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Study on Flexural Behaviour of Concrete by Partial Replacement of Cement with Silica Fume Natural Sand and Manufactured Sand Adittion of Fibres

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Abstract
The building sector consumes a large amount of concrete all around the globe, and this consumption is increasing. Indian traditional concrete is made using fine aggregate derived from natural sand found in river beds as the primary raw material. Natural resources are depleting, posing an environmental threat, and as a consequence, government restrictions on sand mining have resulted in scarcity and a large rise in its price. Instead of employing traditional materials, manufacturable resources are used to make up the difference. These materials include a mixture of M sand and River sand for the substitution of fine aggregate, as well as a combination of M sand and silica fume for the replacement of ceament in certain applications. To demonstrate that the strength-related qualities of the steel fibres are much superior than those of traditional materials, the steel fibres are poured into the moulds without being compacted. It was necessary to create specimens with various steel fibre percentages, such as 4 percent, 6 percent, 8 percent, and 10 percent, in order to compare results. All of the specimens were produced in line with the standards of the International Standards Organization. Molds are allowed to dry for 24 hours before hardened specimens are removed from the moulds and placed in water for curing for seven, fourteen, and twenty-eight days. The importance of critical strengths such as compressive and flexural strength is taken into consideration and shown by the test results. This is done in order to safeguard the naturally occurring resources as well as environmentally acceptable items in order to save the environment.
Keywords: M-sand, River sand, Silica fume, High performance concrete

I.INTRODUCTION

1.1 GENERAL:

A complicated substance, concrete is basically comprised of cement, fine aggregates, and coarse aggregates, all of which are combined with portable water that hardens over time. The aggregates consist mostly of broken rocks or coarse gravels such as lime stones, with a little amount of fine aggregates, such as sand, thrown in for good measure. Concrete is often made using Portland cement, although other materials with cementious qualities such as fly ash and slag cement may also be used to bind aggregates together. Portland cement is the most common kind of cement utilised. As a result of the reaction between the cement and water, concrete hardens into a solid mass. In addition, additives such as fly ash and slag, which are mineral admixtures, are added to the cement production process in order to enhance the qualities of the cement. When the need for river sand increases, it presents significant difficulties in the production of traditional concrete. This prompted a slew of studies to be conducted, with the majority of them focusing on an alternative for fine aggregates. There is an increasing need for concrete with higher compressive strength as the trend toward greater usage of concrete for pre-stressed concrete and high-rise structures continues to gain traction. Mineral additives, also known as mineral admixtures, have been utilised in conjunction with cement for a long period of time. For example, micro silica is a by-product of the manufacturing of elemental silicon's or silicon alloys in an electric arc furnace, and it is used in a variety of applications. This research investigates the feasibility of substituting micro silica and manufactured sand for a portion of the Portland cement and fine aggregates used in the construction of concrete structures. The garbage has a detrimental impact on the environment as a result of the difficulties in storing it. In order to address this issue, an effort was conducted to determine the efficiency of micro silica as a partial substitute for Portland cement in a mortar.

Main reasons to incorporate eco sand in concrete:

Construction operations are now taking place on a massive scale all across the globe, and this is expected to continue. As a result, there has been a significant rise in the cost of building. Natural river sand, which is one of the most important elements in concrete, is becoming more costly as a result of the high cost of transportation from its origins. In addition, the depletion of resources on a big scale causes environmental difficulties. The manufacture of cement, however, includes the release of a significant quantity of carbon dioxide gas into the atmosphere, which is a significant contribution to the greenhouse effect and global warming. There is a pressing need for materials that are cost-effective, environmentally friendly, and inventive in order to address these issues. When it comes to industrial by products, they are ones that come from various industries than the primary product being presented. It may also be referred to as a by-product of the many processes that occur throughout the manufacturing process. In recent years, these goods have been recycled and repurposed for various uses in order to lessen the costs and challenges associated with their waste disposal. When compared to the original raw materials, they are 50 percent less expensive. A cement factory uses between 3 and 6 GJ of fuel every tone of clinker produced, depending on the raw materials utilised and the technique used in the production process. The majority of cement kilns currently run on coal and petroleum coke as main fuels, with natural gas and fuel oil coming in as secondary fuels. Select waste and by-products with recoverable calorific value may be utilised as fuel in a cement kiln, allowing them to replace a part of traditional fossil fuels such as coal provided, they satisfy certain requirements.

