THE EFFECT OF STEEL SCRAP FIBER AND FLY ASH ON THE PROPERTIES ON CONCRETE: A REVIEW

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Abstract – This paper provides a systematic literature review of publication relating to the effect of incorporating fly ash and steel fibres on the properties of concrete. Fly ash can be utilized in concrete as partial replacement of cement and is gaining importance these days. The quality of fly ash is being improved in thermal plants as of due to Technological improvements. Waste generated from lathe machine which has similar physical properties can be availed as a substitute for steel fibers and this will aslo improve the economy. To study the use of fly ash and waste steel scrap fibre in concrete, cement is partially substituted by fly ash and steel scrap fibre is used in concrete. Effect of fly ash on workability, compressive strength, setting time and water content are studied. The test result indicated that the addition of lathe waste significantly improves the compressive, flexural and the tensile properties of concrete when compared with control specimen. Also, replacement of steel fibers with the lathe waste scrap was found to be an economical and sustainable alternative which considerably improves the strength parameters of the concrete.

Key words: lathe waste, compressive strength, split tensile strength, fly ash, Concrete, Workability, Strength, Curing

1. INTRODUCTION

Pozzolans are materials which have next to zero characteristic cementitious properties however create cementitious properties within the sight of calcium hydroxide and water. Such materials normally got from common stores. Numerous advanced pozzolans still get from regular stores, yet the heft of pozzolana get from the burning of powdered coal during electric power generation. This item is usually called fly ash. The utilization of fly ash in portland cement concrete(PCC) has numerous advantages and improves solid execution in both the fresh and solidified state. Fly ash use in concrete improves the functionality of plastic cement, and the strength and toughness of solidified cement. Fly ash use is likewise practical. At the point when fly ash is added to concrete, the measure of portland concrete might be diminished. Steel Fiber Reinforced Concrete (SFRC) isn't regular in the private and standard structures since steel strands accessible in market are exorbitant. Machine squander in creased fiber structure is a loss from machines. In every machine ventures squanders are accessible in type of steel scraps are yield by the machine machines in cycle of completing of various machines parts and unloading of these losses in the infertile soil polluting the dirt and ground water that forms an unfortunate climate. Steel scrap got from machine machines have comparative actual properties as that of steel fiber. Steel fiber are presented in the concrete matrix during the blending of its constituent fixings. After solidifying, these fibers improve the properties of concrete such as ductility, fracture toughness, energy dissipation, impact resistance, fatigue resistance and limiting of crack propagation.

2. RELATED WORK

2.1 ROLE OF FLY ASH IN CONCRETE

[1] Khushal Chandra Kesharwani, Amit Kumar Biswas, Anesh Chaurasiya, Ahsan Rabbani (2017) in their paper named "*Experimental study on Use of Fly Ash in Concrete*" had contemplated the utilization of fly ash in solid, concrete is supplanted halfway by fly ash in concrete. In this examination concrete was set up with substitution of fly ash by 0%, 25%, half, 75%, and 100%. The outcome shown that the strength of the solid abatements with expansion in level of fly ash and after that increment in strength as the level of fly ash increments. From this test it very well may be presumed that concrete substitution by fly ash is helpful for lower evaluation of concrete (e.g.,M-20). So it tends to be inferred that at 25% supplanting of concrete with fly ash, there is an impressive expansion in strength properties of cement.
[2] Dr S L Patil , J N Kale, S Sumanto (2012) in their paper named " *Experimental Study on Use of Fly Ash in Concrete* "considered the use of fly ash in concrete as a fractional supplanting of concrete with additive so to give a naturally reliable method of its removal and reuse. The concrete in solid blend is supplanted by fly ash from 5% to 25%. It tends to be seen that 0% fly ash i.e., concrete with no supplanting of concrete with fly ash, has greatest pace of compressive strength created at 60 days and after it gets steady. 5% fly ash substitution has greatest pace of compressive strength created upto the age of 21 days and afterward its rate diminishes. Strength created at later stage is irrelevant. The rate of strength developed is enormous upto 21 days for 10% fly ash substitution and afterward its rate gets insignificant for few days and following 28 days it increments consistently. Its last strength advancement is adittionaly most extreme than some other fly ash blend. Following 90 days of capacity the cements containing 10 % of fly ash substitution, identified with concrete mass, acquired a compressive strength around 6 % higher than the solid expansion for Ordinary Portland concrete (OPC). For fly ash blend more prominent than 10% fly ash, the paces of solidarity improvement just as conclusive strength both diminish with expansion of fly ash. In long terms, concrete with higher extents of fly ash acquires similar with that of unadulterated cement. Notice that the strength of solid declines with the increment in level of supplanting of concrete with fly ash at 28 days. Be that as it may, at 90 days we get greatest strength for 10% fly ash expansion.

