THE EFFECT ON MECHANICAL PROPERTIES OF STEEL FIBRED SELF COMPACTION CONCRETE WITH PARTIAL REPLACE OF MARBLE DUST WITH SAND

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ABSTRACT

Investigating the properties of steel fiber reinforced (S.F.R.) self-compacting concrete (S.C.C.) produced with marble dust (M.D.) rather than cement is the goal of this project. In this study, we used steel fibers and varied amounts of marble dust (M.D.) in place of cement. Conplast sp 430 is used as a chemical additive in the M30 mix used in this study. We substituted marble dust (M.D) (5 , 10 , 15 and 20 percent) for cement in ratios with steel fibers (0.2 percent), and we assessed the mechanical properties after seven and twenty-eight days.

KEY WORDS*: Marble dust, steel fibre (binding wire) The three kinds of strength are tensile strength, flexural strength, and compressive strength..*

INTRODUCTION

Fiber reinforced self-compacted concrete is composed of steel cement, fibers, and aggregates of different sizes (SFRS.C.C.). Concrete that has fibers scattered throughout is called as fiber-reinforced concrete. When exposed to tensile stress, concrete becomes brittle. but mechanical properties may be improved by the random placement of discrete fibers that prevent and controlbeginning, spreading, and merging of fractures.

1.1 Objectives of this Study .

Investigating the Features of self-compacting steel fiber reinforced concrete made with marble dust (M.D.) instead of cement is the goal of this project. In this investigation, we substituted varying amounts of marble dust for cement and steel fibers. Conplast sp 430 is utilized as a chemical admixture in this study together with M30 mix.

1.2 Self Compacting Concrete (S.C.C)

Self-compacting concrete (S.C.C.) with a high fines concentration has been shown to last longer. Since its launch in Japan, a great deal of study has been published globally on the microstructure, durability, and mix design of S.C.C. The Bureau of Indian Standards (BIS) has yet to develop a typical mix approach, even though many companies and academics have worked hard to develop logical combine design procedures with self-compactibility testing techniques.Cement, water, fine and coarse aggregates, and chemical and mineral admixtures are the same ingredients of self-compaction concrete as they are in regular concrete.Viscosity-modifying agents (VMA), additional particles, and high-range water reduction agents (Super Plasticizers) are what distinguish S.C.C. from regular concrete and change its rheological characteristics to varied degrees.

1.3 Concrete with Fiber Reinforcement for Self-Compression

Because different cement grades and mineral admixtures are now readily available, concrete technology has advanced significantly in recent years. Despite significant progress, certain issues still persist. When compared to materials like steel, these problems can be regarded as drawbacks of this cementative substance. Concrete has very little ductility and a poor tensile strength because it is quasi-fragile. Fibers may help with these two issues to some extent. This has been shown to improve absorption of energy in addition to bridging fractures and stopping them from spreading. Since the 1960s, Fiber Reinforced Concrete (FRC) has gained prominence and been the subject of extensive research. Besides bridging cracks and minimizing their propagation, FRC has several applications, including shotcreting, industrial floors, bridge decks, pre-cast sections, pavements, and critical zones in RCC components. Fiber Reinforced Concrete (FRC) has been the focus of much study and has grown in popularity since the 1960s. Shotcreting, industrial floors, bridge decks, pre-cast parts, pavements, and critical zones in RCC components are just a few of the many uses for FRC. FRC was developed to address the whole spectrum of concrete types using various fiber types in both plain and RCC concrete. To improve its efficacy and efficiency, we must update our knowledge of how fibers affect the behavior of "concrete" of the present generation. One of the newest types of concrete is self-compaction concrete (S.C.C.).In order to maximize the advantages of this special concrete in both its fresh and hardened forms, fibers are added. Because of this, concrete engineers have focused their study on the mechanical qualities and durability of S.C.C. using a range of fiber kinds, including:

1. Steel fibers
2. Nylon-based fibers
3. Polypropylene fibers
4. Glass fibers
5. Carbon fibers
6. Asbestos Fibers

Another idea that has been proven is the hybridization of several fiber kinds in concrete to provide concrete better and more enticing properties. In order to effectively utilize the potential properties of fibers, the hybrid fiber concept calls for merging at least two various types of fibers. Numerous researchers have published a number of research on the qualitiesof ordinary concrete reinforced with hybrid fibers.

