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Study on Properties of Concrete using Rice Husk Ash and Fly Ash with Sisal Fiber as Partial Replacement of Fine Aggregate & Cement: A Review

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ABSTRACT

Concrete is the most widely used construction material in the world it is a mixture of cement, sand, coarse aggregate and water. Storage and safe disposal of industrial by product such as fly ash, SF and rice husk ash is a huge problem everywhere, reuse of these waste eliminates/reduce the problem. This experiment fine aggregate is replaced 0%,10%,20%,30% and 40% of its weight by rice husk ash and cement is replaced 20% of its weight by fly ash & SF in all concrete mix and there effects are studied.

In this experiment the compressive strength of the concrete is increased. The compressive strength of the concrete by replacing the 20% sand by RHS and 20% cement by the 19% fly ash & 1% SF the strength increases at 32.52 to 37.8 in M- 30 concrete. After adding the RHA the strength is Decreases. The flexure strength of the concrete by replacing 20% sand by RHS and 20% cement by the 19% fly ash & 1% SF the strength increases at 5.2 to 6.69 in M-30 concrete. After adding the RHA the strength is Decreases Thus, flexure strength is also increase by including the RHS. It also reduces the consumption of the cement. The split tensile strength of the concrete by replacing 20% sand by RHS and 20% cement by the 19% fly ash & 1% SF the strength increases at 3.09 to 4.49 in M-30 concrete. After adding the RHA the strength is Decreases. Hence by adding the fly ash with stone dust is also increase the tensile strength of the concrete. Hence saving in cost is two ways cost of sand and cement.

KEYWORDS: *Rice Husk Ash, Fly Ash, Sisal Fiber, Fine Aggregate, Compressive Strength, Tensile Strength and Flexural Strength*

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1. INTRODUCTION

Concrete is one of the oldest and most common construction materials in the world, its availability, long durability, and ability to sustain extreme environmental condition. Concrete structures are seen everywhere, such as buildings, roads, bridge and dams etc. The concrete having cement, sand and coarse aggregates mix up in an appropriate percentage in addition to water is called Plain cement concrete. As the demand for infrastructure in increasing in India, the demand for the concrete as a material of construction is considerably increasing. The production of Portland cement must increase in order to meet this elevating demand. However, the contribution of greenhouse gas emission from Portland cement production is about 1.35 billion tons annually or about 7% of the total Green House Gas (GHG) emissions to the earth's atmosphere. Furthermore, Portland cement is among the most energy-intensive construction materials, after aluminum and steel. It is also known that the production of each ton of Portland cement releases almost one ton of carbon dioxide (CO2) into the atmosphere. The production of Portland cement is also very energy intensive. Portland cement is the vast majority of cement used in construction work. Manufacturing of Portland cement consists of blending naturally occurring rocks of calcium carbonate, with the alumina, silica & iron oxides.

Concrete is a composite material which consists eccentrically of a binding medium. Concrete is no longer made of aggregate Portland cement and water only. Often but not always it has to incorporate at least one of the additional ingredients such as admixture or cementitious material to enhance its strength and durability within which are embedded particles or fragments of relative inert filler in Portland cement concrete. The binder is a mixture of Portland cement. The filler may be any of a wide variety of natural or artificial. Fine and coarse aggregate; and in some instances an admixture. Concrete is presently one of the most essential materials that have been used in the civil engineering construction works. When concrete is reinforced with steel, it has got a higher capacity for carrying loads. Concrete being a heterogeneous mix of several ingredients, the quality of the constituent material and their respective proportions inthe concrete, determine its strength and other properties.

The price of the building materials has reached an alarming rate of increase in the recent past. This has necessitated government, private and individuals to go for research of locally available materials to partially or fully replace the conventional materials. The increasing demand for cement and concrete is met by the partial replacement of cement. The entire idea of this thought is to guarantee that a normal common resident of India will actually want to possess a house. Concrete being a composite material unpredictably made out of a cover. Presently, Concrete isn't simply comprised of total, portland concrete and water. Frequently yet not generally it needs to join at any rate oneof the extra fixings like admixture or cementitious material to upgrade its solidarity and sturdiness. Inside which are installed particles or pieces of relative dormant filler in Portland concrete cement.

The turn of events and exploration of materials and the strategy in structural designing was to discover most imported perspectives which are accessibility, climate similarity, and monetary imperatives. The determination of the development materials should just be made after a total audit of its drawn out exhibition, sturdiness in the design and climate similarity.

1.1. CEMENT AND CLIMATE

How does solid fit into this mind boggling world situation of the development business? The appropriate responses are straightforward yet wide-going. Aside from numerous restrictions, concrete is as yet liked as a development material and distinguished as one of the hero of country's foundation. Additionally, monetary advancement and dependability of any country is seen roundabout connection with the solid, and without a doubt, to the standard personal satisfaction. Significant benefit of cement is simple and promptly readiness and creation into practically all possible shapes and primary frameworks in foundation domain. Accessibility of constituents wherever in world makes it generally utilized development material. Either magnificence of cement or reason for its horrible showing relies absolutely on both, decision of the constituents and the proportioning of its constituents by the designer or the technologist. The most extraordinary nature of the material has intrinsic alkalinity into it that gives a passivation instrument which can defend installed steel support by making a non-consuming climate accessible for it. Unwavering quality and strength of cement in development world has been seen by understanding its material after a long encounter on openness to protected conditions (no openness to extreme conditions or forceful specialists). Additionally, there have been astounding confirmations that experience shown difficulty free assistance of planned cement even at openings in tolerably forceful conditions, when furnished rehearsed with care and control at creation and manufacture stages, trailed by very much arranged support and investigation frameworks.

PARTIAL REPLACEMENT OF CEMENT ENABLES

➢ **Sustainability**

- Feasible advancement of the concrete and solid industry requires the use of modern and agribusiness squander parts. As of now, for a different explanation, the solid development industry isn't economical. Right off the bat it devours immense characteristics of virgin materials which can stay for next ages. Besides, the standard cover in concrete is Portland concrete, the creation of which is a significant commitment to ozone depleting substance emanations that are ensnared in an Earth-wide temperature boost and environmental change. Thirdly, toughness of many solid constructions is inadequate with regards to that causes characteristic assets wastage. Along these lines, subbing a piece of concrete with commonsense reused item might be an answer that is by all accounts alluring for reasonable turn of events.