[3] Mukkannan, Akshara, Arjun, Arun Kumar, Vinith Saravanaraj(2019) in their paper named " *EXPERIMENTAL STUDY OF PROPERTIES FLY ASH IN CEMENT CONCRETE PAVEMENT* " concentrated on compressive strength of fly ash concrete cement to decide its properties on building site and which can be used in street development and in country regions. The examination points in getting ready cement by substitution of Ordinary Portland Cement (OPC) with fly ash in different extent like 10%, 20%, 30%, 40% and half fly ash by mass. The examination shows that high volume of fly ash in concrete diminishes the water content. Compressive strength is around same as expected concrete cement. As the measure of fly ash expanded, the compressive strength diminished. Supplanting of fly ash with concrete in concrete up to 30% is viewed as protected as utilized in street development to support its better quality.

[4] Aayush Choure, Dr. Rajeev Chandak (2017) in their paper named *" EXPERIMENTAL STUDY ON CONCRETE CONTAINING FLY ASH* " had examined the use of non-ordinary structure material (fly ash) for improvement of new materials and innovation. In this investigation, concrete has been supplanted by fly ash as needs be in the scope of 0% , 5%, 10%, 15%, 20% by weight of concrete for M-30 blend in with 0.43 water concrete proportion. The compressive strength was expanded with the additions of fly ash because of the pozzolanic reactivity of the ash. The fineness of the particles likewise improved the microstructure of the solidified cement because of pressing and filling impact. 20% fly ash substitution is viewed as the best proportion of concrete substitution in a solid blend.

2.2 ROLE OF STEEL FIBRE IN CONCRETE

[5] Yohannes Werkina Shewalul (2020) in their paper named " *Experimental study of the effect of waste steel scrap fibre as reinforcing material on the mechanical properties of concrete* " presents a test finding on the mechanical properties of cement with squander steel scrap fiber. The research facility tests for compressive strength and parting elasticity were led for various rates of waste steel scrap fiber i.e., 0%, 0.5%, 0.75%, and 1.5% controlled by the volume of cement. With the expansion of waste steel scrap fiber, it was found in the test outcomes that the compressive strength expanded by 26.8% for 0.5%, 30.7% for 0.75%, and decreased by 5.3% for 1.5% by volume of cement. The parting rigidity increased by 11.2% for 0.5%, 5.8% for 0.75% and 2.5% for 1.5% by volume of cement. The test showed that the modulus of elasticity and peak strain contains a wonderful increment with the increment in squander steel scrap volume. Contrasting and plain concrete, the strength properties of cement with steel scrap fiber were improved, anyway with an expanded measure of waste steel scrap fiber, the workability of cement was diminished.

[6] Shivam Darji, Krushil Borsadiya, Abdulrashid Momin, Shweta Chauhan (2018) in their paper named " *Analysis of Properties of Mix Design Concrete Using Steel Scrap* " had contemplated the possibility of utilizing steel scrap fiber in blend configuration concrete by checking different solid boundaries like compressive strength, tensile strength and flexural strength. Every one of the boundaries were checked with differing rate i.e., 0%, 0.5%, 1%, 1.5% and 2% by weight of cement. In this exploratory investigation M-30 evaluation concrete was utilized. For this cube shapes, beams and cylinders were casted to explore. All out 45 solid examples were casted and restored. Tests were done on restored solid examples at multi day. The compressive strength of M-30 evaluation concrete was discovered to be 33.33 N/mm^2, 36.44 N/mm^2, 38.36 N/mm^2, 35.18 N/mm^2 and 33.47 N/mm^2 individually. The split tensile strength was 2.80 N/mm^2, 3.11 N/mm^2, 3.52 N/mm^2, 3.18 N/mm^2 and 2.85 N/mm^2 individually. The flexural strength was 4.47 N/mm^2, 4.44 N/mm^2, 5.34 N/mm^2, 4.89 N/mm^2, and 4.36 N/mm^2 individually according to steel scrap fiber rates. Subsequent to contrasting the outcomes it showed that at the 28 days compressive strength, split tensile strength and flexural strength of steel scrap concrete is more than plain concrete. Steel scrap fiber can be utilized viably to improve properties of blend configuration concrete. Steel scrap fiber improves the properties of blend configuration cement like compressive strength, split tensile strength and flexural strength. So utilization of steel scrap fiber by rate weight of cement diminishes breaks and shrinkage in blend configuration concrete. Steel scrap fibre reduces the consumption of reinforcement in R.C.C. structures.

