Review on Experimental Study on High Performance Steel Fiber Reinforced Concrete Using Metakaolin

V. V. Sawant[1] Dr. C. P. Pise[2] Prof. G.D. Lakade[3]
[1]PG Student [2]Head of Department [3]Assistant Professor
[1,2,3]Department of Civil Engineering
[1,2,3]SKNSCOE, Korti, Pandharpur, Maharashtra, India

Abstract— A review article focuses on the studies done in the favour to understand the concept of reinforced concrete with additions of variety of materials as per the needs. In today's world, various kinds of civil engineering structures are coming into picture, placing greater demand on material performance, the need for more fundamental information on the behaviour of concrete and fiber reinforced concrete under different types of loads is of prime importance. The above factors and man's curiosity for inventing new products has led to the significant research on this topic. As we know, brittle failure is the inherent property of the plain concrete, i.e. it has very low tensile strength and low strain capacity at fractures. These shortcomings of plain concrete are overcome by adding reinforcing bars or pre-stressing steel. It is necessary to find out essential properties of the concrete for variety of applications.

Keywords: High Strength Concrete (HSC), Normal Strength Concrete (NSC), High Strength Fiber Reinforced Concrete (HSFRC)

I. INTRODUCTION

In recent years, high strength concrete (HSC) is becoming an attractive alternatively to traditional normal strength concrete (NSC). High strength concretes of strength in excess of 80 MPa are often used in a wide range of applications. With the increased use of HSC, concern has developed regarding the behaviour of such high strength concrete. The high strength in HSC is obtained often, by reducing the amount of water, with the use of special admixture that also improves the workability. The high strength concrete not only increases the strength of concrete but also it reduced the permeability. High strength concrete is generally, used for increasing the durability, tensile strength, modulus of elasticity and flexural strength of concrete. Thus high strength fiber reinforced concrete (HSFRC) is a composite material essentially consisting of conventional high strength concrete reinforced by random dispersal of short, discontinues and discrete fine fibers of specific geometry. The different types of fibers had investigated, and utilized for different applications. Each types of fiber have its own characteristic property and limitation. Several different types of fibers, both manmade and natural, have been incorporate into high strength concrete.

II. LITERATURE REVIEW

1) Zongjin Li and Zhu Ding (2003) studied physical and mechanical properties of Portland cement (PC) containing Metakaolin (MK) or combination of MK and slag and the compatibility between such materials and super plasticizers were investigated. After MK was incorporated into PC, the compressive strength of the blended cement was enhanced. However, the fluidity of MK blended cement became poorer than that of PC at the same dosage of super plasticizers and the same water/binder ratio. When both MK (10%) and ultra-fine slag (20% or 30%) were incorporated into PC together, not only the compressive strength of the blended cement was increased, but also the fluidity of the blended cement paste was improved comparing to MK blended cement. This indicates that ultra-fine slag can improve the physical and mechanical properties of MK blended cement. The physical and chemical effects of two mineral admixtures were also discussed [1].
2) P. S. Song and S. Hwang (2004) investigated the Mechanical properties of high-strength steel fiber-reinforced concrete. The properties included compressive and splitting tensile strengths, modulus of rupture, and toughness index. The steel fibers were added at the volume fractions of 0.5%, 1.0%, 1.5%, and 2.0%. The compressive strength of the fiber-reinforced concrete reached maximum at 1.5% volume fraction, being a 15.3% improvement over the HSC. The splitting tensile strength and modulus of rupture of the fiber-reinforced concrete improved with increasing the volume fraction, achieving 98.3% and 126.6% improvements, respectively, at 2.0% volume fraction. The toughness index of the fiber-reinforced concrete improved with increasing the fraction. Strength models were established to predict the compressive and splitting tensile strengths and modulus of rupture of the fiber-reinforced concrete. The models gave predictions matching the measurements [2].
3) H. Abdul Razak and H.S. Wong (2005) studied the strength estimation model for high-strength concrete incorporating Metakaolin and silica fume. They presented a mathematical model for estimating compressive strength of high-strength concrete incorporating pozzolanic materials, based on the strength of a control ordinary Portland cement (OPC) concrete made with similar mixture characteristics and curing history. In this study, Metakaolin (MK) and silica fume (SF) were used as cement replacement materials at 5%, 10%, and 15% by mass. Water/cementitious materials (w/cm) ratios varied from 0.27 to 0.33, and strength testing was conducted up to an age of 180 days. It was found that the strength of a pozzolanic mixture could be related to the strength of its equivalent control by a linear function. The study concludes that the accuracy of the model increases with concrete age [3].
4) C. S. Poon, S. C. Kou and L. Lam (2006) studied the compressive strength, chloride diffusivity and pore structure of high performance Metakaolin and silica fume concrete. The compressive strength and chloride penetrability of the control and the concretes incorporated with MK or silica fume (SF) at water-to-