➢ **Natural effects**

- Specialists can't stand to overlook the effect of development innovation on our environmentalfactors - and these ramifications are applied to local, public and Worldwide scale on climate. World Assets, energy utilization and emanation of carbon dioxide are not many noticeable impacts of quick development. Concrete has a fantastic environmental profile when contrasted with glasses, metals and different polymers. Material and energy needs for the creation of cement is least for an acceptable wanted designing property like strength, versatilemodulus or toughness. Additionally, concrete is known for creation of least hurtful results, and makes the least harm the climate when contrasted with other skillful development materials. Regardless of this, we need to acknowledge that Portland concrete is both asset and energy - serious. Each huge load of concrete needs about 1.5 huge loads of crude materials, and around 4000 to 7500 MJ of energy for creation. The expense of energy to deliver a huge load of concrete is assessed to represent 40 - 45% of the absolute plant creation cost. Significantly more critically, every huge loads of concrete deliveries 1.0 to 1.2 huge loads of CO_2 into the encompassing climate on when material is kept set up. On the planet we live in, the utilization of assets and energy, and the level of climatic contamination that it exacts are generally significant.

➢ **Properties of Cement**

- Concrete has numerous credits that establish it a well known structure material. The right extent of fixings, situating, and relieving are required in parliamentary strategy for these credits to be ideal.
- Great quality cement has numerous benefits that add to its notoriety. Principal, it is practical when fixings are promptly usable. Cement's long life and relatively low upkeep necessities increment its monetary advantages. Concrete isn't similarly prone to spoil, consume, or rot as other structure materials. Concrete can be framed or projected into practically any ideal structure. Development of the projects and projecting can happen on the worksite which diminishes costs.
- Concrete is a non-ignitable material which makes it fire-protected and capable with stand high temperatures. It is impervious to wind, water, rodents, and worms. Subsequently, concrete is regularly utilized for tornado cellars.
- Concrete has a few constraints in spite of its various benefits. Concrete has a generally low rigidity (contrasted with other structure materials), low pliability, low solidarity to-weight proportion, and is vulnerable to breaking. Solid remaining parts the material of decision for some applications, paying little heed to these restrictions.
- The compressive strength of cement is regularly at any rate multiple times its elasticity, and five to multiple times its flexural strength. The primary variables overseeing compressive strength are introduced beneath:
- Water-concrete proportion is by a long shot the main component.

- The age of the restored concrete is excessively critical. Concrete slowly develops fortitude in the wake of blending because of the synthetic communication between the concrete and the water. It is ordinarily tried for its 28-day strength, however the strength of the solid may keep on expanding for a year in the wake of blending.
- The personality of the concrete, relieving conditions, dampness, and temperature. The more prominent the time of soggy stockpiling (100% mugginess) and the higher the temperature, the more noteworthy the strength at some random age.
- Air entrainment, the presentation of tiny air voids into the solid blend, serves to incredibly build the end result's protection from breaking from freezing-defrosting cycles. Most outside structures today utilize this method.

SUPLEMENTARY CEENTITIOUS MATERIAL

As there is immense expansion in the business and private squanders and industry by items like fly debris, silica seethe, ground granulated impact heater slag and so on The utilization of these materials in solid developments is prescribed to limit the contamination yet in addition to improvethe properties of cement.

The SCM can be classified based on response water powered and pozzolanic. Pressure driven materials can respond with water to make cementitious compound like ground granulated impact heater Slag (GGBS). Pozzolanic materials are not having any cementitious property, nonetheless, when utilized withcementor lime can form products possessing cementitious successes.

RICE CREATION

Rice is a weighty staple on the planet market all things considered. It is the second biggest measure of any grain delivered on the planet. The primary biggest is corn, however is delivered for elective reasons instead of rice which is created fundamentally for utilization. Along these lines, rice can be viewed as the main yield delivered for human utilization on the planet. The main locale of the world which produces rice is Asia. Rice can without much of a stretch be filled in tropical districts on a territory. It is appropriate to nations and locales with low work expenses and high precipitation, as it is exceptionally work serious to develop and requires a lot of water for development.

Fig.1.1. Rice Straw

India is one of the world's largest producers of white rice, accounting for 20% of all world rice production. Rice is India's preeminent crop, and is the staple food of the people of the eastern and southern parts of the country.

Table.1.1. Top rice producing countries based on the stats of Food and Agriculture Organization.

Counties	Production of Rice (Million Metric Ton)
China	197.2
India	120.6
Indonesia	66.4
Bangladesh	49.3
Vietnam	39.9
Myanmar	33.2
Thailand	31.5
Philippines	15.7
Brazil	11.3
United States	11
Japan	10.6
Cambodia	8.2

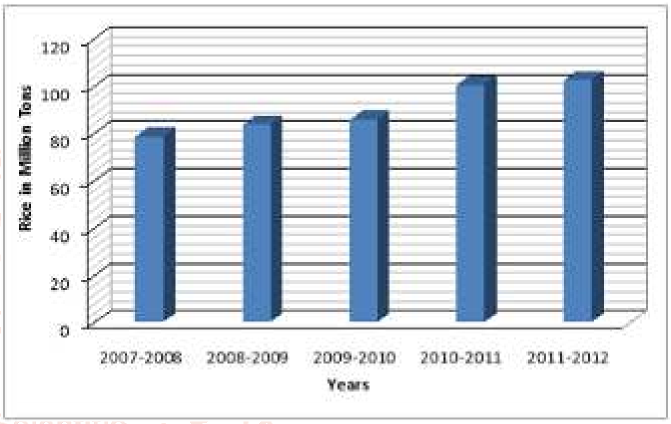

Fig.1.2. Rice Production in India in Last Five Years

FLY ASH

Fly ash is pozzolana SC material one of the residues produced in the combustion of coal. Fly ash is generally confined from the chimneys of power plants. Relying upon the source of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial. Since the worldwide production of Portland cement is expected to reach nearly 2 billion tons by 2010, replacement of any large portion of this cement by fly ash could significantly reduce carbon emissions associated with construction.

It has been experimentally proved to replace Portland cement up to 30% by mass, without harmfully affecting the strength and durability of concrete. Several laboratory and field investigations have reported to reveal excellent strength and durability properties. However, the strength development occurs only at later period. Due to the spherical shape of fly ash particles,it can also increase workability of cement while reducing water demand.

ORGANIZATION OF THESIS

This thesis is divided into 6 chapters as follows

CHAPTER-1

This chapter consists the framework of the research question, explaining the necessity and sustainable construction materials in developing.