1.4 Backdrop about self-compacting concrete

The most prevalent of all manufactured goods, cement-based products are crucial to design and are only anticipated to grow in significance going forward.These anatomical and design products, however, need to meet higher and new standards. When considering production, general economics, quality, and environmental concerns, weather-resistant materials like wood, plastic, and other design goods are used.One path in this evolution is self-compacting concrete (S.C.C.), a superior product that passes and consolidates only by its own weight without requiring additional compaction energy.

Concrete that can be poured and compacted by its own weight without the need for vibration is known as self-compacting concrete. This kind of concrete offers full formwork coverage even in situations when access is restricted by filter gaps between reinforcing plates. The expanding sector finds it challenging to comprehend that vibration is not ideal. The new concrete must simultaneously demonstrate both beneficial cohesiveness and observable fluidity in order to exhibit this behavior.

1.5 REQUIREMENT FOR S.C.C.

Both reddish-colored and foundry fine sand feature pozzolanic homes, which improve holding houses, provide higher quality durability, and lessen charge problems. Additionally, the amount of waste from the foundry is reduced. It proves to be ineffectual when property is being disposed of. The groundwater starts to get contaminated. It should therefore be used effectively in some way. There are several reasons why this could be appealing. aid in raising the concrete's superior quality. The durability of concrete setups has been a major concern for designers for a long time. For concrete constructions to last, compaction is necessary. Normal concrete compaction is completed by vibratory compaction. Vibration is not the only factor that can lead to segregation.In strongly reinforced areas, it is challenging to use regular concrete to achieve both beneficial density and consistent product quality.

LITERATURE SURVEY

[1] Abbas AL-Ameeri (2013)

Abbas AL-Ameeri claims that in addition to the ultrasonic pulse velocity, steel fibers had an impact on the steel fiber self-compacting concrete's compressive, tensile, flexural, and modulus of elasticity. The combination contained 0.5% to 1.5% by volume of steel fiber.

Tensile and flexural strength tests were performed on all fiber mixes at different curing ages, comparing them to the simple mix. Strength increased in tandem with the fiber content. The results demonstrated that workability declined with increasing steel fiber percentage. S.C.C. toughened properties were positively impacted by a steel fiber component of 1.5% by mix volume, whereas S.C.C. fresh properties were negatively impacted. Furthermore, less than 0.5 percent steel fiber was sufficient to provide good performance in both fresh and hardened S.C.C. characteristics.

[2] Krishna Murthy.N (2012)

Krishna Murthy.N discovered that self-compacting concrete has improved quality, productivity, and working conditions as a result of the voids being eliminated. A basic tool has been created for designing self-compacting concrete mixes with 29 percent coarse aggregate, class-F flyash and Metakaolin in place of cement, blends of both, and regulated S.C.C. mixes with a water/powder ratio of 0.36 (by weight) and 388 litter/m3 of cement paste volume.They discovered that this tool is easy to use for S.C.C. design combinations and is the most promising building material for revolutionary construction advancements.

[3] Hajime Okamura and Masahiro Ouchi (2002)

In their study of the development of self-compacting concrete, also referred to as "High Performance Concrete," H Okamura and M Ouchi distinguished three stages of concrete: fresh (self-compactable), early age (to avoid early defects), and after hardening (protection against external forces). The procedure for determining self-compatibility, the effect of coarse aggregate on spacing size, the role of mortar as solid particles, the function of mortar as a fluid in new concrete flowability, and the effects of coarse aggregate on content, form, and grading were discussed by him. He therefore came to the conclusion that we would have succeeded in creating durable, dependable concrete structures that require minimal upkeep if self-compacting concrete were to become so widely used that it was considered "normal concrete" as opposed to "special concrete."