1.2 SAND MINING AND ITS ENVIRONMENTAL IMPACTS:

Depending on the application, concrete is the most widely used building material on the planet. It is a heterogeneous composite made up of a variety of readily available basic building materials such as cement, water, coarse aggregate, fine aggregate and, depending on the application, admixtures, fibres or other additives. These components combine to make a fluid mass that can be readily shaped into any shape after being combined together. When the cement has been allowed to dry enough, it hardens into a matrix that holds the other materials together to produce a durable stone-like substance known as concrete. The reason for the widespread use of concrete in the construction industry is due to its versatility, dependability, and long-term durability, as well as its strength, stiffness, durability, moldability, efficiency, and affordability. For millennia, humans have used concrete in the construction of ground-breaking architectural structures. The current growth in the housing sector, as well as other development activities in the construction area, is driving up the demand for concrete at an alarmingly high rate all across the globe.

1.3 MANUFACTURED SAND:

Although aggregates are finished products for aggregate producers, aggregates are raw materials for concrete makers. aggregate producers generate concrete, whilst concrete manufacturers produce aggregates. The quality of aggregates may be affected by the manufacturing process, although raw materials such as gravel or rock may have properties that cannot be altered by the manufacturing process. One critically crucial component is a regular supply of coarse, fine aggregate, which is difficult to come by. In this sense, course aggregate, which is formed by crushing basaltic stone and river sand, is the most important natural source of fine aggregate in the United States. The intense construction activity, on the other hand, is resulting in a growing shortage of natural sand in the country, as well as an increase in public awareness of environmental threats.

1.4 ALTERNATIVES FOR NATURAL SAND:

When acceptable natural sand resources are depleted near the point of consumption, the price of this sand rises, which in turn raises the overall cost of the building project. In order to ensure the long-term viability of infrastructure development, it is necessary to discover a substitute material that not only meets the technical specifications of fine aggregate, but is also readily accessible. Many hours of effort have been put into finding alternative sources for fine aggregate in the past. It has become more common to use crushed sand, which is a fine aggregate created by stone crushing, in regions where natural sand is not readily accessible or when natural sand is in short supply. The Mumbai-Pune express route was a project in which the purchase of natural sand proved to be problematic. As a result, the building business was forced to employ crushed sand to produce the nearly 20 lakh cubic meters of concrete required for the construction. However, since such sands have a high proportion of micro-fines, which are particles with a size of less than 75 microns, they may have a negative impact on the characteristics of concrete. When crushed sand is used in concrete, the proportioning of various raw materials at the time of mix design is very critical to get the desired result.

1.5 M SAND CHARACTERISTICS:

Quarry operations have traditionally been focused on the production of course aggregate and road building materials from rock crushed and sized in the quarry. M sand is described as a purpose-made crushed fine aggregate manufactured from acceptable source materials with a specific purpose in mind, such as construction. Artificial sand has been manufactured using a variety of crushing machinery, such as cone crushers, impact crushers, roll crushers, road rollers, and other similar devices. The parent mass of rock serves as the starting point for the formation of M sand. The chemical and mineral qualities of sand, as well as its texture and content, are determined by the rock from which it is formed.

1.6 FIBER REINFORCED CONCRETE:

Fiber reinforced concrete (FRC) is a kind of concrete that contains fibrous material to enhance the structural integrity of the concrete. For the purposes of this definition, fibre reinforced concrete is defined as a composite material consisting of cement concrete or mortar and discontinuous, discrete, and uniformly distributed fibre. Fiber is a tiny piece of reinforcing material with specific qualities and capabilities that are used to reinforce other materials. In cross-section, they might be round, triangular, or flat in shape. These fibres are made from a variety of materials, including steel, plastic, glass, carbon, and other naturally occurring substances. Steel fibre is one of the most often utilised fibres in the construction industry. Typically, round fibres are used. The diameter may range between 0.25mm and 0.75mm.

1.7 NECESSITY OF FIBERS:

In addition, it increases the tensile strength of concrete as well as its ductility and longevity, as well as its resistance to water and air gaps

• Increasing the durability of concrete is a good thing.

• Fibers have a significant part in the performance of creeping objects.

Concrete reinforcing bars are minimized when using fibres. Fibers increase the dynamic and static characteristics of concrete. Fibers improve the resistance to plastic shrinkage. Fibers improve the structural strength of concrete and its resistance to free-thaw.