CHAPTER-2

This chapter comprises literature review, reviews the work that has been alreadycompleted in the field.

CHAPTER-3

This chapter consists the problem identification and objective of study.

CHAPTER-4
This chapter consists the details of experimental investigation for the present study toinvestigate properties of materials.

CHAPTER-5
This chapter shows the results of experiments conducted to find properties of concrete.

CHAPTER-6
This chapter shows Conclusions and future scope of work.

2. LITERATURE REVIEW

Many studies have been done to investigate the benefits of applying pozzolanic materialsin constituting and improving the properties of concrete.

M. Nehdi, J. Duquette, A. El Damatty (2003) considered Execution of rice husk debris created utilizing another innovation as a mineral admixture in concrete. He researched the utilization of another strategy for the controlled ignition of Egyptian rice husk to relieve the ecological concerns related with its uncontrolled consuming and give an advantageous establishing material to the neighborhood development industry. The reactor utilized gives effective ignition of rice husk in a short residency time by means of the suspension of handled particles by planes of an interaction air stream that is constrained however fixed calculated edges at high speed. Examinations on the rice husk debris (RHA) hence created included oxide investigation, X-beam diffraction, carbon content, grind ability, water interest, pozzolanic action record, surface region, and molecule size conveyance estimations. What's more, solid blends consolidating different extents of silica smolder (SF) and Egyptian RHA (EG-RHA) created at various burning temperatures were made and looked at. The usefulness, superplasticizer and air-entraining admixture prerequisites, and compressive strength at different times of these solid blends were assessed, and their protection from fast chloride vulnerability and deicing salt surface scaling were inspected. Test outcomes demonstrate that in opposition to RHA created utilizingexisting innovation, the superplasticizer and air-entraining specialist necessities didn't increment definitely when the RHA created in this examination was utilized. Compressive qualities accomplished by solid combinations joining the new RHA surpassed those of cements containing comparative extents of SF. The protection from surface scaling of RHA concrete was superior to that of cement containing comparable extents of SF. While the chloride vulnerability was generously diminished by RHA, it remained marginally higher than that accomplished by SF concrete.

D. D. Bui, J. Hu, P. Stroeven (2005) examined impact of molecule size on the strength of rice husk debris mixed hole reviewed Portland concrete cement. He utilized rice husk debris (RHA) as an exceptionally responsive pozzolanic material to improve the microstructure of the interfacial progress zone (ITZ) between the concrete glue and the total in elite cement. Mechanical trialsMuhammad Shoaib Ismail, A.M. Waliuddin (1996) produced a high strength concrete (hsc) by using locally available materials. They obtained an ash by burning rice husk, an agro-waste material. They studied the effect of rice huskash (rha) that passes through #200 and #325 sieves as a 10–30% replacement of cement on the strength of HSC. They casted & tested a total of 200 test specimens at 3, 7, 28 and 150 days. Compressive and split tensile strengths of thetest specimens were determined. They found that cube strength over 70 MPa was obtained without any replacement of cement by rice husk ash. Test results indicated that strength of hsc decreased when cement was partially replaced by rha for maintaining same level of workability.

M. Nehdi, J. Duquette, A. El Damatty (2007) studied Performance of rice husk ash produced using a new technology as a mineral admixture in concrete. He investigated the use of a new technique for the controlled combustion of Egyptian rice husk to mitigate the environmental concerns associated with its uncontrolled burning and provide a supplementary cementing material for the local construction industry. The reactor used provides efficient combustion of rice husk in a short residency time via the suspension of processed particles by jets of a process air stream that is forced though stationary angled blades at high velocity. Investigations on the rice husk ash (RHA) thus produced included oxideanalysis, X-ray diffraction, carbon content, grindability, water demand, pozzolanic activity index, surface area, and particle size distribution measurements. In addition, concrete mixtures incorporating various proportions of silica fume (SF) and Egyptian RHA (EG-RHA) produced at different combustion temperatures were made and compared. The workability, superplasticizer and air-entraining admixture requirements, and compressive strength at various ages of these concrete mixtures were evaluated, and their resistance to rapid chloride penetrability and deicing salt surface scaling were examined. Test results indicate that contrary to RHA produced using existing technology, the superplasticizer and air-entraining agent requirements did not increase drastically

S.SARANYA et al 2009 studied on Self Compacting Concrete (SCC) Using Fly Ash and GGBS. This investigation plans to center around the likelihood of utilizing mechanical side-effects like Ground Granulated Blast Furnace Slag(GGBS) and Fly Ash (FA) in readiness of SCC. This undertaking presents the consequences of an exploratory investigation went for delivering SCC blends of M30 review by receiving diverse blend extents, fusing two mineral admixtures Fly Ash, Ground Granulated Blast Furnace Slag (GGBS), as supplementary solidifying materials and examination of their exhibitions.

Biswadeep Bharali et al 2010 concentrated on self compacting concrete (SSC) utilizing GGBS and fly debris. Right now considers are finished to understand the new and hardened properties of Self Compacting Concrete (SSC) in which bond is replaced by Ground Granulated Impact Heater Slag (GGBS) and Fly Debris (FA) in various degrees for M 30 survey concrete. The degrees wherein concrete superseded are 30% of GGBS, 20% of both GGBS and FA, 40% of GGBS, 15% of both GGBS and FA, 40% of FA and 30% of FA. The quality lead, Flexural direct and Split unbending nature direct of SSC are inspected. The parameters are attempted at different ages in concurrence with Department of Indian Benchmarks (BIS) for the various degrees wherein bond is superseded and moreover the gotten parameters are differentiated and customary SSC (100%bond). Super plasticizer GLENIUM B233 a thing from BASF is used to keep up convenience with consistent Water-Folio extent.

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Velosa and Cachim 2012 completed exploratory work on Oxygen and water fume transport in concrete glues, and inferred that the expansion in compressive quality of mortar containing silica smolder as a fractional substitution for concrete, enormously added to reinforcing the bond between the concrete glue and total. It was likewise shown that super plasticizer in blend with silica seethe assumes a more successful job in mortar blends than in glue blends. This can be credited to an increasingly proficient usage of super plasticizer in the mortar blends because of the better scattering of the silica rage.