[4] NAN SU METHOD (2001)

.The NAN SU Technique is a novel mix design method for self-compacting concrete (S.C.C.) developed by Nan Su. The type and dosage of superplasticizer (SP), as well as the quantity of aggregates, binders, and mixing water employed, have a major impact on the properties of S.C.C..S.C.C. performance was assessed using compressive strength, L-box, U-box, V-funnel, and slump flow tests; the findings indicate that the recommended method can generate high-quality S.C.C.. The aggregate packing factor they developed is calculated by dividing the mass of aggregate in a densely packed condition in S.C.C. by the mass of aggregate in a loosely packed state.

[5] Yajurved M and D.V. Swetha (2015)

Yajurved.M and D.V. Swetha investigated the workability, strength, and durability of concrete that used synthetic sand in percentages of 0%, 20%, 40%, 60%, and 100% in place of natural sand. Concrete grades M20 and M30 were used for the experiments. Slump cone, compaction factor, and vee-bee time tests were used to assess workability. The results demonstrated that as the percentage of natural sand replaced with artificial sand rose, workability decreased. The concrete's strength was evaluated using tests for flexural strength, split tensile strength, and compressive strength.

[6] I.B. Muhit (2013)

I.B.Muhit looked at the dose limit and how a superplasticizing ingredient affected the characteristics of concrete. His experiments indicate that the range of effective dosages is 0.6 to 1.0 percent of the cement's weight. Furthermore, his study shown that adding more superplasticizer increased compressive strength to a certain degree.

[7]. Vijaya G. S., Dr. Vaishali G. Ghorpade, and Dr. H. Sudarsana Rao (2018).

A laboratory investigation on the chloride resistance of waste plastic fiber reinforced self-compaction concrete is described by For M40 grade of concrete, self-compactionVarious ratios were used to manufacture concrete mixes.of waste plastic fibers, such as 0.0%, 0.25%, 0.5%, 0.75%, 1.00%, 1.1%, 1.2%, 1.3%, and 1.4%.

The mix proportion was calculated using the NANSU method. The new property test results are within the EFNARC's bounds.For thirty, sixty, and ninety days, the cubes and cylinders were submerged in a 5% magnesium chloride solutionThe degree of chloride attack is determined by calculating the percentage of specimen weight loss, the decrease in compressive strength, and the split tensile strength.According to the test results, 1% of plastic fiber produced the highest compressive and split tensile strengths. The chloride content is established using the Argentometric titration method.

[8]. Dinesh A., Jasmine Jeba P., and Harini S. (2017)

Because concrete is a firm, long-lasting cement mixture, it is used as a building material, sand, gravel, and water. For concrete to flow into extremely complex shapes or shapes with numerous reinforcing bars, it must be vibrated vigorously. Self-compacting concrete is therefore employed to get around these flaws. A flowing concrete mixture that may solidify under its own weight is known as self-compacting concrete. Without being severely vibrated, the self-compacting concrete flows into the formwork at a proper speed and without obstructing the reinforcement. In this experiment, fly ash and silica fume are used to partially substitute cement in self-compaction concrete.Here, fly ash (5%, 10%, 15%, 20%, and 25%) and silica fume (2.5, 5%, 7.5%, 10%, and 12.5%) are substituted for ordinary Portland cement. According to the experimental studies, replacing silica fume results in an increase in both the fresh qualities (workability) and the hardened properties (compressive strength and split-tensile strength).

[9]. Nageswararao (2015)

Substituted crushed stone dust (CSD) and marble sludge powder (MSP) in different ratios for the fine aggregate. MSP and CSD were partially replaced at 0%, 20%, 40%, 60%, 80%, and 100% to create six mix designs. To get the flow characteristics, super plasticizer is applied in different ratios of 0.35, 0.3, and 0.25. Both fresh and cured concrete's compressive, split tensile, and flexural strengths exhibit favorable outcomes when MSP (60%) and CSD

(40%) are partially substituted with reduced water content. However, compared to regular self-compaction concrete, the durability results are not comparable. By adding a super plasticizer and using a low water-to-cement ratio, self-compaction concrete can be produced.