binder (w/b) ratios of 0.3 and 0.5 were determined. The pore size distribution and porosity of the concretes were also measured. It was found that MK concrete has superior strength development and similar chloride resistance to SF concrete, and the MK concrete at a w/b of 0.3 has a lower porosity and smaller pore sizes than the control (plain) concrete. The resistance of the concretes to chloride ion penetration correlates better with the measured concrete porosity than with the paste porosity. The differences between the measured and calculated concrete porosity is smaller for MK and SF incorporated concrete than for the control concrete, indicating an improvement in the interfacial microstructure with the incorporation of the pozzolanas. This difference was found to be related to the strength and chloride penetrability of concrete to some degree [4].

5) A. Sivakumar and Manu Santhanam (2007) studied the mechanical properties of high strength concrete reinforced with metallic and non-metallic fibers. This paper focuses on the experimental investigation carried out on high strength concrete reinforced with hybrid fibers (combination of hooked steel and a non-metallic fiber) up to a volume fraction of 0.5%. The mechanical properties such as compressive strength, split tensile strength, flexural strength and flexural toughness were studied for concrete prepared using different hybrid fiber combinations – steel–polypropylene, steel–polyester and steel–glass. Fiber addition was seen to enhance the pre-peak as well as post-peak region of the load–deflection curve, causing an increase in flexural strength and toughness, respectively. Addition of steel fibers generally contributed towards the energy absorbing mechanism (bridging action) whereas, the non-metallic fibers resulted in delaying the formation of micro-cracks. Compared to other hybrid fiber reinforced concretes, the flexural toughness of steel–polypropylene hybrid fiber concretes was comparable to steel fiber concrete. Increased fiber availability in the hybrid fiber systems, in addition to the ability of non-metallic fibers to bridge smaller micro cracks, are suggested as the reasons for the enhancement in mechanical properties [5].
6) N. Banthia and M. Sappakittipakorn (2007) studied the toughness enhancement in steel fiber reinforced concrete through fiber hybridization. In the opinion of these two researchers, crimped steel fibers with large diameters are often used in concrete as reinforcement. Such large diameter fibers are inexpensive, disperse easily and do not unduly reduce the workability of concrete. However, due to their large diameters, such fibers also tend to be inefficient and the toughness of the resulting fiber reinforced concrete (FRC) tends to be low. Hence, an experimental program was carried out to investigate if the toughness of FRC with large diameter crimped fibers can be enhanced by hybridization with smaller diameter crimped fibers while maintaining workability, fiber dispersability and low cost. The results showed that such hybridization, replacing a portion of the large diameter crimped fibers with smaller diameter crimped fibers can significantly enhance toughness. The results also suggested that such hybrid FRCs fail to reach the toughness levels demonstrated by the smaller diameter fibers alone [6].