Problem of the statement:

Various previous studies came to the conclusion that manufactured sand is important in concrete because it may be used to partially replace river sand in a concrete mix. However, in the current investigation, the fine aggregate utilised was 100 percent manufactured sand, rather than natural sand. The waste materials utilised in previous research were only employed as a partial substitute for river sand, and no studies were conducted to determine the long-term performance and structural behaviour of concrete made with these industrial wastes in M sand. As a result, there is a great deal of potential for investigating the impacts of Granite powder and Bottom ash as partial replacements for M-sand on the mechanical, durability, structural behaviour, and microstructural qualities of concrete.

1.8 OBJECTIVES:

- To reduce river sand usage in construction and safeguard environment So, M-Sand is to be used.
- Study on flexural bheviour of Concrete by Partial Replacement of Cement with Silica

II.LITERATURE REVIEW

Bhikshma et al. (2009) reported on the performance of high strength silica fume concrete in their paper. They came to the conclusion that replacing up to 12 percent of the cement with silica fume results in increases in compressive strength, splitting tensile strength, and flexural strength for both M40 and M50 grades of cement. During the 28-day curing period for replacements with a percentage more than 12 percent, there was a drop in compression strength, tensile strength, and flexural strength. The compressive strength, splitting tensile strength, and flexural strength of M40 grade concrete were all increased by 16.37 percent, 36.06 percent, and 16.40 percent, respectively, over controlled concrete, while the compressive strength, splitting tensile strength, and flexural strength of M50 grade concrete were all increased by 20.20 percent, 20.63 percent, and 15.61 percent, respectively, over controlled concrete. Increasing the amount of silica fume present in concrete results in an increase in the modulus of elasticity of the concrete up to a replacement level of 12 percent. Workability decreased as the amount of replacement increased, and as a result, water consumption increased as the level of replacement increased. He comes to the conclusion that the maximum replacement amount of silica fume was 12 percent for concrete grades M40 and M50, respectively.

III.METHODOLOGY

3.1 GENERAL:

Concrete is a long-lasting building material made up of a certain mix of water, m-sand, aggregates, and cement in a specific proportion. Numerous variables influence the strength and durability of concrete. By choosing an acceptable alternative material to replace the components that are currently utilised in concrete, the strength and durability of the concrete may be improved. A special concrete is a form of concrete that is used specifically for a certain purpose. Mineral admixtures and fibre particles are used in the production of special concrete, which boosts the structural strength of the finished product. Scrap metal is a byproduct of the lathe industry that is discarded after being turned. A large amount of metal scrap is created in India each year, making disposal problematic. By incorporating this scrap into concrete, the dumping of these wastes may be minimized or eliminated entirely. It is possible to boost the flexural strength of concrete by using steel debris. Silica fume is a by-product of the reduction of high quality quartz with coal in an electric arc furnace, which is used in the production of silicon or ferrosilicon alloy. It cools, condenses, and then collects in cotton bags to be disposed of. It is subjected to further processing in order to eliminate contaminants and regulate particle size. The usage of silica fume in combination with a super plasticizer has long been recognized as the foundation of current high-performance concrete. Silica fume, on its own, does not significantly add to the strength of a concrete mix, but it does so by acting as a very fine pozzolanic ingredient and by forming dense packing and pore filler in a cement paste mix, which both contribute to strength. Silica fume, on the other hand, demonstrates significant Materials Used:

In this investigation, ordinary Portland Cement (OPC 53 grade) that is compliant with Indian Standard IS: 1226916, as well as the additional materials Silica fume that has been certified to be compliant with IS: 1538817 and GGBS, are employed. The specific gravity of the cement and the specific gravity of silica fume were determined to be 3.15 and 2.20, respectively. Sugar Cane Bagasse Ash (SCBA), which has a specific gravity of 2.74 and is used as a partial replacement material for binder in different percentages (IS: 12089)18, is used as a partial replacement material for binder. GGBS is a non-metallic substance that is mostly composed of silicates and aluminates of lime, as well as other bases, which help to increase the strength of the concrete mix.

3.2 AGGREGATE:

In order to obtain the highest possible particle packing density, coarse aggregates of two distinct sizes–20 mm and 12.5 mm–were employed. A variety of coarse aggregates with particle sizes ranging from 20 mm to 12.5 mm were obtained using sieve analysis; the particle size distributions of coarse aggregates with 20 mm and 12.5 mm are shown in Table 1. The specific gravity of 20 mm and 12.5 mm coarse aggregate was found to be 2.80, while the water absorption of 20 mm and 12.5 mm coarse aggregate was found to be 0.57 and 0.60, respectively.

