(kg/mt$^3$) | Density after 28 days(kg/mt$^3$) |
|---|---|---|---|
| 1 | 0 % | 480 | 495 |
| 2 | 7 % | 540 | 555 |
| 3 | 12 % | 580 | 585 |
| 4 | 15 % | 590 | 610 |




**Graph 4.4:** Density of cylinders

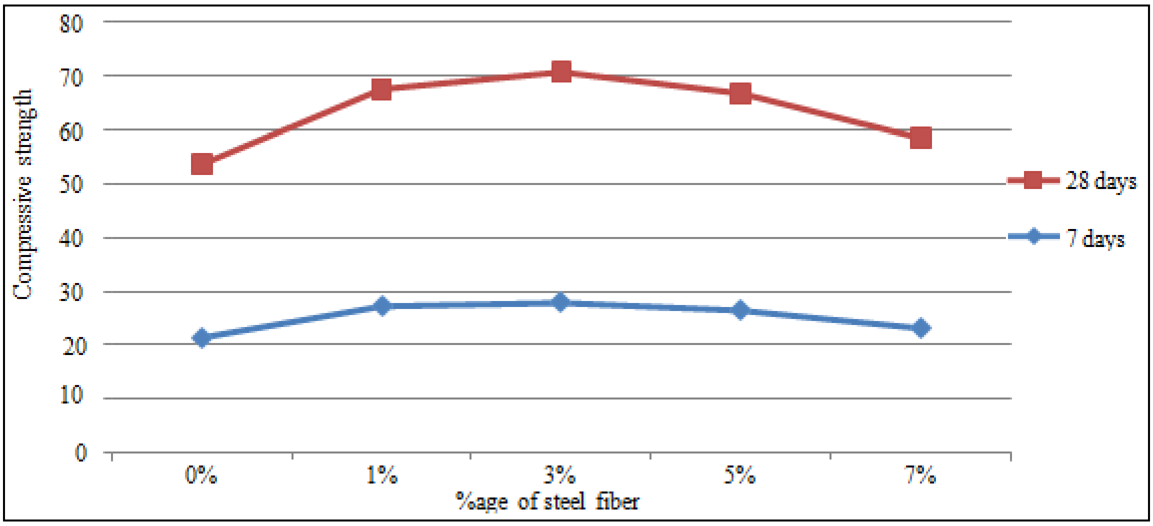
### 4.3 Compressive strength

The compressive strength of any material is defined as the ability of a material to carry loads on its surface without any cracks or deflection. We are finding Compressive strength for the different percentages of steel fiber 0 %, 1%, 3 %,5 % and 7%.I found the optimum value of steel fibre is 3% for adding into the concrete by the weight. And the size of cube is 150mm*150mm*150mm which is used for finding the compressive strength. Compressive strength is determined by using of UTM, where the load was applying at the size of cube 150mm*150mm*150mm 2.33 /sec. Total number of cube casted is 27.

**Figure 4.0** Sample during compressive testing

**Table 4.7** Compressive strength of cubes by using SF (optimum value of RHA used is12%)

| Sr. No. | % of RHA | % of steel | Compressive Strength | | | |
|---|---|---|---|---|---|---|
| | | | 7 Days(Mpa) | Avg(Mpa) | 28 Days(Mpa) | Avg(Mpa) |
| 1 | 12% | 0% | 21.66 | 21.31 | 31.22 | 32.27 |
| | | | 20.95 | | 32.8 | |
| | | | 21.32 | | 32.72 | |
| 2 | 12% | 1% | 26.8 | 27.15 | 40.2 | 40.33 |
| | | | 28.15 | | 40.5 | |
| | | | 26.52 | | 40.3 | |
| 3 | 12% | 3% | 27.41 | 27.79 | 42.2 | 42.84 |
| | | | 28.2 | | 43.52 | |
| | | | 27.76 | | 42.8 | |
| 4 | 12% | 5% | 26.51 | 26.34 | 40.8 | 40.38 |
| | | | 25.2 | | 40.2 | |
| | | | 27.32 | | 40.13 | |
| 5 | 12% | 7% | 25.32 | 23.07 | 35.12 | 35.34 |
| | | | 20.67 | | 35.3 | |
| | | | 23.22 | | 35.6 | |