7) Fatih Altun, Tefaruk Haktanir and Kamura Ari (2007) studied the effects of steel fiber addition on mechanical properties of concrete and RC beams. They studied C20 and C30 classes of concrete produced each with addition of Dramix RC-80/0.60-BN type of steel fibers (SFs) at dosages of 0 kg/m^3, 30 kg/m^3, 60 kg/m^3, and their compressive strengths, split tensile strength, moduli of elasticity and toughness were measured. Nine reinforced concrete (RC) beams of 300×300×2000 mm outer dimensions, designed as tension failure and all having the same steel reinforcement, having SFs at dosages of 0 kg/m^3, 30 kg/ m^3, 60 kg/m^3 with C20 class concrete, and nine other RC beams of the same peculiarities with C30 class concrete again designed as tension failure and all having the same reinforcement were produced and tested under simple bending. The load versus mid-span deflection relationships of all these RC and steel-fiber-added RC (SFARC) beams under simple bending were recorded. First, the mechanical properties of C20 and C30 classes of concrete with no SFs and with SFs at dosages of 30 kg/m^3 and 60 kg/m^3 were determined in a comparative way. The flexural behaviors and toughness of RC and SFARC beams for C20 and C30 classes of concrete were also determined in a comparative way. The experimentally determined (mid-section load)–(SFs dosage) and (toughness)–(SFs dosage) relationships are given to reveal the quantitative effects of concrete class and SFs dosage on these crucial properties [7].
8) Ilker Bekir Topcu and Mehmet Canbaz (2007) the results of an experimental investigation to study the effects of replacement of cement (by weight) with three percentages of fly ash and effects of addition of steel and polypropylene fibers are presented. Current day knowledge of concrete technology focuses attention primarily on the use of different materials in the production of concrete, industrial wastes in particular. The use of fly ash in concrete today is an important subject and is growing in importance day by day. Using fly ash in concrete may both provide economical advantages and better properties in the production of concrete. Besides, concretes produced with three different replacement ratios of fly ash and three different types of steel and polypropylene fibers were compared to those without fibers used in concrete with FA. According to the results of the study, addition of fibers provide better performance for the concrete, while fly ash in the mixture may adjust the workability and strength losses caused by fibers, and improve strength gain. [8]
9) Semsi Yazici, Gozde Inan and Volkan Tabak (2007) investigated the effects of aspect ratio (l/d) and volume fraction (Vf) of steel fiber on Study of High Strength Fiber Reinforced Concrete for M80 Grade by using Different Types of Steel Fiber 613 the compressive strength, split tensile strength, flexural strength and ultrasonic pulse velocity on steel fiber reinforced concrete (SFRC). For this purpose, hooked-end bundled steel fibers with three different l/d ratios of 45, 65 and 80 were used. Three different fiber volumes were added to concrete mixes at 0.5%, 1.0% and 1.5% by volume of

concrete. Ten different concrete mixes were prepared. After 28 days of curing, compressive, split and flexural strength as well as ultrasonic pulse velocity were determined. It was found that, inclusion of steel fibers significantly affect the split tensile and flexural strength of concrete in accordance with l/d ratio and Vf. Besides, mathematical expressions were developed to estimate the compressive, flexural and split tensile strength of SFRCs regarding l/d ratio and Vf of steel fibers. [9]