Victor Ajileye Faseyemi 2013 explored the utilization of smaller scale silica and fly debris in self compacting concrete. Right now, exploratory program was proposed to investigation into the usage of fly debris stays, small scale silica in self compacting concrete. The substitution levels of bond by fly blazing stays, smaller scale silica are picked as 35%, 30%, 25%, 15% and 10% for fly soot while miniaturized scale silica are 10%, 8%, 6%, 4% and 2% for standard size of 3D shapes for C 50 audit of self compacting concrete. The instances of standard strong shapes (150 X 150 X 150 mm) were tossed with fly blazing flotsam and jetsam, small scale silica. Compressive machine was used to test all of the models. The models were tossed with C 50 audit concrete with different substitution levelsof bond from 0-35% with fly red hot remains, superplasticizer and gooey modifier while substitution levels of bond from 0 to 10% with smaller scale silica. Hundredmodels were tossed and the 3D shapes were set in relieving tank for 3, 7, 28 and 56 days and thickness of the squares and compressive quality were settled and recorded properly. Helpfulness was settled using hang stream, V-channel, L-

Ahmed Fathi 2013 proposed that, self-compacting concrete is the strong mix that has ability to restrict the confinement and to stream under its own weight and not by the vibration. By decreasing the all out substance and augmentation thesolid aggregate and furthermore the development of creation admixture, for instance, super plasticizer, we can achieve the necessary mix. The development inbond substance will incite increase in full scale cost. To keep up a key good ways from this issue the solid substitution material can be used. Fly red hot remains, microwave consumed rice husk ash and silica fume are the commended sort of bond substitution material to replace the solid substance in the strong and can fabricate the convenience properties of self compacting strong mix. All self compacting solid mixes showed commendable hang stream estimation of 650-768 mm that bunches a fair deformability. Oneself compacting solid mixes gavevalues inside the extent of 0.8 to 1.0 in L-box test. To achieve the fresh properties,microwave consumed rice husk requires more water than silica rage. The most imperative compressive quality and split flexibility was cultivated in 5% silica rage and 30% fly red hot stays with strong mix. Though all solid substitution material mixes realized high flexural quality, which was a result of the superfluous depleting and high cohesiveness. The execution of microwave consumed rice husk to override the solid depends upon the devouring degree which will impact the microstructure of the spread.

Bourmatte Nadjoua and Houari Hacene (2013) examined that the assortment of mortars and cements with substitution totals having particular extent for example 0% - 25% - half - 100%. The considered reused total is of blocks and of crushed cement. They watched and reason that the conduct to the state of new and solidified different materials made with the reused totals. The reused coarse totals are commonly more spongy and less thick than the customary totals.

Jitender Sharma and Sandeep Singla (2014) explore the utilization ofreused solid totals as interchange of common total; they utilized reused total in different rate and tests were directed and introduced. They reasoned that reused total has unpleasant, water assimilation multiple times all the more then to NA, lower in thickness, lower in usefulness. Which are expanding regarding augmentation of level of reused solid totals; Cost of development is 20% to 30% diminished by the utilizing of reused total; so that in other hand RCA is attainable for development work blended in with admixture.

Raju (2014) investigated the effect by use of coal bottom ash as partial replacement of fine aggregates in different percentages (0–30%) for M35 grade ofconcrete; tests were performed on these mixes. They concluded that concrete properties such as workability of bottom ash concrete decreased, modulus of elasticity of concrete decreased, crack nucleation and propagation during compressive and flexural loading for concrete incorporating bottom ash. Compressive strength was increased, the flexural strength of concrete almost decreased when fine aggregate was replaced by bottom ash.

Aruna et. al. (2015) contemplated the presentation of constructional squander material in new solid blend. They utilized tile total as incomplete substitution to coarse total in ordinary pervious and mixed cements just as halfway substitution of tile squander as totals alongside somewhat supplanting OPC by fly debris and explored quality, execution, solidness and so on they presumed that tile based cement, as around 10-15% abatement in quality and mix made by fractional substitution by earth rooftop tile to coarse totals diminishes with increment in level of mud rooftop tile as total. The decrease in quality is of the request for 10%, 17% and 46% comparing to P10, P20 and P30 blends.

Muhammad Nouman Haral 2016 determined that, an elective folio in the improvement business is normal pozzolan. Nowadays' common viewpoints have transformed into a significant stress of various in the improvement field. The solid business spoils nature identified with liberal proportion of CO_2.It is fundamental to control the entire methodology of security creation by constraining the proportion of CO_2 familiar with condition. The introduction of beneficial cementitious materials, this can be practiced. The strengthening cementitiousmaterials increase beginning with multi day then onto the following and beginning with one application then onto the following because of the solicitation and the resulting included expense. Self compacting concrete should have higher measure of folio, a higher fine all out substance and lesser proportion of coarse complete substance. Thus it is basic to intertwine substance admixtures, for instance, super plasticizers to keep proper handiness and consistency edges into thought of self compacting concrete. To achieve fresh strong properties, higher measures of better particles are incorporated. The utilization of Characteristic pozzolan as an elective spread in self compacting solid works up to 20% give stream fit mix. The confirmation of perfect poly carboxylic ether portion for various pastes can be found from balanced bog cone test. The stream limit of the pastes and mixes increases with the development in Poly carboxylic ether estimations. The hang stream increase with the development in volume division of paste of higher folio content. Higher water volume causes the threat of segregation and settlement of aggregate. The estimation of T500 reduces with the development in the paste volume part and water spread extent.

Y. S. Tai et. al. (2018) they examined the mechanical conduct of elite steelfilaments inserted in UHPC at different pullout speeds the test factors were steel fiber type, grid constituents, and pullout rates. Specifically, five kinds of high quality steel fiber were utilized and five pullout rates from semi static to affect rates were applied. What's more, the impact of decreased measure of glass powder, as key network constituent, on pullout conduct was investigated. Trial results show that the pullout reaction of the entirety of the fiber types display dynamically expanding rate affectability as the pullout speed increments and gets noteworthy during sway stacking. It is generally conspicuous in the smooth and bent filaments and least in the snared strands. Furthermore, examining electron magnifying lens considers are exhibited and used to clarify the system of rate upgrade from a minuscule point of view.

Anju Ramesan et. al. (2019) they learned about reasonableness of execution of light weight concrete with plastic total. the reasonableness of reused plastics (high thickness polyethylene) as coarse total in concrete by directing different tests like usefulness by droop test, compressive quality of shape and chamber, parting rigidity trial of chamber, flexural quality of R.C.C just as P.C.C Shafts, to decide the property and conduct in concrete. Impact of supplanting of coarse total with different rates (0% to 40%) of plastic total on conduct of cement was tentatively examined and the ideal substitution of coarse total was discovered.The outcomes demonstrated that the expansion of plastic total to the solid blend improved the properties of the resultant blend.