[10]. Prof. Shriram H. Mahure (2014)

Using fly ash as a partial substitute of cement in varying percentages together with filler, conducted research on the fresh and hardened properties of self-compaction concrete.The specimens' fresh properties were determined by calculating their slump, V-funnel, and L-box values, while their hardened characteristics were determined by calculating their compressive, flexural, and split tensile strengths. It is discovered that the hardened properties of concrete are significantly improved and that the fresh features of concrete show an acceptable value up to 30% replacement of fly ash as compared to the standard mix.

[11]. Dhiyaneshwaran, S. (2013)

Examines how self-compacting concrete (S.C.C.) is impacted by the application of Class F fly ash and Viscosity Modifying Admixture (VMA). Along with cement, coarse and fine aggregate, and water, mineral additive fly ash was utilized at six different replacement levels: 0%, 10%, 20%, 30%, 40%, and 50%. Glenium B233, a super plasticizer with a w/c ratio of 0.45 and viscosity-modifying properties, was utilized.Experiments on Self-compacting Concrete (S.C.C.) with fly ash differing between 0% to 50% showed that the material's compressive strength increased from 30 MPa to 35.9 MPa. According to the data, he came to the conclusion that using fly ash to replace up to 30% of the cement content shows a significant improvement in performance and compressive strength.Strength decreased when replacement was increased above 30%. As a result, it may be thought that 30% fly ash substitution of cement is ideal.

[12]. Anant Patel (2011).

Anant Patel (2011) examined the modulus of elasticity and compressive strength of self-compaction concrete with admixtures and different cement and fly ash levels. According to the test results, a lower concrete flow was the outcome of a lower water-to-powder ratio. He discovered that specimens with a high compressive strength and a cohesive mixture are produced by a higher cement content. He also concluded that the modulus of elasticity of the fly-ash-containing concrete is almost the same as that of the conventional mix. Finally, he pointed out that the amount of cement, fly ash, and water-powder ratio had a big impact on the strength and production of self-compaction concrete.

METHODOLOGY

3.1 Mix Design

Mix design using Nan-Su method:

Nan Su and colleagues proposed a straightforward mix design approach for S.C.C. that prioritizes filling in aggregate spaces that are not tightly packed with binder paste. They created a factor known as the Packing Factor (PF) for aggregate. It is calculated by dividing the mass of materials in a densely packed state by the mass of materials in a loosely packed state. The only factor affecting the procedure is the Packing Factor (PF). A greater PF value indicates a higher aggregate content, which reduces flow ability and calls for less binder. Among other properties, it was found that the packing factor influences the aggregate's strength, flow ability, and self-consolidation capability.the ratio in his mixture of mortar to FA. The PF value, he discovered would be the U-box test's governing element, and the design ranged from 54 to 60 percent. He found that the PF value would be the governing factor for the U-box test and that the volume of FA to mortar in his mix design was between 54 and 60 percent.

The steps of the recommended mix design technique are elaborated in the following stages

Step 1: Establish the desired mean strength

Step 2: Water cement ratio assumptions and water content calculation

Step 3: Calculate the amount of cement

Step 4.The coarse aggregate is calculated in

Step 5: Calculation of fine aggregate

•**Step 1:** Calculation of target mean strength

F min =fck + ks (from IS 10262: 2009)

=30 + 1.65 * 5 =38.65 N/mM.2.

F min = 38.65 N/mM.2.

Step 2: Assumption of water cement ratio and calculation of water content Water cement ratio (w/c)

= 0.42

Maximum size of coarse aggregate is 12 mm

Water content = 186 Litters (from IS 10262: 2009)

Step 3: Calculation of cement content

Cement content =water content/water cement ratio

=186/0.42 = 440 kg/M.3.