[7] Shivam P. Darji, Krushil J. Borsadiya, Abdulrashid S. Momin, Guide Prof. Raju G. Prajapati (2017) in their paper named " *ANALYSIS OF COMPRESSIVE STREGTH OF CONCRETE USING STEEL SCRAP*" had contemplated the successful utilization of steel scrap fiber in concrete. In this examination, complete 39 solid 3D shapes of size 150 mm x 150 mm x 150 mm were casted utilizing steel scrap fiber solid evaluation M-20. Steel scrap utilized around 2.4% by weight, at a gap of 0.2% (for example 0.2%, 0.4%, 0.6%, 0.8%, 1.0%, 1.2%, 1.4%, 1.6%, 1.8%, 2.0%, 2.2%, 2.4%). According to Indian norm, following 28 days compressive strength test done on projected solid blocks and test outcomes were contrasted and plain concrete cement. The compressive strength was discovered to be 22.56N/mm^2, 24.43N/mm, 24.53N/mm^2, 24.60N/mm^2, 24.71N/mm^2, 24.80N/mm^2 24.82N/mm^2, 24.90N/mm^2, 24.38N/mm^2, 23.71 N/mm^2, 23.50 N/mm^2, 23.00 N/mm^2, 22.63 N/mm^2 for 0%, 0.2%, 0.4%, 0.6%, 0.8%, 1%, 1.2%, 1.4%, 1.6%, 1.8%, 2%, 2.2%, 2.4% steel scrap individually. Toward the finish of trial, seen that compressive strength expanded by adding steel scrap up to 1.4% and this is ideal level of steel scrap for most extreme compressive strength of cement. At that point subsequent to adding more level of steel scrap causes slight decrease in compressive strength. Be that as it may, strength was discovered to be more than plain concrete cement.

[8] Pooja Shrivastavaa, Dr.Y.p. Joshib (2014) in their paper named "*Reuse of Lathe Waste Steel Scrap in Concrete Pavements*" had examined the usefulness and mechanical strength properties of the solid supported with industrialized waste fibre or the reused fibre. Scrap Steel fibers acquired from the machine machines of length 20-30 mm, width 1.5-2 mm and thickness 0.3-0.6 mm were utilized here to support the solid lattices. Also, angle proportion changes from 50-70 with high modulus of elasticity around 200 GPa. The state of steel scrap strands cross area might be rectangular, curved and metallic bight appearance. Less fiber content 0.5% with low perspective proportion is insignificant consequences for the strength while snared or expanded finishes have delivered flexural strength over 100% when contrasted with unreinforced or ordinary cement. The outcomes accomplished following 28 days were,

- Compressive strength of SFRC somewhat increments 3% when contrasted with plain concrete.
- Tensile strength of scrap steel fiber solid increments up to 20% significant increments.
- Flexural strength of SFRC viably increments almost 40 %.

2.3 PART OF FLY ASH AND STEEL FIBRE TOGETHER IN CONCRETE

[9] R. Dharmaraj(2020) in their paper named "*Reuse of Lathe Waste Steel Scrap in Concrete Pavements* " presents test concentrate on the strength qualities of utilization of iron scrap in concrete from 0 to15% with the timespan and furthermore the expansion of fly ash with the iron fibre blended cement from 0 to 25% in with the time period. Iron pieces were blended in the rates 2.5%, 5%, 7.5%, 10%, 12.5%, and 15% and in the wake of finding the ideal rate fly ash was blended for 5%, 10%, and 15%. They have explored the strength attributes like compression, tension, flexure and impact with different rates of fly ash like 0%, 5%, 10%, 15%, 20%, and 25%. In M-20 evaluation concrete, the compressive strength was found to increment steadily up to 53.72% for iron fibre of 10% in concrete. Expansion of iron pieces past 10% brought about decline in the worth of compressive strength. The fly ash was blended in with the solid alongside ideal level of iron fibre and the most extreme compressive strength was acquired for a blend level of 15%. So the most extreme compressive strength can be acquired by blending 15% of fly ash and 10% iron fibre with concrete. Most extreme flexural strength was found at 15% of fly ash and 10% of iron fiber. In concrete mortar 1:3 blend, the hardness file was found to increment steadily up to 21.64% for iron fiber of 10% in concrete mortar. Addition of iron scraps beyond 10% resulted in decrease in the value of hardness index.