10) Job Thomas and Ananth Ramaswamy (2007) proposed models for predicting the various mechanical properties of steel fiber reinforced concrete. Models were derived from regression analysis of the test data. The strength of steel fiber reinforced concrete predicted using the proposed models was compared with the test data from the present study and with various other test data reported in the literature. The proposed model predicted the test data quite accurately. The study indicated that the fiber matrix interaction contributes significantly to enhancement of mechanical properties caused by the introduction of fibers, which is at variance with both existing models and formulations based on the law of mixtures. [10]
11) J.M. Khatib (2008) this paper investigates the performance of concrete containing Metakaolin (MK) at a low water to binder ratio of 0.3. Portland cement (PC) was partially replaced with 0–20% MK. Testing included, compressive strength, ultrasonic pulse velocity (V), dynamic modulus of elasticity (Ed) and length change. Specimens were either cured in water or in air at 20°C. The results indicate that the performance of MK concrete at low water to binder ratio is not different from that at higher water to binder ratios reported in a previous investigation. The maximum contribution of MK to strength occurs at 14 days of curing in that the relative strength of MK concrete shows a maximum value at that curing time as found in a previous investigation. The optimum replacement level of cement with MK is about 15%. Linear relationship exists between V and Ed for air cured and water cured specimens. A systematic increase in MK content of up to at least 20% leads to a decrease in shrinkage and an increase in expansion after 56 days of curing. Correlation between the various properties is also conducted. [11]
12) Y. Mohammadi, S.P. Singh and S.K. Kaushik (2008) studied properties of plain concrete and steel fiber reinforced concrete (SFRC) containing fibers of mixed aspect ratio. An experimental programme was planned in which various tests such as inverted cone time, Vebe time and compaction factor were conducted to investigate the properties of plain concrete and fiber reinforced concrete in the fresh state. Compressive strength, split tensile and static flexural strength tests were conducted to investigate the properties of concrete in the hardened state. The specimen incorporated three different volume fractions, i.e., 1.0%, 1.5% and 2.0% of corrugated steel fibers and each volume fraction incorporated mixed steel fibers of size 0.6 · 2.0 · 25 mm and 0.6 · 2.0 · 50 mm in different proportions by weight. Complete load deflection curves under static flexural loads were obtained and the flexural toughness indices were obtained by ASTM C-1018 as well as JCI method. A fiber combination of 65% 50 mm + 35% 25 mm long fibers can be adjudged as the most appropriate combination to be employed in SFRC for compressive strength, split tensile strength and flexural strength. They found better workability as the percentage of shorter fibers increased in the concrete mix. [12]
13) Fuat Koksal, Fatih Altun, Ilhami Yigit and Yusa Sahin (2008) showed that the compressive strengths of concretes produced by additions of both steel fiber and silica fume had higher than the ones containing only silica fume. A considerable increase in the splitting and flexural tensile strengths of the concretes was obtained by using silica fume and steel fibers together. There were no more changes on toughness of concretes containing 5% and 10% silica fume at 0.5% and 1% steel fiber volume fractions. However, a decrease in toughness of concrete with 15% silica fume content for each steel fiber volume fraction was seen in comparison with 5% and 10% silica fume contents. (Rashad et al. 2014) showed that the Irrespective of Fly ash (Zero), incorporation 20 % of equally combination of Silica Fume and slag (i.e. 10 % SF and 10 % slag) in high volume fly ash concrete gave the highest compressive strength and abrasion resistance at 7 and 28 days. [13]
14) Vikrant S. Vairagade, Kavita S. Kene and Tejas R. Patil (2012) Fiber reinforced concrete has been successfully used in slabs on grade, shotcrete, architectural panels, precast products, offshore structures, structures in seismic regions, thin and thick repairs, crash barriers, footings, hydraulic structures and many other applications. The usefulness of fiber reinforced concrete in various Civil Engineering applications is thus indisputable. Present review study is a trial of giving some highlights for inclusion of steel fibers especially in terms of using them with new types of concrete. Concrete is characterized by brittle failure, the nearly complete loss of loading capacity, once failure is initiated. This characteristic, which limits the application of the material, can be overcome by the inclusion of a small amount of short randomly distributed fibers (steel, glass, synthetic and natural) and can be practiced among others that remedy weaknesses of concrete, such as low growth resistance, high shrinkage cracking, low durability, etc. Steel fiber reinforced concrete（SFRC) has the ability of excellent tensile strength, flexural strength, shock resistance, fatigue resistance, ductility and crack arrest. Therefore, it has been applied abroad in various professional fields of construction, irrigation works and architecture. There are currently 300,000 metric tons of fibers used for concrete reinforcement. Steel fiber reinforced concrete under compression and Stress-strain curve for steel fiber reinforced concrete in compression was done by Nataraja.C. Dhang, N. and Gupta, A.P. They have proposed an equation to quantify the effect of fiber on compressive strength of concrete in terms of fiber reinforcing parameter. Mechanical properties of high-strength steel fiber reinforced concrete were done by Song P.S. and Hwang S. They have marked brittleness with low tensile strength and strain capacities of high

strength concrete can be overcome by addition of steel fibers. Tdyhey investigated an experimental study were steel fibers added at the volume of 0.5%, 1.0%, 1.5% and 2.0%. [14]