Figure 1: aggregates

Table 1: Gradation of coarse aggregate of 20 mm and 12.5 mm

Particle size, mm	% Finer	
	20mm	12.5mm
25.00	99.48	-
20.00	90.68	-
16.00	26.54	100.00
12.50	4.66	96.55
10.00	0.38	50.40

Table 2: Gradation of M sand and river sand

Particle size (mm)	% Passing		Zone II Limits as per IS: 383 (1970)	
	M Sand	River sand	Upper Limit	Lower Limit
10.00	100	100	100	100
4.75	99	98	100	90
2.36	83	89	100	75
1.18	57	55	90	55
0.60	39	36	59	35
0.30	16	8	30	8
0.15	3	2	10	0

Table 3: Specific gravity, water absorption, fineness modulus of M sand and river sand

Properties	River Sand	M Sand
Specific Gravity	2.60	2.70
Water Absorption	1.18	1.80
Fineness Modulus	3.12	3.02
Particle size, mm		
Finer (0.075 – 0.425), %	20	27
Medium (0.425 – 2.0), %	60	50
Coarser (2.000 – 4.750), %	20	23

The mixing and curing of the concrete and steel in this research were done using potable water that was clean and devoid of harmful chemicals such as oil, acid, alkali, salt, sugar, silt, organic matter, and other materials that are harmful to the concrete or steel.

For the experimental investigation, the PCE-based chemical admixture with the following parameters was used: pH 7.20, Solid Content 33.72 percent, Chloride ion content 0.0079 percent, and Relative Density at 25 degrees Celsius was 1.08 grams per cubic centimeter.

3.3 CEMENT:

Cement is a binder, a substance that sets and hardens and can bind other materials together. Cements used in construction can be characterized as being either hydraulic or nonhydraulic, depending upon the ability of the cement to be used in the presence of water.

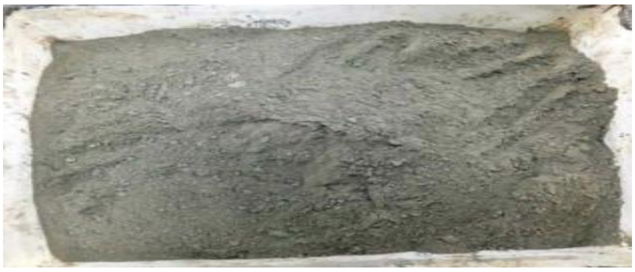


Figure 2: M 30-Grade (Cement)

Table 4: Properties of Cement

Particulars	Results
Specific Gravity	3.16
Fineness	272 m²/kg
Initial setting time	48 minutes
Final setting time	268 minutes
Normal consistency	36%

3.4 SILICA FUME:

As defined by the American Concrete Institute (ACI), silica fume is defined as "a extremely fine non crystalline silica created in electric arc furnaces as a by-product of the manufacturing of elemental silicon or silicon-containing alloys". A variety of names for silica fume include micro silica, condensed silica fume, volatized silica, and silica dust. It has the ability to display both pozzolanic and cementitious characteristics. Silica fume has long been known as a pozzolanic admixture that is capable of significantly improving the mechanical characteristics of a variety of materials. It is believed that the addition of silica fume to concrete enhances the durability of concrete while also shielding the embedded steel from corrosion.

Figure 3: Silica Fume

Table 5: Properties of Silica Fume

Specific gravity	2.2
Bulk density	576 Kg/m^3
Size	0.1 Micron
Surface area	20000 m^2/Kg
Sio2	90-96 %
Al2o3	0.5-0.8 %

Table 6: Properties of Fine Aggregate

Particulars	Results
Specific gravity	2.63
Fineness modulus	2.9
Water absorption	0.76%
Bulk density	1477.22 kg/m^3

3.5 WATER AND SUPER PLASTICIZER:

The preparation and curing of SIFCON specimens is carried out using ordinary potable water appropriate for human consumption that is readily accessible at the location. Conplast SP - 430 is the Super plasticizer that was used in order to improve the workability of the concrete mix. The item has primarily been designed for use in concrete where high durability and performance are needed, such as in high performance concrete, and has a limited lifespan.

Table 7: Properties of M sand and River sand

S.No	Properties	Type of sand	
		M-sand	River sand
1.	**Textural composition (%by weight)** Coarse sand (4.75 – 2.00 mm) Medium sand (2.00 – 0.425 mm) Fine sand(0.425 – 0.075 mm)	 28.1 44.8 27.1	 6.6 73.6 19.8
2.	**Specific Gravity**	2.63	2.67
3.	**Bulk Density(kN/m^3)**	15.1	14.5
4.	**pH**	10.11	8.66
5.	**Chemical composition of M sand**	Si,Al,Ca,Mg Na,K,Fe,etc	

Figure 4: the following image shows the physical appearance of M-Sand.