K.R.S Maruthi Raj 2019 The Beneficial cementitious materials like silica seethe (small scale silica), fly debris, and impact heater slag are normally used to activate their pozzolanic activity that improves the quality, usefulness, toughness, protection from splits and porousness Silica Smoke is most usually utilized valuable cementitious material which results from the electric heater activity during the creation of silicon metal and ferrosilicon combination as an oxidized fume. Silica Smoke comprises of exceptionally fine vitreous particles with a surface territory somewhere in the range of 13,000 and 30,000m2/kg and its particles are around multiple times littler than the normal concrete particles.

Saresh Arya 2020 The fundamental point of the present investigation is to decide the quality of solid blend of M30 grade, with halfway supplanting of concrete with Silica seethe, Rice husk debris and FLY-Debris. Portland concrete is the most significant element of cement and is a flexible and moderately significant expense material. Huge scope creation of concrete is causing ecological issues on one hand and exhaustion of characteristic assets on other hand. Consequently, the specialists are presently centered around utilization of waste material having solidifying properties, (for example, fly debris, GGBS, metakaloin, silica seethe, rice husk debris) which can be included concrete as fractional substitution of concrete, without settling on its quality and strength, which will bring about lessening of concrete creation in this manner decrease in emanation in ozone harming substances, notwithstanding maintainable administration of the waste. This paper introduces an investigation on mechanical and solidness properties of ternary mix is a blend of three items (for example portland concrete and two SCMs) and quaternary mix is a blend of four items(for example portland concrete and three SCMs). The pozzolanic material, for example, fly debris, silica seethe, rice husk debris were utilized as a concrete supplanting materials in conjuction with standard Portland concrete. This paper introduces an investigation on mechanical and sturdiness properties of cement made with multi part concrete. Study incorporates idea of multi mixed concrete adventures the advantageous attributes of all pozzolanic materials in creating better concrete.

3. PROBLEM IDENTIFICATION AND OBJECTIVES

PROBLEMS IDENTIFICATION

- Scarcity of natural sand and cement necessitates alternate substitute materials
- Fly ash and RHS is generated in large quantity.
- The disposal problem of rice husk has become a serious environmental issue.
- This study is conducted to determine the replacement ratio of cement with rice husk ashand fly ash.

OBJECTIVES

- To find out alternative materials as partial replacement of cement and sand.
- To check the workability of the concrete by adding Fly ash and RHS with SF.
- To find out properties of concrete by adding Fly ash and RHS with SF.
- To study techno-economic feasibility of concrete using Fly ash and RHS with SF as asubstitute material.

4. METHODOLOGY

In this study different ratio of partial replacement of cement with fly ash + sisal Fiber andfine aggregates with RHA will be carried out by mixing concrete.

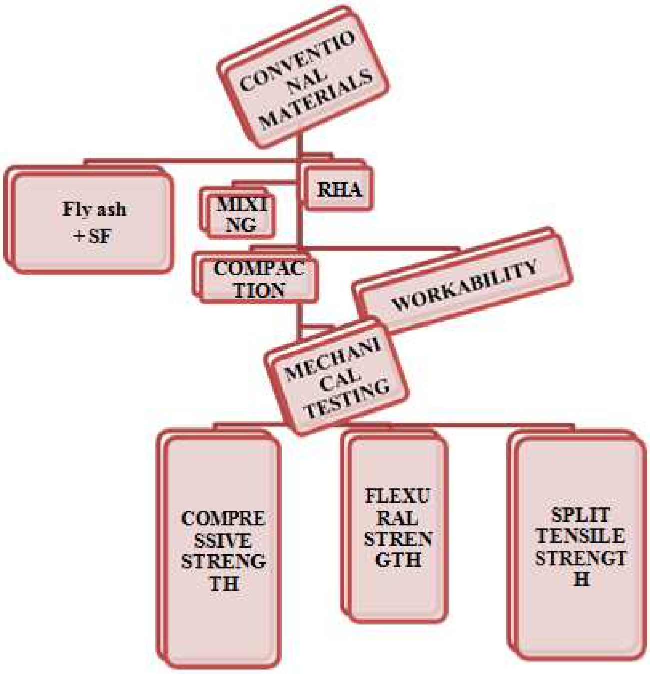

Figure.4.1 - Flow chart of Methodology

MATERIALS
Following materials are used in the present study.

RHA
The rice husk ash has good reactivity when used as a partial substitute for cement. The ash obtained from properly burned rice husk is found to be active within the cement paste. The use and practical application of rice husk ash for concrete manufacturing may be cost effective.

SISAL FIBER
Fibres are used as stabilizer in concrete mix. Fibres helps to increase the strength.

Figure.4.2 Sample of sisal fibre

Sisal fibre is one of the most widely used natural fibres and is very easily cultivated. It hasshort renewal times and grows wild in the hedges of fields and railway tracks. Nearly 4.5 million tons of sisal fibre is produced every year throughout the world.

TABLE 4.1: CHEMICAL COMPOSITION OF SISAL FIBRE

Cellulose	65%
Hemicelluloses	12%
Lignin	9.9%
Waxes	2%
Total	100%

sisal fibre in the concrete as the reinforcement and in this investigation the fibre is mixed in different proportions by cutting it into small pieces of size 3 to 5 cm.

TABLE 4.2: PHYSICAL PROPERTIES OF SISAL FIBRE

S. No	Property	Value
1	Average length (mm)	300
2	Averagediameter (mm)	0.12
3	Density(g/cm3)	1.45
4	AverageTensile strength (N/mm2)	1090
5	Elongation(%)	18.2
6	Water absorption(%)	76.7%

FLY ASH CEMENT
Fly ash, which is mainly made up of silicon dioxide and calcium oxide, can be used as a alternate for Portland cement, or as a add-on to it. The materials which build up fly ash are pozzolanic, hence, they can be used to bind cement materials together.

Chemical analysis of fly ash cement
The chemical analysis of fly ash cement has been conducted by several researchers to investigate the chemical composition. These are listed in Table 4.3

TABLE 4.3 CHEMICAL ANALYSIS OF FLY ASH CEMENT

Chemical Compound	Fly Ash Cement (%)
SiO_2	6
CaO_2	49
MgO_2	0.66
Fe_2O_3	15
Al_2O_3	16

SAND
Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. The most common constituent of sand, in inland continental settings and non-tropical coastal settings, is silica(silicon dioxide, or SiO_2), usually inthe form of quartz which, because of its chemical inertness and considerable hardness, is the most common mineral resistant to weathering. It is used as fine aggregate in concrete.