Step 4: Calculation of c. agg. = bulk density of coarse agg./sp. gravity of coarse agg.

= 1265/2.68 = 472 kg/M.3.

Step 5: Calculation of fine agg. =bulk density of fine agg. /sp. gravity of fine agg.

= 1595/2.61 = 611.11 kg/M.3.

Now by Nan-Su method

M.3.0 = 440 : 472 : 611.11

= 1 : 1.07 : 1.38

Water cement ratio (w/c) = 0.42

0.2 % of steel fibers is considered on the basis of literature surveys. Admixture is taken 0.6% by weight of the cement.

3.2 calculation of materials quantity

3.2.1 Calculation of materials for cube

Size of the cube mould = 150mm x 150mm x 150mm

Volume of cube (V) = length x breadth x height = 0.15 x 0.15 x 0.15 = **0.003 M.3.**

Cement required = 1/3.45 x 1.57 x 0.003 x 1440 = 2.26 kg Sand required = 1.07/3.45 x 1.57 x 0.003 x1240 = 2.067 kg

Coarse aggregate required = 1.38/3.45 x 1.57 x 0.003 x 1595 = 3.38 kg

Water = 0.42 x 2.2 = 928 ml

0.2 % of steel fibers = 17.17 gm

Admixture is 0.6% by the weight of cement = 14 ml

3.2.2 Calculation of materials for cylinder

Size of cylinder mould = 300 mm in height and
150 mm in diameter

Volume of cylinder (V) = $\pi/4$ x d^2x h = **0.0058 M.3.**

Cement required = 1/3.45 x 1.57 x 0.0053 x 1440 = 3.473 kg

Sand required = 1.07/3.45 x 1.57 x 0.0053 x1260 = 3.206 kg

Coarse aggregate required = 1.38/3.45 x 1.57 x 0.0053 x 1595 = 5.3 kg

Water = 0.42 x 3.473 = 1458 ml 0.2 % of steel fibers= 27.9 gm

Admixture is 0.6% by the weight of cement = 20 ml

3.2.3 Calculation of materials for prisms

Size of the prism mould = 100mm x 100mm x 500mm

Volume of the mould (V) = length x breadth x height

= 0.5 x 0.1 x 0.1 = **0.005 M.3.**

Cement required = 1/3.45 x 1.57 x 0.005 x 1440 = 3.28 kg

Sand required = 1.07/3.45 x 1.57 x 0.005 x1260 = 3.067 kg

Coarse aggregate required = 1.38/3.45 x 1.57 x 0.005 x 1595 = 5.0083 kg

Water = 0.42 x 3.28 = 1377.6 ml

0.2 % of steel fibers = 25.46 gm

Admixture is 0.6% by the weight of cement = 19.68 ml

Table:3.1 . Marble Dust (MD)Replacement with cement for cubes

O.P.C. 53 grade (100%)	**MD(0%)**	2.26 kg	2.26kg
O.P.C. 53 grade (95%)	**MD(5%)**	2.26x5%	113gm

O.P.C. 53 grade (90%)	**MD(10%)**	2.26x10%	226gm
O.P.C. 53 grade (85%)	**MD(15%)**	2.26x15%	339gm
O.P.C. 53 grade (80%)	**MD(20%)**	2.26x20%	452gm

Table:3.2 Marble Dust (MD)Replacement with cement for cylinder

O.P.C. 53 grade (100%)	**MD(0%)**	3.47kg	3.47kg
O.P.C. 53 grade (95%)	**MD(5%)**	3.47x5%	173gm
O.P.C. 53 grade (90%)	**MD(10%)**	3.47x10%	347gm
O.P.C. 53 grade (85%)	**MD(15%)**	3.47x15%	520gm
O.P.C. 53 grade (80%)	**MD(20%)**	3.47x20%	694gm