3.6 GLASS FIBER:

Fibre Reinforced Concrete is a novel building material that is defined as a composite compound comprising cement mortar and fibre reinforcement. It is possible that concrete without fibre will develop surface fissures. Cracks and shrinkage in the surface are eliminated as a result of the incorporation of glass fibre into cement mortar. The mechanical properties of glass fibre are determined by the orientation of the fibres and the length of the fibres. There are many different varieties of Glass Fibres available. A-glass is a kind of alkali glass manufactured from soda lime silicate (soda lime). C-glass is a kind of corrosive-resistant glass formed of calcium borosilicate crystals.

Table 8: Properties of glass Fiber

Fiber	Density (gm/cm3)	Elastic Modulus (Gpa)	Tensile Strength (Mpa)	Diameter In Microns	Length In mm	Percent Elongation	Aspect ratio
S-Glass fiber	2.53	89	4600	10	6	5.2	600

3.7 EXPERIMENTAL WORK AND RESULTS:

3.7.1 Mix design:

Mix design according to established guidelines is essentially only a process of making educated guesses about the optimal combination of elements, and the ultimate mix percentage is only determined after a number of more rail mixes have been completed. As previously stated, a comparison research is being conducted as part of the project; as a result, just the kind of fine aggregate is being modified, while all other elements are remaining constant. A constant mix design was used to arrive at the concrete mix used in this investigation. In order to arrive at a concrete mix design for this investigation, M30 concrete was used in accordance with the IS regulation. The mix percentage used in this research is M30 grade (1:1.644:2.945), with a water-to-cement ratio of 0.40 and a water-cement ratio of 0.40. The cubes and cylinders of standard size 150x150x150mm, the prisms of standard size 100x100x500mm, and the cylinders of standard height 300mm are casted and cured for seven and twenty-eight days, respectively, and then tested according to codes IS: 516-1959 and IS: 5816-1999.

Table : Mix Proportion for M30 Grade Concrete (1:1.85:3.2)

Water	Cement (kg)	Fine aggregate (kg)	Coarse aggregate (kg)
175	389	720	1257

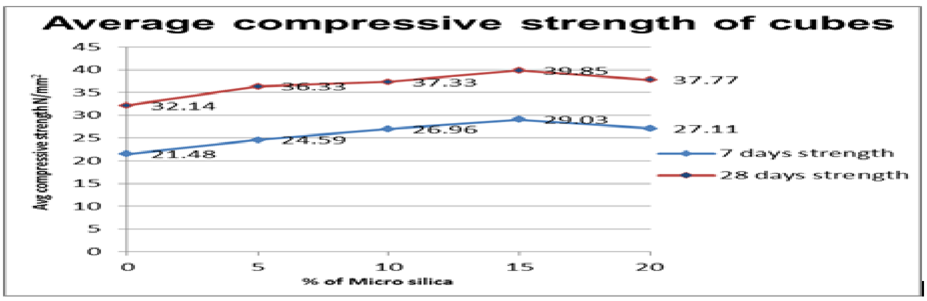
Table 9: Strength of concrete for cement replacement

Mix	% replacement of cement by micro silica	Compressive strength N/mm^2	Split tensile strength N/mm^2	Flexural strength N/mm^2
CM	100% cement	32.14	2.83	4
MS-5	100% cement +5% MS	36.33	2.97	4.21
MS-10	100% cement +10% MS	37.33	3.02	4.34
MS-15	100% cement +15% MS	39.85	3.30	4.5
MS-20	100% cement +20% MS	37.77	2.92	4.26

Table : strength of concrete for natural sand replacement

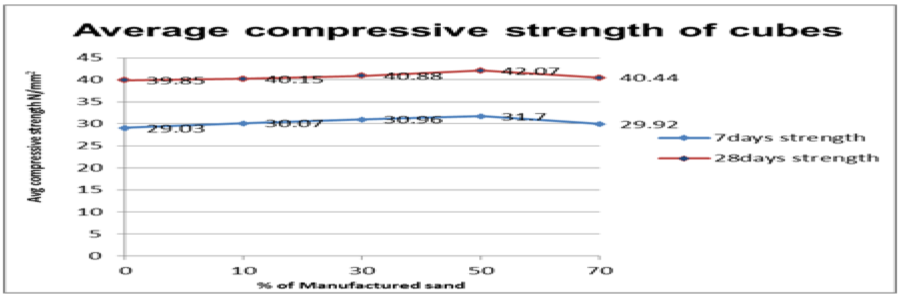
Mix	% replacement of fine aggregate by manufactured sand	Compressive strength N/mm^2	Split tensile strength N/mm^2	Flexural strength N/mm^2
MS-15 + M sand-10	15% MS + 10% M sand	40.15	3.44	4.53
MS-15 + M sand-30	15% MS + 30% M sand	40.88	3.67	4.72
MS-15 + M sand-50	15% MS + 50% M sand	42.07	3.77	4.85
MS-15 + M sand-70	15% MS + 70% M sand	40	3.48	4.61