[10] Atteshamuddin S. Sayyad, Subhash V.Patankar(2013) in their paper named "*Effect of Steel Fibres and Low Calcium Fly Ash on Mechanical and Elastic Properties of Geopolymer Concrete Composites* " presents test work to examine the impact of steel fibre on the mechanical and elastic properties on geopolymer concrete. The materials utilized for making fly ash geopolymer solid composite examples are low-calcium fly ash, coarse and fine aggregate, steel fibre, alkaline solution and water. Geopolymer concrete blends were readied utilizing low-calcium fly ash and enacted by alkaline solution (NaOH and Na2SiO3) with answer for fly ash proportion of 0.35. Creased steel fibre having viewpoint proportion of 50 with volume part of 0.0% to 0.5% at a timespan of 0.1% by mass of typical geopolymer concrete were utilized. The compressive strength of solid increments concerning steel fiber content up to 0.2% and afterward it decreases because of the fact that higher level of steel fiber content reduces the workability of GPCC. The greatest rate expansion in compressive strength, flexural strength, split tensile strength, and bond strength is 29.98%, 30%, 30.05%, and16.11% respectively. The proposed condition for modulus of elasticity yield incredible outcome and Poisson's proportion shifts between indicated limit.

[11] Savita, Shwetha S, Malanbi, Shweta, Saksheshwari, Manjunath K (2018) in their paper named " *Experimental Study on Strength Parameters of steel fiber Reinforced Concrete using galvanized (GI) Wire & Fly Ash* ". An endeavor were made to introduce the aftereffects of an exploratory examination did on steel fiber supported cement. GI wires were utilized as a fibre with aspect ratio 50. In this examination the steel fiber were arbitrarily arranged and range from 0.1% to 0.4% at 0.1% interval by weight of concrete. The outcomes shows that the greatest compressive strength is gotten at 0.3% of steel fiber at 3 and 7 days and at 0.2% of steel fiber at 28 days. The most extreme split tensile strength and flexural strength are discovered to be at 0.2% of steel fiber for 7and 28 days. What's more, workability and strength diminishes with halfway substitution of concrete by fly ash with addition of steel strands.

[12] Falah M. Wegian, Anwar A. Alanki, Hana M. AlSaeid, Fahad A. Alotaibi, Mubarak S. Al-Mitairi and Fahad A. Kandari(2011) in their paper named "*Influence of Fly Ash on Behavior of Fibres Reinforced Concrete Structures*" presents test to measure compressive and tensile strengths of concrete with different steel fibre and fly ash percentages. concrete with fiber substance of 0.50, 1.0 and 1.50% by volume were tried. Fly ash substance in blends went somewhere in the range of 0 and 30% by weight. This examination explored steel fiber effect on the compressive and flexural qualities of fly ash concrete containing 10, 20 and 30% of fly ash. The steel fiber substance explored were 0.5, 1 and 1.5% by volume. To begin with, the expansion of steel fiber into the solid blends didn't altogether improve extreme compressive qualities however it was compelling in opposing flexural pliable burdens. Second, the ideal boundaries for compressive strength were acquired at 90 days, 1.5% steel fiber and 0% fly ash. Third, the most perceptible factors affecting compressive strength were time, fly ash rate and steel fiber rate. Fourth, steel fiber have no impact on flexural elasticity at 0.5% of the blend. Notwithstanding, an improvement of 0-15% in the flexural strength was seen at 1.0% of steel fiber and expanded to 30-66% at 1.5% fiber. Fifth, flexural strength is subject to steel fiber and fly ash rates just as on restoring time. Furthermore, an expansion of compressive and flexural qualities with periods of the examples was noticed. The compressive strength increment is more articulated somewhere in the range of 28 and 90 days than somewhere in the range of 7 and 28 days, while the inverse was valid for flexural strength expansions in the examples. At last, compressive and flexural strength proportions can upgrade a lower steel fiber content combined with the expansion of more fly ash.