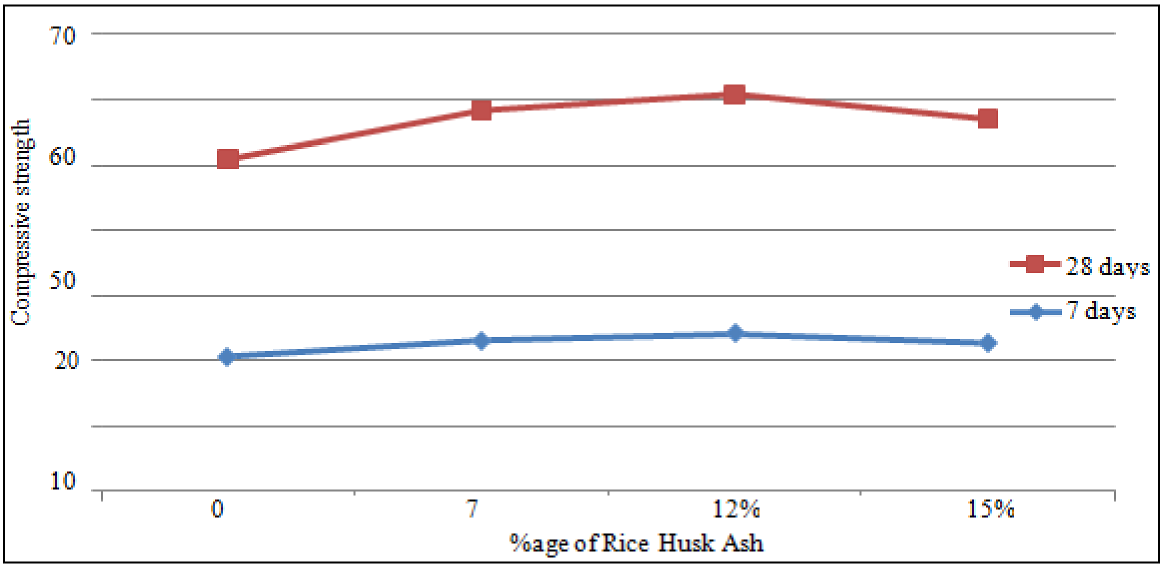



**Graph 4.5:** Between compressive strength and %age of steel fibre

**Figure 5:** During testing the compressive strength with RHA

**Table 4.8:** Compressive strength of cubes by using RHA( steel fibre used is 3%)

| Sr. No. | % of RHA | % Of Cement | % Of SF | Compressive strength | | | |
|---|---|---|---|---|---|---|---|
| | | | | 7 days(Mpa) | Avg (Mpa) | 28Days(Mpa) | Avg(Mpa) |
| 1 | 0% | 100% | 3% | 30.3 | 29.62 | 45.32 | 39.21 |
| | | | | 29.65 | | 37.8 | |
| | | | | 28.89 | | 37.8 | |
| 2 | 7% | 93% | 3% | 27.2 | 29.1 | 40.8 | 41.2 |
| | | | | 30.8 | | 42.8 | |
| | | | | 30.3 | | 43 | |
| 3 | 12% | 88% | 3% | 28.6 | 29.06 | 35.32 | 41.74 |
| | | | | 33.8 | | 46.48 | |
| | | | | 25.8 | | 43.4 | |
| 4 | 15% | 85% | 3% | 31.2 | 26.67 | 33.52 | 39.29 |
| | | | | 24.1 | | 46.37 | |
| | | | | 23.7 | | 37 | |