Up until the day of testing, all of the cubes had been wet cured. The cubes are evaluated for curing time of seven days and twenty-eight days. The following three specimens were prepared for each age group tested and for each mix made with a partial replacement of micro silica in the order of appearance: (0 percent, 5 percent, 10 percent, 15 percent and 20 percent). The highest value of compressive strength was found when micro silica was used to replace 15 percent of the cement in the experiment. Figure 1 depicts the fluctuation in compressive strength over time.



Graph : Compressive strength for variation of micro silica (7 & 28 days)

Compressive strength test was then carried out on cubes which were cast by fixing the micro silica variation as 15% and replacing the natural sand with manufactured sand in the order (10%, 30%, 50% and 70%). The variation of the compressive strength is shown in figure



Graph : Compressive strength for variation of manufactured sand (7 & 28 days)

3.8 MIXING, CASTING AND CURING OF CUBES:

Table : Details of Size and Mix Proportion (River sand and M sand)

Specimen Tested	Silica fume in River sand	Silica fume in M sand	Size (mm)	No. of specimens
Cube (28dayscompressive strength)	Conventional	conventional	150x150x150	6
	5% replacement	5% replacement	150x150x150	6
	10% replacement	10% replacement	150x150x150	6
	15% replacement	15% replacement	150x150x150	6
	20% replacement	20% replacement	150x150x150	6

Table : Details of PCC Prism Specimen

Specimen Tested	Silica fume in River sand	Silica fume in M sand	Size (mm)	No. of specimens
PCC prism (28 days compressive strength)	Conventional	conventional	700x150x150	2
	5% replacement	5% replacement	700x150x150	2
	10% replacement	10% replacement	700x150x150	2
	15% replacement	15% replacement	700x150x150	2
	20% replacement	20% replacement	700x150x150	2

Table 10: Details of Reinforced Beam Specimen

Specimen Tested	Silica fume in River sand	Silica fume in M sand	Size (mm)	No. of specimens
Beam (28 days compressive strength)	Conventional	Conventional	1000x150x200	2
	5% replacement	5% replacement	1000x150x200	2
	10% replacement	10% replacement	1000x150x200	2
	15% replacement	15% replacement	1000x150x200	2
	20% replacement	20% replacement	1000x150x200	2

Figure : Unmolded specimen

Figure : Loading setup for specimen

Sand with silica fume, an alternative to river sand and in concrete industry:

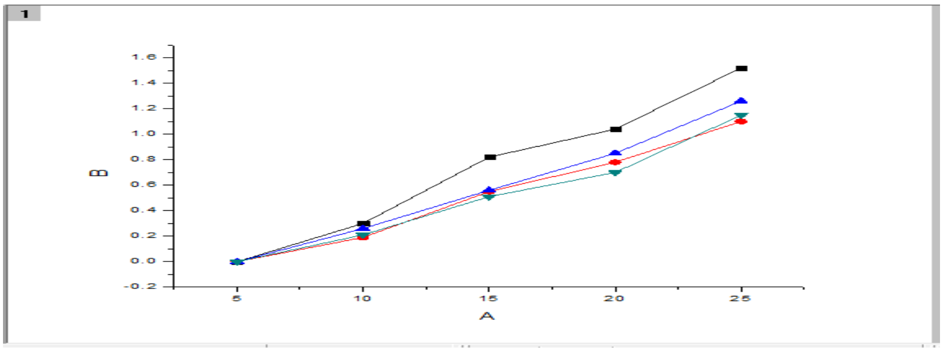
There is a scarcity of high quality. As a result of the depletion of natural resources and restrictions imposed by environmental regulations, concrete manufacturers are looking for viable alternatives for fine aggregate in their mix designs. "Manufactured sand" is one example of such a substitute. Despite the fact that manufactured sand has been used in concrete production in India for some time, the proportion of its contribution is still quite little in many regions of the nation. To guarantee the building of a long-lasting R.C.C. structure, it is essential that the concrete used is of high quality and meets the specifications. As a result, durable concrete covers and bears the duty of maintaining the whole reinforced concrete structure throughout its service life. It has the potential to be utilised in concrete as a suitable substitute for natural sand. The uses of manufactured sand in India are discussed in this study as part of an effort to achieve sustainable development in the country. It will aid in the discovery of a feasible solution to the diminishing supply of natural sand for the purpose of achieving eco-balance.