[13] Cengiz Duran Atis, Okan Karahan(2007) in their paper named "*Properties of steel fiber reinforced fly ash concrete*" studied on the properties of concrete containing fly ash and steel fibers. Properties contemplated incorporate unit weight and usefulness of new concrete, and compressive strength, flexural elasticity, parting rigidity, elasticity modulus, sorptivity coefficient, drying shrinkage and freeze–defrost opposition of solidified cement. Fly ash content utilized was 0%, 15% and 30% in mass premise, and fiber volume portion was 0%, 0.25%, 0.5%, 1.0% and 1.5% in volume premise. It is seen that steel strands didn't recuperate the compressive strength loss of fly ash. Steel fiber have no huge consequences for flexural rigidity at 0.25% and 0.5% volume portions utilized in this investigation. Be that as it may, the improvement began from 0% to 15% at 1.0% portion and extended to 30–66% augmentation at 1.5% part. There is an increment in parting rigidity fluctuating from 1% to 5%, 1% to 3%, 21% to 32% and 44% to 71% for concrete blends having 0.25%, 0.5%, 1.0% and 1.5% volume parts of fiber with and without fly ash, separately. The addition of fiber and fly ash into solid blend altogether builds the sorptivity coefficient. After freeze–defrost testing, strength loss of cement with and without fly ash, made with steel fiber decreases about 5%. Freeze–defrost opposition of steel fiber concrete was found to marginally increment when contrasted with concrete without strands.

3. CONCLUSION

The following conclusions were drawn from studying the various factors related to the inclusion of fly ash and steel fibres on the properties of concrete.

- The strength of concrete decreases with increases in percentage of fly ash first and then increases as the percentage of fly ash increases.
- Due to lesser rate of strength the fly ash finds specific application in mass concreting e. g. dam construction. It can be concluded that power plant waste (fly ash) is extensively used in concrete as a partial replacement for cement and an admixture.
- Fly ash takes longer time to settle down as compare to ordinary Portland cement. Cement paste settle down in 45 to 50 minute. On other hand as amount of fly ash increased its settling time also increased.
- The fineness of the particles likewise improved the microstructure of the solidified cement because of pressing and filling impact.
- 20% fly ash is considered to be the best ratio of cement replacement in a concrete mix.
- From some researchers, Supplanting of fly ash with concrete in concrete up to 30% is viewed as protected as utilized in street development to support its better quality.
- Concrete substitution by fly ash is helpful for lower evaluation of concrete (e.g.,M-20).
- The inclusion of steel scrap marginally increases the compressive strength, modulus of elasticity of concrete, split tensile strength and flexural strength.
- With an increasing volume of waste steel scrap fibre, the workability of fresh concrete is reduced. This is due to the interlocking behavior of steel scraps fibre.
- Use of steel scrap by percentage weight of concrete reduces cracks and shrinkage in mix design concrete.

- By some researchers, Compressive strength increased by adding steel scrap fibre up to 1.4% and this is optimum percentage of steel scrap fibre for maximum compressive strength of concrete. Then after adding more percentage of steel scrap fibre causes slight reduction in compressive strength but strength is more than plain cement concrete.
- In SFRC, steel fibers balance the forces by transmitting tensile forces to the steel fibers which run along the cracks, as the result flexural toughness and flexural strength increases to great amount
- Mechanical properties of SSFRC increases up to addition of 1.5% fiber contents and on further increasing fiber contents it will decrease the strength.
- Steel scrap reduces the consumption of reinforcement in R.C.C. structures.
- The iron scrap mixed concrete shows the increased load carrying capacity that the ordinary concrete in compression & flexure.
- The hardnes index of cement was discovered to be expanded with the utilization of iron fiber and fly ash in the standard cement.
- Compressive and flexural strength proportions can upgrade a lower steel fiber content combined with the expansion of more fly ash.
- The addition of fiber and fly ash into solid blend altogether builds the sorptivity coefficient. After freeze–defrost testing, strength loss of cement with and without fly ash, made with steel fiber decreases about 5%.

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