15) Khadake S. N. and Konapure C. G. (2012) This paper deals with Investigation for M-25 grade of concrete having mix proportion 1:1.50:3.17 with water cement ratio 0.465 to study the compressive strength, and Flexural strength of steel fiber reinforced concrete (SFRC) containing fibers of an interval of 0.5% from 0.0% to 1.5% volume fraction of hook end Steel fibers of 71 aspect ratio were used. The percentage of Fly Ash by weight is to be increased by 10% from 00% to 30%. After curing these specimens were tested as per relevant codes of practice Bureau of Indian Standard. A result data obtained has been analysed and compared with a control specimen. A relationship between Compressive strength vs. days, and flexural strength vs. days represented graphically. Result data clearly shows percentage increase in 7, 28 & 45 days Compressive strength for M-25 Grade of Concrete. [15]
16) Milind V. Mohod (2012) Cement concrete is the most extensively used construction material in the world. The reason for its extensive use is that it provides good workability and can be moulded to any shape. Ordinary cement concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks, leading to brittle failure of concrete. In this modern age, civil engineering constructions have their own structural and durability requirements, every structure has its own intended purpose and hence to meet this purpose, modification in traditional cement concrete has become mandatory. It has been found that different type of fibers added in specific percentage to concrete improves the mechanical properties, durability and serviceability of the structure. It is now established that one of the important properties of Steel Fiber Reinforced Concrete (SFRC) is its superior resistance to cracking and crack propagation. In this paper effect of fibers on the strength of concrete for M 30 grade have been studied by varying the percentage of fibers in concrete. Fiber content was varied by 0.25%, 0.50%, 0.75%, 1%, 1.5% and 2% by volume of cement. Cubes of size 150mmX150mmX150mm to check the compressive strength and beams of size 500mmX100mmX100mm for checking flexural strength were casted. All the specimens were cured for the period of 3, 7 and 28 days before crushing. The results of fiber reinforced concrete for 3days, 7days and 28days curing with varied percentage of fiber were studied and it has been found that there is significant strength improvement in steel fiber reinforced concrete. The optimum fiber content while studying the compressive strength of cube is found to be 1% and 0.75% for flexural strength of the beam. Also, it has been observed that with the increase in fiber content up to the optimum value increases the strength of concrete. Slump cone test was adopted to measure the workability of concrete. The Slump cone test results revealed that workability gets reduced with the increase in fiber content. [16]
17) A.M. Shende, A.M. Pande, M. Gulfam Pathan (2012), Critical investigation for M-40 grade of concrete having mix proportion 1:1.43:3.04 with water cement ratio 0.35 to study the compressive strength, flexural strength, Split tensile strength of steel fibre reinforced concrete (SFRC) containing fibers of 0%, 1%, 2% and 3% volume fraction of hook tain. Steel fibers of 50, 60 and 67 aspect ratio were used. A result data obtained has been analyzed and compared with a control specimen (0% fiber). A relationship between aspect ratio vs. Compressive strength, aspect ratio vs. flexural strength, aspect ratio vs. Split tensile strength represented graphically. Result data clearly shows percentage increase in 28 days Compressive strength, Flexural strength and Split Tensile strength for M-40 Grade of Concrete. [17]
18) Amit Rana (2013) Fibres are generally used as resistance of cracking and strengthening of concrete. In this project, I am going to carry out test on steel fibre reinforced concrete to check the influence of fibres on flexural strength of concrete. According to various research papers, it has been found that steel fibres give the maximum strength in comparison to glass and polypropylene fibres. Hence, in this project I was interested in finding out the optimum quantity of steel fibres required to achieve the maximum flexural strength for M25 grade concrete. From the exhaustive and extensive experimental work it was found that with increase in steel fibre content in concrete there was a tremendous increase in Flexural strength. Even at 1 % steel fibre content flexural strength of 6.46 N/mm2 was observed against flexural strength 5.36 N/mm2 at 0% hence increase of 1.1% flexural strength was obtained. [18]
19) Khadake S.N. and Konapure C.G. (2013) perform the study on the effect of steel fibers with Fly Ash can still be a promising work as there is always a need to overcome the problem of brittleness of concrete. Also found that, density of concrete is more as the percentage of steel fiber increases. [19]
20) Shelorkar Ajay P., Malode Abhishek and Loya Abhishek (2013) found that the specimen with steel fibre was found to be good in compression which had the compressive strength of 3.82 % more than the control concrete. Also, split tensile strength was achieved with the addition of the steel fibre in concrete. The strength has increased up to 15.86 % when compared to that of the control concrete specimen. In flexure the specimen with Metakaolin and steel fibre was found in the flexural strength increased by 58.28% that of the control concrete. [20]
21) Arfath Khan Md, Abdul Wahab and B. Dean Kumar (2013) investigate and found that the M80 mix concrete with total steel fiber percentage of 1.5 and admixture percentages of 10% CSF and 5% Mk showed maximum increase in strength of 163.97% when compared to base reference mix without admixture and fiber and other specimens with total fiber percentages of 0.5, 0.75, 1.0 and 1.25 also exhibited higher strengths when compared to the base reference mix. In the case of blended CSF and Mk at higher percentages of replacement by weight of cement, the strength has decreased when compared to mixes with lower replacement. 15% is found to be