Table:3.3 .Marble Dust (MD)Replacement with cement for prism

O.P.C.53grade (100%)	**MD(0%)**	3.47kg	3.47kg
O.P.C. 53 grade (95%)	**MD(5%)**	3.47x5%	173gm
O.P.C. 53 grade (90%)	**MD(10%)**	3.47x10%	347gm
O.P.C. 53 grade (85%)	**MD(15%)**	3.47x15%	520gm
O.P.C. 53 grade (80%)	**MD(20%)**	3.47x20%	694gm

3.3 Casting and curing of test specimens

Standard size of cylinders (150 mm in dia. and 300 mm in height), standard cubes (150 mmx 150 mmx 150 mm), and standard prisms dimensions (100mm x 100mm x 500 mm) were all cast.

3.4 Batching of Concrete

Measured quantities of cement, fine agg. and coarse agg. were spread out on an impermeable floor. While mixing the concrete, steel fibers are randomly added. Continue doing this until the color is uniform; ten to fifteen minutes should be allotted for mixing.

Figure 4.1 concrete batching

3.5 Placing & compacting

To guarantee that no water escaped during the filling process, mold oil was sprayed on the mold sections and a similar coating was placed between the base plate and the molds' bottom contact surfaces. The concrete is then poured layer by layer into the molds and properly compacted. Finally, after the molds are completely filled, they are leveled.

Figure 4.2 Compaction the prism mould

3.6 Workability

To examine the novel qualities of the S.C.C., recent tests such as the slump flow test, L-box test, J ring test, and V- funnel test were carried out. To increase flowability, super plastisizers were added to the mixture.

Description for Mix	Slump Value (mm)	T50 Slump flow(sec)	v-funnel test (sec)	J-ring test H1-H2(mm))	L-box test H1/H2
O.P.C. 53 grade (80%) M.D(20%)	796	2.57	8.2	4	0.93

O.P.C. 53 grade (80%) M.D(20%) S.F.(0.2%) Admixture (0.6%)	645	6.6	13.9	18	1.55

3.7 Curing

The test specimen cubes, prisms, and cylinders were kept in a vibration-free environment at 27°C and 90% relative humidity for twenty-four hours after water was added to the dry components twelve hours earlier. The cubes, prisms, and cylinders of concrete are then taken out of the molds and left to cure for three, seven, or twenty-eight days.

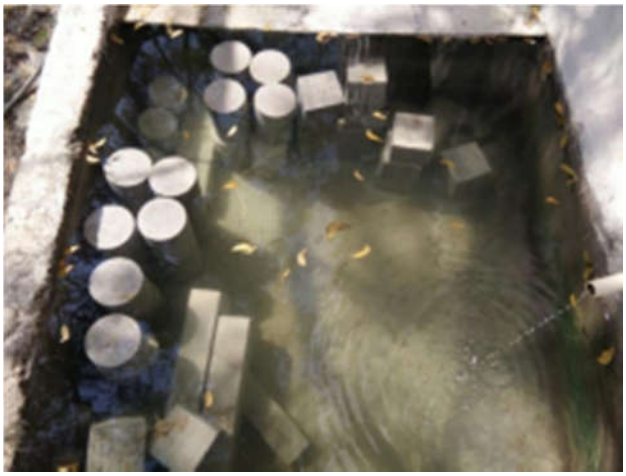

Figure 3.3 Curing the test Specimens

RESULTS AND DISCUSSION

4.1 Compressive strength test on cubes

Definition of Compressive Strength

Compressive strength is the capacity of a material or structure to withstand forces on its surface without breaking or deflecting. When compressed, a material shrinks, and when stretched, it lengthens. Formula for Compressive Strength

The formula for compressive strength for any given material is the load applied at the point of failure to the cross-section area of the face on which the load was applied.

$$\textit{Compressive Strength} = \frac{\textit{Load}}{\textit{Cross Sectional Area}}$$