Concrete Mix Design
The concrete mix design is a process of selecting the suitable ingredients of concrete and determining their most optimum proportions which would produce, as economically as possible, concrete that satisfies the job requirements, i.e. the concretehaving a certain minimum compressive strength, the desired workability and durability. In addition to these requirements, the cement content in the mix should be as low as possible to achieve maximum economy. The proportioning of the ingredients of concrete is an important part of concrete technology as it ensures the quality and economy.

PRINCIPAL OF CONCRETE MIX DESIGN
Proportioning of a solid blend contains deciding the general amounts of materials to be utilized underway of cement for a given reason. The way toward choosing extents of these materials is classified "Solid Blend Plan" and ought not be misconstrued with underlying model. Proportioning might be founded on certain information got by viable experience and examinations of test consequences of different fixings or an observational information. The cycle of blend configuration includes the thought of properties and expenses of fixings.

Prerequisites of putting and completing the new concrete and properties of solidified cement like strength, solidness, and volumetric soundness and so forth The principle destinations of the solid blend configuration would thus be able to be begun as creation of solid, which will be:

- Fulfilling the necessities of new solid (Usefulness).
- Satisfying the properties of solidified solid (Strength and solidness).
- Most prudent for the ideal particulars and given materials at a given site.
- Performing most ideally in the given design under given states of climate.

THE SOLID BLEND CONFIGURATION

1. Workability of new concrete.
2. Desired strength and sturdiness of solidified solid which thus is administered by water-concrete proportion law.
3. Conditions at the site, which helps in choosing functionality, strength andsolidness prerequisites.

The compressive strength of solidified solid which is by and large viewed as a record of its different properties, relies on numerous components, for example quality and amount of concrete, water and totals; clumping and blending; putting, compaction and relieving.

SORT OF BLENDS

- Nominal Blends

In the past the particulars for concrete recommended the extents of concrete, fine and coarse totals. These blends of fixed concrete total proportion which guarantees satisfactory strength are named ostensible blends. These offer straightforwardness andunder typical conditions, have an edge of solidarity over that predefined. Be that as it may, because of the fluctuation of blend fixings the ostensible cement for a given usefulness differs generally in strength.

- Standard blends

The ostensible blends of fixed concrete total proportion (by volume) differ broadly in strength and may result in under-or over-rich blends. Therefore, the base compressivestrength has been remembered for some particulars. These blends are named standard blends.

- Designed Blends

In these blends the presentation of the solid is indicated by the planner yet the blend extents are controlled by the maker of cement, then again, actually the base concrete substance can be set down. This is most reasonable way to deal with the choice of blend extents in with explicit materials at the top of the priority list having pretty much special qualities. The methodology brings about the creation of cement with the suitable properties most financially. Be that as it may, the planned blend doesn't fill in as a guide since this doesn't ensure the right blend extents for the recommended execution.

For the solid with undemanding execution ostensible or standard blends (recommended in the codes by amounts of dry fixings per cubic meter and by droop) might be utilized uniquely for little positions, when the 28-day strength of cement doesn't surpass 30 N/mm2. No control testing is essential dependence being set on themajority of the fixings.

COMPONENTS INFLUENCING THE DECISION OF BLEND EXTENTS

- Compressive strength

It is perhaps the main properties of cement and impacts numerous other describable properties of the solidified cement. The mean compressive strength needed at a particular age, typically 28 days, decides the ostensible water-concrete proportion of the blend. The other factor influencing the strength of cement at a given age and relieved at an endorsed temperature is the level of compaction. As per Abraham's law the strength of completely compacted concrete is contrarily corresponding to the water-concrete proportion.

- Workability

The level of functionality required relies upon three components. These are the size ofthe part to be cemented, the measure of support, and the technique for compaction to be utilized. For the limited and convoluted segment with various corners or unavailable parts, the solid should have a high functionality so full compaction can beaccomplished with a sensible measure of exertion. This likewise applies to the implanted steel segments. The ideal functionality relies upon the compacting hardware accessible at the site.

- Durability

The sturdiness of cement is its protection from the forceful ecological conditions. High strength concrete is by and large more sturdy than low strength concrete. In the circumstances when the high strength isn't important however the states of openness are to such an extent that high toughness is essential, the solidness prerequisite will decide the water-concrete proportion to be utilized.

- Maximum ostensible size of total

As a rule, bigger the greatest size of total, more modest is the concrete necessity for a specific water-concrete proportion, on the grounds that the functionality of solid increments with increment in most extreme size of the total. Notwithstanding, the compressive strength will in general increment with the diminishing in size of total. IS 456:2000 and IS 1343:1980 suggest that the ostensible size of the total ought to be just about as extensive as could really be expected.

- Grading and kind of total

The evaluating of total impacts the blend extents for a predetermined usefulness and water-concrete proportion. Coarser the reviewing less fatty will be blend which canbe utilized. Extremely lean blend isn't attractive since it doesn't contain sufficient better material to make the solid strong.

The sort of total impacts firmly the total concrete proportion for the ideal functionality and specified water concrete proportion. A significant element of an agreeable total is the consistency of the reviewing which can be accomplished by blending diverse size divisions.

- Quality Control

The level of control can be assessed measurably by the varieties in test results. The variety in strength results from the varieties in the properties of the blend fixings and absence of control of exactness in grouping, blending, putting, restoring and testing. The lower the distinction between the mean and least qualities of the blend lower will be the concrete substance required. The factor controlling this distinction is named as quality control.

MIX PROPORTION DESIGNATIONS

The common method of expressing the proportions of ingredients of a concrete mix isin the terms of parts or ratios of cement, fine and coarse aggregates. The proportions are either by volume or by mass. The water-cement ratio is usually expressed in mass.

FACTORS TO BE CONSIDERED FOR MIX DESIGN
The grade designation giving the characteristic strength requirement of concrete.

The type of cement influences the rate of development of compressive strength of concrete. Maximum nominal size of aggregates to be used in concrete may be as large as possiblewithin the limits prescribed by IS 456:2000.

The cement content is to be limited from shrinkage, cracking and creep.

The workability of concrete for satisfactory placing and compaction is related to the size and shape of section, quantity and spacing of reinforcement and technique used for transportation, placing and compaction.