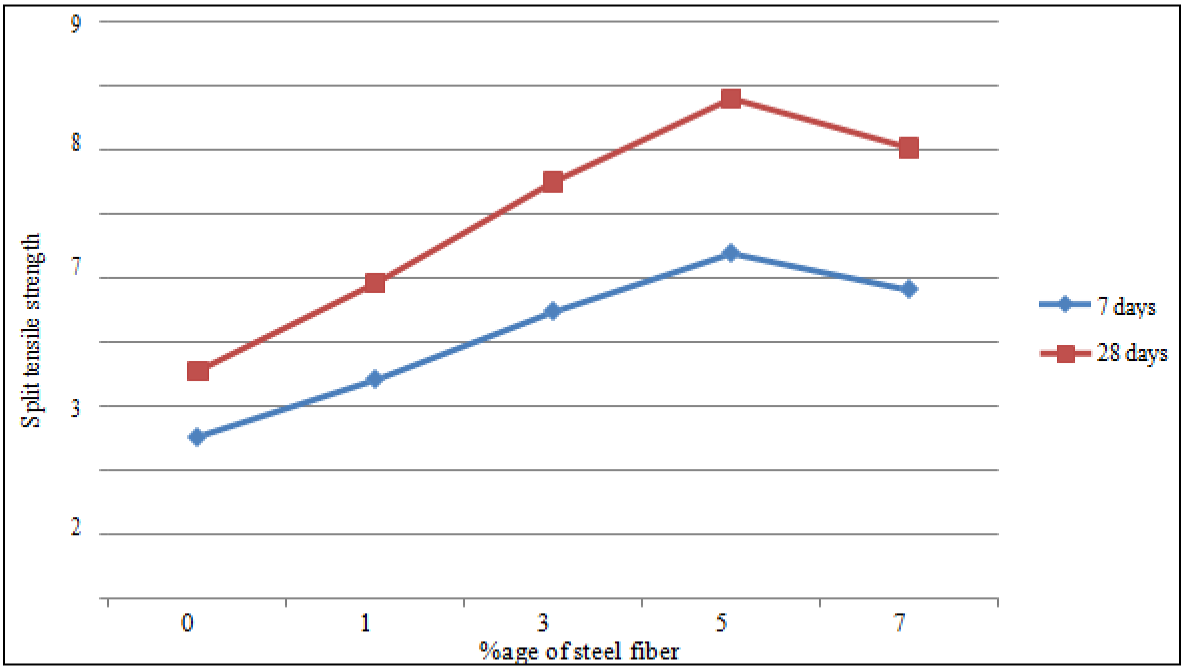

**Graph 4.6:** Between the compressive strength and RHA

### 4.4 Split tensile strength

Split tensile strength of cylindrical concrete sample will be determined by applying the load along the length of the sample at a continuous rate until failure occurs. The splitting tensile strength will be finding out by dividing the applied load by the area. The load applied by the rate of 1.2/sec, size of the cylinder is 30cm*15cm. Total number of casted cylinder is 27.

**Table 4.9:** Split tensile strength of cylinder by using SF by replacing 12% of cement with RHA

| Sr no. | % of SF | % of RHA | Split tensile Strength | | | |
|---|---|---|---|---|---|---|
| | | | 7days (Mpa) | Avg (Mpa) | 28days (Mpa) | Avg (Mpa) |
| 1 | 0% | | 1.6 | 1.53 | 2.6 | 2.86 |
| | | 12% | 1.48 | | 2.58 | |
| | | | 1.53 | | 3.52 | |
| 2 | 1% | | 1.35 | 1.55 | 2.9 | 2.97 |
| | | 12% | 1.59 | | 2.93 | |
| | | | 1.72 | | 3.1 | |
| 3 | 3% | | 1.5 | 1.63 | 2.99 | 3.1 |
| | | 12% | 1.79 | | 3.13 | |
| | | | 1.6 | | 3.2 | |
| 4 | 5% | | 1.6 | 1.72 | 3.2 | 3.23 |
| | | 12% | 1.72 | | 3.3 | |
| | | | 1.86 | | 3.19 | |
| 5 | 7% | | 1.49 | 1.57 | 3.1 | 2.89 |
| | | 12% | 1.63 | | 2.88 | |
| | | | 1.51 | | 2.73 | |