Figure 4.1 Compressive Strength test of cubes

Table: 4.1 Compressive Strength Test results

SI.NO	Mix	Description of Mix	7Days	28Days
1.	**M.1.**	**O.P.C. 53 grade (100%)**	22.4	32.5
2.	**M.2.**	**O.P.C. 53 grade (95%) M.D(5%)**	24.2	33.8
3.	**M.3.**	**O.P.C. 53 grade (90%) M.D(10%)**	23.8	34.2
4.	**M.4.**	**O.P.C. 53 grade (85%) MD(15%)**	25.4	34.6

5.	**M.5.**	**O.P.C. 53 grade (80%) M.D(20%)**	26.2	35.8
6.	**M.D.5**	**O.P.C. 53 grade (95%) M.D(5%) S.F.(0.2%) Admixture (0.6%)**	32.2	52.4
7.	**M.D.10**	**O.P.C. 53 grade (90%) M.D(10%) S.F.(0.2%) Admixture (0.6%)**	33.4	55.2
8.	**M.D.15**	**O.P.C. 53 grade (85%) M.D(15%) S.F.(0.2%) Admixture (0.6%)**	34.5	57.4
9.	**M.D.20**	**O.P.C. 53 grade (80%) M.D(20%) S.F.(0.2%) Admixture (0.6%)**	35.2	59.1

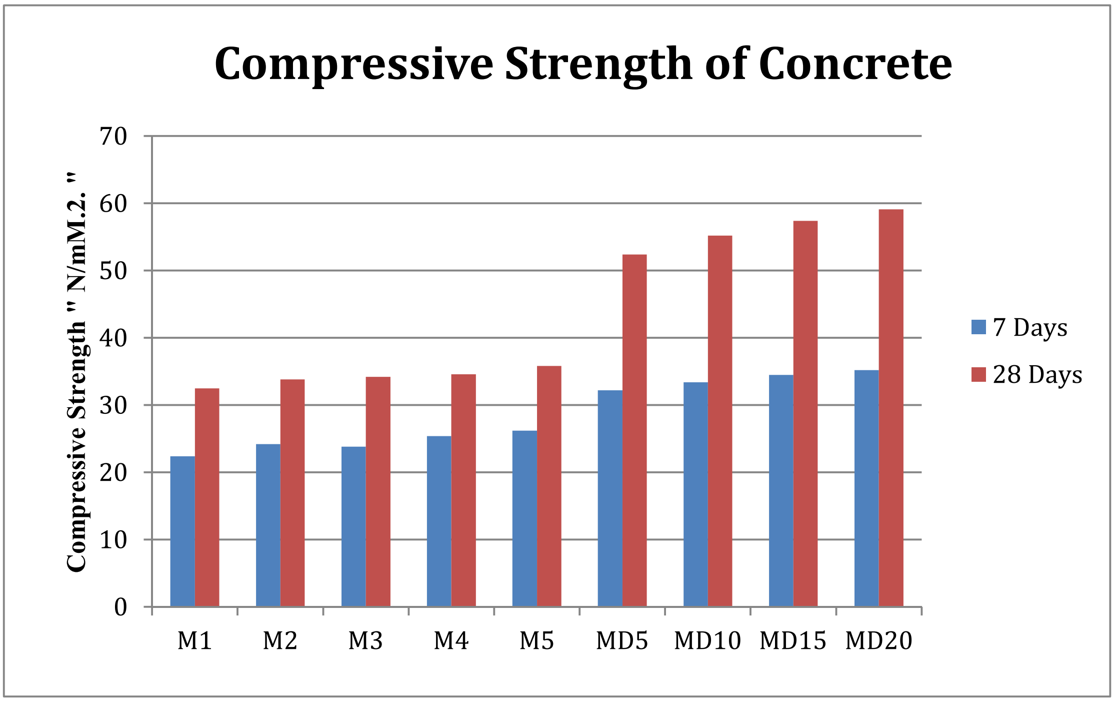

Figure 4.2 Graphical Representation for compressive strength of cubes

4.2 Concrete Cylinders

The number and size of cracking in buildings are greatly influenced by the tensile strength of concrete, which is one of its most basic and important properties. Additionally, the concrete is incredibly weak under tension due to its brittle structure. It is therefore unlikely to tolerate direct strain. Fractures therefore develop when tensile pressures exceed the concrete's tensile strength. Therefore, to calculate the load at which the concrete members may fracture, the tensile strength of the concrete must be ascertained.