CONCRETE MIX FOR M30

A. Test data for materials:
1. Cement used : OPC 43 grade,
2. Specific gravity of cement : 3.15
3. Specific gravity :
   a. Coarse aggregate : 2.68
   b. Fine aggregate : 2.65
4. Water absorption:
   a. Coarse aggregate : 0.68 %
   b. Fine aggregate : 0.84 %
5. Surface moisture:
   a. Coarse aggregate : Nil
   b. Fine aggregate : Nil

B. Design stipulations for Proportioning: (ASPER IS: 10262-2009)
1. Grade Designation : M 30
2. Type of cement : OPC 43 grade, IS-8112
3. Maximum normal size of aggregate : 20 mm
4. Minimum cement content : 320 kg/m^3
5. Maximum water content ratio : 0.45
6. Workability : 75 mm (slump)
7. Type of aggregate : Crushed angular aggregate;
8. Chemical admixture : Not Used
9. Method of concrete placing : Manual

C. Target mean strength for Mix Proportioning:

f_t = fck + 1.65 x S
= 30+1.65×5= 38.25N/mmsq

(Where f_t= target mean strength, fck= characteristic compressive strength,S= standard deviation)

By IS10262-2009 from Table – 1: (Standard deviation S = 5 N/mm^2 for M30 mix)

D. Selection of Water Content:
From table 2 of IS 10262-2009, Maximum Water Content = 186 liters (for 25mm-50mm slump)
3% increase for every 25 mm slump over and above 50 mm slump.
Therefore w/c =186 +3% of 186 =191.5liters

E. Selection of Water Cement ratio:
We have adopted w/c ratio= 0.42
(As per IS-456-2000, Table-5, Maximum water cement ratio= 0.45)

F. Calculation of Cement Content:
We have adopted w/c ratio = 0.42
So cement content= Total Water Content / w/c ratio
(As per IS 456-2000, Table-5 – Minimum cement content =330 Kg/m^3 for mild exposurecondition)

So cement content = 191.5/0.42 = 455.95Kg/m3

G. Proportions of volume of Coarse Aggregate and Fine Aggregate:
From Table -3 of IS 10262-2009, Volume of Coarse Aggregate of 20 mm sizeand Fine aggregate (zone -II), for Water cement ratio 0.5 will be =0.62

In present case, w/c ratio 0.42

It is less by 0.08 so coarse aggregate (0.5-0.42) is to be increased @ 0.01 forevery decrease in w/c ratio of 0.05.

Therefore 0.01/0.05×0.08 = 0.016.

Therefore corrected proportion of volume of coarse aggregate =0.62+0.016= 0.636,

Proportion of volume of fine aggregate =1-0.636 = 0.364

H. Mix Calculations:
The mix calculations per unit volume of concrete will be as follows
1. Volume of concrete (a) = 1m3
2. Volume of water (b) = Mass of water/Specific gravity of waterx(1/1000)
3. So Volume of Water =191.5/1 x (1/1000) = 0.192 m^3
4. Volume of Cement (c) = Mass of cement /Specific gravity of cement x (1/1000) =455.95/ 3.15x (1/1000)
   So Volume of Cement = 0.145 m3
5. Volume of Chemical Admixture (d) = 0 (Admixture not use)

Volume of all in aggregate = a-(b + c + d)= 0.701m^3
1-(0.192+ 0.145+0)
So volume of all in aggregate = 0.66 m3

6. Volume and Wt of Fine Aggregate:

Volume of fine aggregate = volume of all in aggregates x proportion of fineAggregate
= 0.66x 0.364 m^3 =0.24 m^3

Wt of fine aggregate = volume of fine aggregate x specific gravity of fineaggregate x 1000
= 0.24 x 2.65 x 1000 = 636.64 Kg/m^3

7. Volume and wt of Coarse Aggregate ;

Volume of coarse aggregate = volume of all in aggregate x proportion of coarse aggregate
= 0.66 x 0.636 = 0.42m3

Wt of coarse aggregate = Volume of coarse aggregate x specific gravity of coarseaggregate x 1000
= 0.42 x 2.68 x 1000 Kg/m^3
= 1124.96 Kg/m^3

Therefore mix proportion for this concrete M30 mix will be follows:
- Water content 191.5 Kg/m^3
- Water cement ratio 0.42
- Cement content 455.95 kg/m^3
- Fine aggregate 636.64 Kg/m^3
- Corse aggregate 1124.96 Kg/m^3
- Chemical admixture not used

Correction in the quantity of aggregate due to Water Absorption
Water absorption by:
1. Coarse aggregate =0.68%
2. Fine aggregate = 0.84%

Water Absorbed by Coarse Aggregate=0.68/100x1124.96 = 7.65 Litre

Water Absorbed by Fine Aggregate = 0.84/100 x 636.64 = 5.35 LitreTotal water absorbed = 7.65 + 5.35 = 13 litre

Actual amount of water used = 191.5 + 13 =204.5liter Actual wt of fine aggregate = 636.64 – 5.35 = 631.29 kg/m3

Actual wt of coarse aggregate = 1124.96 – 7.65 = 1117.31 kg/m3

Therefore Proportion of Materials Used:
Cement : 455.95 kg/m3
Water : 204.5 kg/m3
Fine Aggregate : 631.29 kg/m3
Coarse Aggregte : 1117.31 kg/m3
OR

CEMENT	FA	CA	WATER
455.95	631.29	1117.31	204.5
1	1.38	2.45	0.45

Figure.4.3 Casting of Concrete

Figure.4.4 Cubes Test

EXPERIMENTAL INVESTIGATIONS
- Workability Test
- Compressive strength
- Flexural Strength
- Split Tensile strength

SLUMP CONE TEST

This test is performed to check the workability of freshly made concrete. This test separately performs on fresh concrete and the concrete replacing sand with quarry dust to find the workability. The slump is very useful in detecting variations in the uniformity of a mix of given nominal proportions; it is a measure of consistency of the fresh concrete. This test is conducted immediately after the concrete has been made.

Workability is a property of newly blended concrete, and a concrete is a blend of cement, aggregate, water & admixture. Because of this all the properties of cement, whether in fresh state or solidified state, is influenced by these ingredients and their proportions. A concrete is said to be workable if it is easily transported, placed, compacted and finished without any segregation. Slump cone test is utilized to focus the workability of new concrete. Slump conetest as per IS: 1199 – 1959 is followed. The device utilized for doing slump test are Slump cone with top diameter 10cm, bottom diameter 20 cm and a height of 30 cm and Tamping rod.