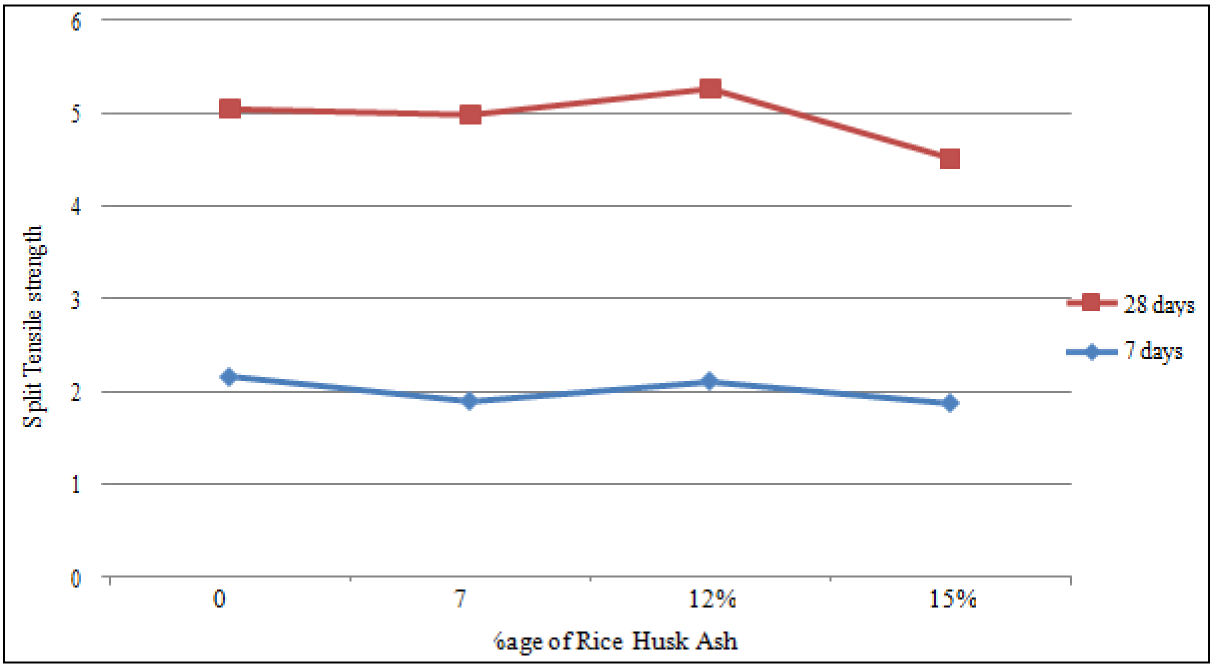

**Graph 4.7:** Between Split tensile strength and %age of steel fibre

**Figure 6:** During the testing of split tensile strength

**Figure 7:** Shows the cracks

**Table 4.10:** Split tensile strength of Cylinder by using RHA (optimum value of steel fibre used is 5%)

| Sr no. | % of RHA | %of SF | Split tensile strength | | | |
|---|---|---|---|---|---|---|
| | | | 7 days(Mpa) | Avg(Mpa) | 28Days(Mpa) | Avg(Mpa) |
| 1 | 0% | 5% | 2.2 | 2.16 | 1.23 | 1.38 |
| | | | 2.1 | | 1.46 | |
| | | | 2.18 | | 1.46 | |
| 2 | 7% | 5% | 1.8 | 1.89 | 2.7 | 2.75 |
| | | | 1.98 | | 2.72 | |
| | | | 1.88 | | 2.85 | |
| 3 | 12% | 5% | 2.1 | 2.1 | 3.15 | 3.16 |
| | | | 2.12 | | 3.23 | |
| | | | 2.08 | | 3.1 | |
| 4 | 15% | 5% | 1.88 | 2.31 | 2.68 | 2.64 |
| | | | 2.89 | | 2.66 | |
| | | | 2.16 | | 2.58 | |




**Graph 4.8:** Between Split tensile strength and %age of RHA

## 5. Conclusion

Following conclusion may be drawn based on the observation.

- Addition of 3 % of steel fiber brings about increment in the compressive strength and utilization of more than 3 % steel fiber will diminish the compressive strength.
- Addition of 5 % of steel fiber brings about increment in split tensile strength and utilization of more than 5 % steel fiber brings about decline in the split strength.
- Addition of 12 % of RHA brings about increment in compressive strength and utilization of more than 12 %

of RHA brings about lessening in compressive strength.
- Addition of 12 % of RHA brings about increment in split tensile strength and utilization of more than 12 % of RHA brings about abatement in the split strength.
- The steel fibre and Rice Husk Ash (RHA) steel fibre is better for split tensile strength.
- RHA is cheap compared to steel fiber

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