optimum with both the admixtures. Out of all the blended cements tried in the investigation, mixture of 10%CSF and 5%Mk with cement is found to give the highest flexural strength. In the case of M80 mix the increase is 66.16% and is same in both the high strength mixes considered. Among the fibres percentages, 1.5% is found to give the highest flexural strength among all the fibrous mixes. Compare to the same mix without fibres the strength increase is nearly 98% and compared to base mix it is 163.97%. It is clear from the above discussions that the blended mixes are giving higher flexural strength compared to the base mix even without fibres. [21]

22) G. Murali, A. S. Santhi and G. Mohan Ganesh (2014) it is well known that concrete is characterized by its high compressive strength, yet its brittle mode of failure is considered as a drawback of high strength concrete when it is subjected to impact and dynamic loads. This study aims to investigate the impact resistance of fibre reinforced concrete (FRC), incorporated with steel fibres at various dosages. For this, a drop weight test was performed on the 28 days cured plain and fibre reinforced concrete samples as per the testing procedure recommended by ACI committee 544. Crimped and hooked end steel fibre of length 50 mm and an aspect ratio equal to 50 was added to concrete in different proportions i.e. 0%, 0.5%, 1.0% and 1.5% with water cement ratio of 0.42. From the test results, it was proved that the (FRC) was effective under the impact loads thus improving the impact resistance. Also, the reduction of strength under impact load in each specimen for every three blows was determined by ultrasonic pulse velocity (UPV) test. Further, a statistical correlation between (UPV) and number of blows under impact load was developed using regression analysis. The developed regression model predicts the reduction in strength of concrete under impact load accurately. [22]

23) Patil Shweta and Rupali Kavilkar, (2014), Concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. Various types of fibre reinforced concrete are being used against plain concrete due to their higher flexural strength, better tensile strength, modulus of rupture and crack resistance. In the present investigation properties of steel fiber reinforced concrete like flexure and compressive strength are studied. Tests were conducted to study the flexural and compressive strength of steel fibre reinforced concrete with varying aspect and varying percentage of fibre. In the experiments conducted four aspect ratio were selected i.e. 40,50,60,70 and percentage of steel in each case varied from 0.5% to 2.5% at interval of 0.5%. The various strength parameters studied are compressive strength and flexural strength as per the relevant IS standards. The experimental results indicate that the addition of steel fibre into concrete significantly increases the flexural strength. It also indicates that at constant percentage of fibre, that is 1.5% by increasing the aspect ratio of fibre from 40 to 70, flexural strength increased from 36.7% to 58.65%. The research paper proposes that due to these properties of steel fibre reinforced concrete, it can be used for the design of curvilinear forms. [23]