Procedure
1. The interior surface of the mould is altogether cleaned and a light layer of oil isapplied.
2. The mould is put on a smooth, flat, rigid and non-absorbent surface.
3. The mould is then filled in three layers with newly blended concrete, each prettynearly to one-third of the mould's height.
4. Each layer is tamped 25 times by the rounded end of the tamping bar (strokes are Appropriated equitably over the cross segment).
5. After the top layer is rodded, the concrete is hit off the level with a trowel.
6. The mould is expelled from the concrete promptly by bringing it gradually up in theVertical course.

Figure 4.5 Slump cone test

COMPRESSIVE STRENGTH TEST
1. Filling of cube moulds of size **(150x150x150)mm** must be done in three layers. The concrete must be placed using a scoop and the scoop should be moved around the top edges of the cube mould so that symmetrical distribution of concrete is done in each layer as the concrete slides down from the inclined scoop into the moulds. 18 cubes were prepared.

2. Each layer must be compacted fully either by using a tamping rod or by using vibration techniques. Concrete is compacted by hand tamping, in 150 mm mould, then 35 strokes are given per layer uniformly covering the entire surface especially the corners.

3. The concrete should be compacted fully well in each layer leaving no chance for air entrapment within its mass. When air bubbles no longer appear on the top

surface of concrete it is understood that the concrete is fully compacted.

Figure.4.6 Compressive Strength test

FLEXURAL STRENGTH TEST

Flexural strength test was conducted as per recommendations IS: 516 – 1959, The flexural strength test was done in Universal testing machine (UTN) on 150×150×700mm beam specimen at each age and the average strength was computed. Before testing, the two loading surfaces were ground evenly by using a grinding stone to ensure that the applied load was uniform. The flexural strength was calculated according to the type of fracture in the beam as follows:

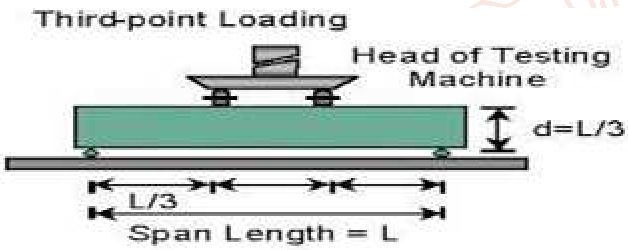

Figure.4.7Flexural test setup

Figure shows a typical setup of the beam during testing. If the fracture initiates in the tension surface within the middle third of the span length, then modulus of rupture is calculated as follows:

$$R = \frac{PL}{bd^2}$$

Where R = modulus of rupture (mm^3);
P = maximum applied load indicated by the testing machine (N);
L = span length (mm);
b = average width of specimen (mm) at the fracture; and
d = average depth of specimen (mm) at the fracture.

If the fracture occurs in the tension surface outside of the middle third of the span length by not more than 5% of the span length, then modulus of rupture is calculated as follows:

$$R = \frac{3Pa}{bd^2}$$

Where R = modulus of rupture (mm^3);
P = maximum applied load indicated by the testing machine (N);
a = average distance between line of fracture and the nearest support measured on thetension surface of the beam (mm);
b = average width of specimen (mm) at the fracture; and
d = average depth of specimen (mm) at the fracture.

If the fracture occurs in the tension surface outside of the middle third span length bymore than 5% of the span length, discard the results of the test. Figure shows a typical failed beam specimen after the flexural test.

Figure.4.8 Beam Specimen Failure

SPLITTING TENSILE STRENGTH TEST

The Split tensile strength test was carried out on the compression testingmachine. The casting and testing of the specimens were done as per IS5816: 1999. The splitting tensile strength of concrete was done in accordance with Indian Standard on cylindrical specimens (150×300mm). Four lines were drawn along the centre of the cylinder to mark the edges of the loaded plane and to help align the test specimen before the application of load. Figure shows a typical setup of the cylinder during testing. A strip of wood, 3-mm thick and 25-mm wide, was inserted between the cylinder and the platens; this helped the applied force to be uniformly distributed. Load was applied and increased under a controlled rate until failure by indirect tension in the form of splitting along vertical diameter took place.

Figure.4.9 Splitting tensile setup

Figure shows a typical failed sample. The splitting tensile strength of a cylinder specimen was calculated using the following equation:

$$R = \frac{2P}{\pi LD}$$

Where T = splitting tensile strength of cylinder (mm^3);
P = maximum applied load (N);
L = average length of cylinder (mm); and
D = average diameter of cylinder (mm).

FUTURE SCOPE OF WORK

- The study can also be carry out by increasing the percentage of fly ash up to maximum level with SF.
- The effect temperature and humidity can also be study.
- Research can be carried out to investigate the compressive strength of combination of more types of pozzolana inside concrete.
- Few more properties for comparing the performance of concrete composed by blending fly ash and other materials in different proportions need to be investigated materials other than RHA.

CONCLUSIONS

The strength analysis is carried out which is explained in the following given points:

- The compressive strength of the concrete by replacing the 20% sand by RHS and 20% cement by the 19% fly ash & 1% SF the strength increases at 32.52 to 37.8 in M-30 concrete. After adding the RHA the strength is Decreases..
- The flexure strength of the concrete by replacing 20% sand by RHS and 20% cement by the 19% fly ash & 1% SF the strength increases at 5.2 to 6.69 in M-30 concrete. After adding the RHA the strength is Decreases Thus, flexure strength is also increase by including the RHS. It also reduces the consumption of the cement.
- The split tensile strength of the concrete by replacing 20% sand by RHS and 20% cement by the 19% fly ash & 1% SF the strength increases at 3.09 to 4.49 in M-30 concrete. After adding the RHA the strength is Decreases.
- Hence by adding the fly ash with stone dust is also increase the tensile strength of the concrete. Hence saving in cost is two ways cost of sand and cement.
- The RHA is to be used as partial replacement of the natural sand.
- Increase in strength up to 1% is due to utilization of water present in fiber for chemical reaction at time of curing and less concentration of fibre created densely compacted medium in cement concrete. The addition of the fibre in small amounts will increase the tensile strength. Addition of fibres not only increases tensile strength but also increases bond strength, decreases permeability. Toughness of concrete also increases by the addition of the fibre.
- The use of the RHA, Fly ash and SF also saves the environmental pollution or solves thedisposal problems.
- The use of RHA, Fly ash and SF in this study also saves the costly cement and sand. This is great saving in the construction material and also reduces the cost of construction.

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