IV.RESULTS AND DISCUSSION

Concrete and other traditional building materials are utilised extensively across the globe. Mineral admixtures are frequently employed in concrete for a variety of reasons, the most common of which is to reduce the quantity of cement needed for concrete production, resulting in a decrease in the cost of construction. The primary area of use for pozzolanic material is high performance concrete, which is the primary application for this material. Silica fume, also known as micro silica, is a non-crystalline polymorph of silicon dioxide that is amorphous (non-crystalline). It is an ultrafine powder that is collected as a by-product of the manufacturing of silicon and ferrosilicon alloys. It is spherical in shape with an average particle diameter of 150mm and is composed of spherical particles. This silica fume is utilised as a partial substitute for cement in several applications. Manufactured Sand is a kind of sand created by crushing granite stones to the appropriate grade for use in building applications as a substitute for river sand. The crushed sand is cubical in form with grounded edges, and it has been cleaned and graded to be used as a building material. Manufactured sand (M-Sand) has a particle size of less than 4.75mm. It has been properly graded in the appropriate proportion. It does not include any organic or soluble compounds that may interfere with the setting time and qualities of cement, allowing the needed strength of concrete to be maintained at all times. It does not include impurities like as clay, dust, or silt coatings, nor does it increase the amount of water required, as in the case of river sand, which might cause the binding between the cement paste and the aggregate to be compromised. It is possible to produce M-Sand from a certain hard rock (granite) by using state-of-the-art international technology, which results in sand with the desired characteristics. M-Sand is cubical in shape and is manufactured using technology such as high carbon steel hit rock and then rock on rock process, which is synonymous to the natural process undergoing in river sand information. M-Sand is manufactured using technology such as high carbon steel hit rock and then rock on rock process. Modern and imported machinery are utilised in the production of M-Sand to guarantee that the sand has the proper grading zone. The primary goal of this effort is to determine the strength of concrete when M-sand is replaced with river sand and when silica fume is added to the mix with cement.

Table: Load Vs Deflection value for River sand and M-sand for Beam

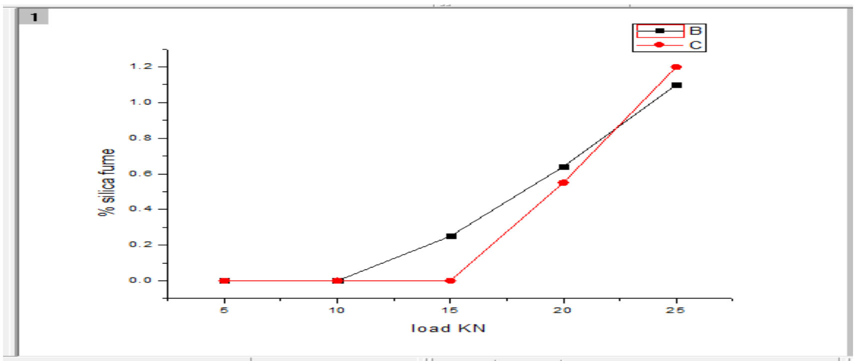
Load (kN)	Conventional Beam Deflection (mm)		5% silica fume Deflection (mm)	
	River Sand	M-Sand	River Sand	M-Sand
5	0	0	0	0
10	0.30	0.19	0.26	0.21
15	0.82	0.55	0.56	0.51
20	1.04	0.78	0.85	0.70
25	1.52	1.10	1.26	1.15



Graph : Load Vs Deflection value for River sand and M-sand for Beam

Table : Load (kN) vs 10% silica fume Deflection (mm)