24) Abdul Ghaffar, Amit S. Chavhan, Dr. R. S. Tatwawadi (2014), the purpose of this research is based on the investigation of the use of steel fibres in structural concrete to enhance the mechanical properties of concrete. The objective of the study was to determine and compare the differences in properties of concrete containing without fibres and concrete with fibres. This investigation was carried out using several tests, compressive test and flexural test. A total of eleven mix batches of concrete containing 0% to 5% with an interval of 0.5% by wt. of cement. 'Hooked' steel fibres were tested to determine the enhancement of mechanical properties of concrete. The workability of concrete significantly reduced as the fibre dosage rate increases. [24]

25) Ali Amin and Stephen J. Foster (2016) despite the increased awareness of Steel Fibre Reinforced Concrete (SFRC) in practice and research, SFRC is yet to find common application in load bearing or shear critical building structural elements. Although the far majority of studies on SFRC have focused on members containing fibres only, in most practical applications of SFRC construction, structural members made of SFRC are also reinforced with conventional reinforcing steel for shear ligatures. In this paper, results are presented on shear tests which have been conducted on ten 5 m long by 0.3 m wide by 0.7 m high rectangular simply supported beams with varying transverse and steel fibre reinforcement ratios. The tests have been analysed along with complete material characterisation which quantify the post-cracking behaviour of the SFRC. [25]

26) Rubén Serrano, Alfonso Cobo, María Isabel Prieto and María de las Nieves González (2016), the decrease in concrete resistance and the expansion generated in reinforced concrete structures by direct exposure to fire at 400 C maximum temperatures serves as the basis for the present research. The aim is to improve these problems by the addition of steel fibers or of polypropylene fibers in concrete. From the results analysis of compression fracture tests on cylindrical concrete specimens, it can be concluded that concrete with addition of polypropylene fibers or steel fibers are a good alternative to traditional concrete, because both its strength, and its behaviour in case of fire are improved, delaying the appearance of fissures and explosive concrete spalling. [26]

27) P. Hareesh, S.Pravin Kumar (2018) it has been investigated comparison of BFRP with the steel fiber and concluded BFRP reinforcement beam shows high deflection compared to steel reinforcement beam By addition of 1% steel fibre in BFRP reinforcement beam result shows deflection is reduced and ultimate load where increased compared to BFRP reinforced beam. [27]

28) Hiren Kamani, Prof. Amitkumar Raval, Dr. Jayeshkumar Pitroda (2020) this research work is carried out to study the effects of steel fibre inclusion on mechanical properties of concrete. The present work deals with the compressive strength and water absorption studies on steel fibre reinforced concrete (SFRC) of grade M40 with steel fibre. The mix proportions for SFRC were arrived

at by performing mix design. In SFRC the steel fibre total is 1%, 1.5%, 2% by volume of concrete has been taken. In this experiment two types of fibres has been used hooked end fibres and flat crimped fibres. All mixes were designed at single water cement ratio (w/c ratio) is 0.4. The results of compressive strength test and water absorption test has been compared and also equate with conventional concrete. Addition of fibres to concrete increased the 28 days Compressive strength and decreased water absorption. [28]

III. CONCLUSIONS

This Review article mainly focused to study the different types of previous work done in the favor of Steel fiber and Metakaolin and their effects in the compositions. On investigating above mentioned works, we found definite results as follows,

1) Density of the Concrete goes on increasing with the increase in steel fiber.
2) SFRC is expansive due to high price of steel fibres, but this drawback is overcome by advantages of SFRC like crack resistance and highly improved mechanical property of concrete.
3) The inclusion of steel fibres significantly influences the water absorption properties of concrete. Percentage change of water absorption with respect to reference mix A0 is 15.32% in the H1.5 concrete mix.
4) Steel fibres have no poisonous impact on air & water even water absorption without changing its property is observed which is satisfying special needs of special application for a specific site condition.

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