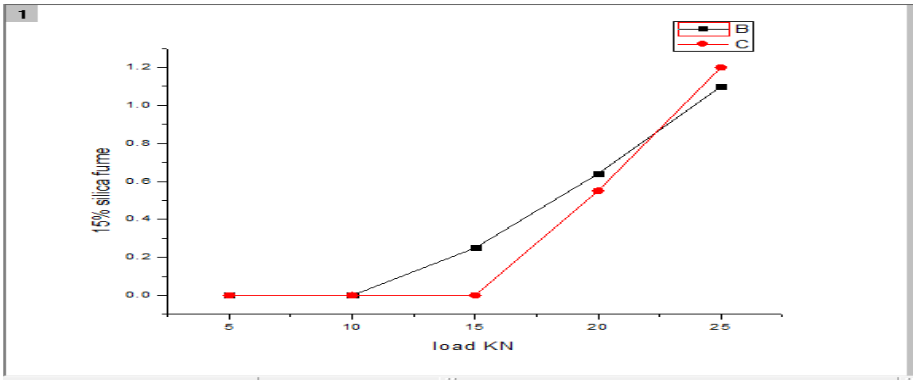
Load (kN)	10 % silica fume Deflection (mm)	
	River Sand	M-Sand
5	0	0
10	0	0
15	0.25	0
20	0.64	0.55
25	1.10	1.20



Graph : Load (kN) vs 10% silica fume Deflection (mm)

Table : Load (kN) vs 15 % silica fume Deflection (mm)

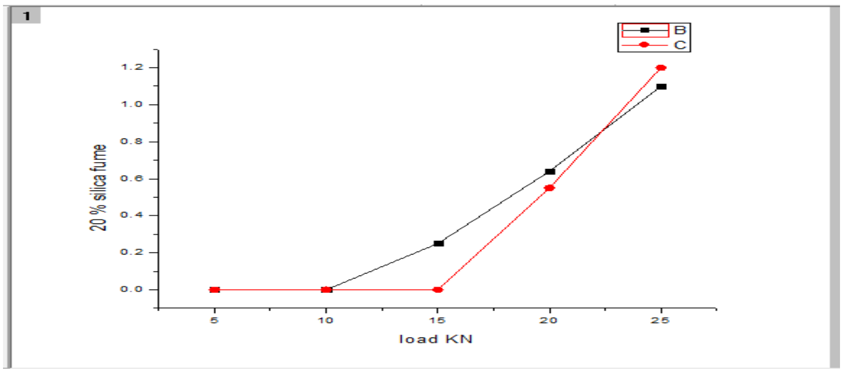
Load (kN)	15 % silica fume Deflection (mm)	
	River Sand	M-Sand
5	0	0
10	0	0
15	0	0
20	0.10	0
25	0.19	0.20



Graph : Load (kN) vs 15 % silica fume Deflection (mm)

Table : Load (kN) vs 20 % silica fume Deflection (mm)

Load (kN)	20 % silica fume Deflection (mm)	
	River Sand	M-Sand
5	0	0
10	0	0
15	0	0
20	0	0.08
25	0.15	0.19



Graph : Load (kN) vs 20 % silica fume Deflection (mm)

V.CONCLUSION

The following conclusions have been reached as a consequence of the experimental investigation. The strength of concrete made using M-sand is greater than the strength of concrete made with river sand after 28 days. Additionally, the higher gradation of M-sand resulted in outstanding flexibility in the mortar, which resulted in great workability. At the age of 28 days, the combination of silica fume and manufactured sand achieved strengths that were 5 percent, 10 percent, 15 percent, and 20 percent higher than the target strength. Other strength parameters, such as compressive strength and flexural strength, were also slightly increased in this combination when compared to the control. The use of M-sand in high strength high performance concrete results in stronger and more lasting concrete buildings that are both cost-effective and environmentally benign since natural resources such as river sand are preserved.

Compressive Strength: Based on the findings of both the 7-day and 28-day compression tests, it is obvious that the maximum strength of the cube is attained at a 15 percent substitution of cement by silica. Thus, the micro silica concentration is set at 15 percent of the final product. Results of compression tests conducted after natural sand has been replaced with manufactured sand reveal that the highest strength is attained when 15 percent micro silica and 50 percent manufactured sand are combined.

Split Tensile Strength: In the test findings, it is obvious that the split tensile strength of concrete improves to some degree with an increase in the percentage of micro silica and produced sand, after which it begins to decline.

Flexural Strength: Based on the test findings, it is obvious that the flexural strength of concrete improves to a certain amount with an increase in the proportion of micro silica and produced sand, and then begins to decline.

• The inclusion of steel fibres results in an increase in rebound number of up to 8%, indicating improved surface hardness.

• Based on the overall findings of the Strength tests, it can be concluded that adding 8 percent of steel fibres by volume to SIFCON is the maximum quantity of steel fibres that can be added.

According to the results of the workability tests, SIFCON is self-compactable and has superior workability than other materials.

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