Now **split tensile strength of Cylinder = 2P/πLD**

Where P = Cracking load , L = cylinder length

D = dia. of cylinder

Figure 4.3 Split tensile test on concrete cylinder

Table:4.2 Split Tensile Test results

SI.NO	Mix	Description of Mix	7 Days	28Days
1.	M.1.	O.P.C. 53 grade (100%)	2.52	3.63
2.	M.2.	O.P.C. 53 grade (95%) M.D(5%)	3.17	3.48
3.	M.3.	O.P.C. 53 grade (90%) M.D(10%)	3.32	3.72
4.	M.4.	O.P.C. 53 grade (85%) M.D(15%)	3.28	3.84
5.	M.5.	O.P.C. 53 grade (80%) M.D(20%)	3.36	3.96
6.	M.D.5	O.P.C. 53 grade (95%) M.D(5%) S.F.(0.2%) Admixture (0.6%)	3.70	4.05
7.	M.D.10	O.P.C. 53 grade (90%) M.D(10%) S.F.(0.2%) Admixture (0.6%)	3.81	4.26
8.	M.D.15	O.P.C. 53 grade (85%) M.D(15%) S.F.(0.2%) Admixture (0.6%)	3.94	4.34
9.	M.D.20	O.P.C. 53 grade (80%) M.D(20%) S.F.(0.2%) Admixture (0.6%)	4.09	4.47

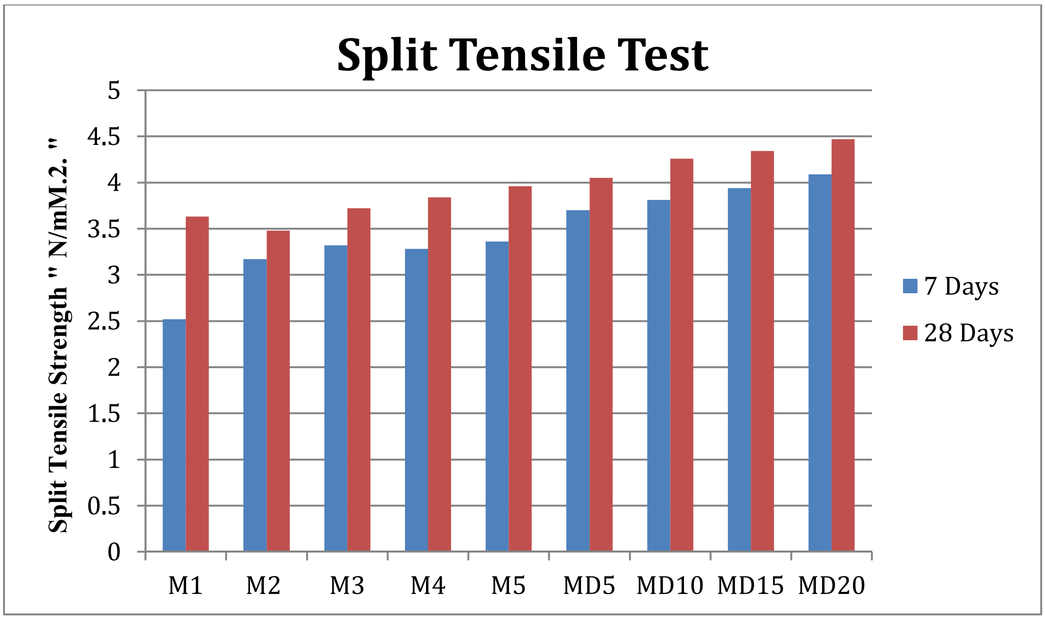

Figure 4.4 Graphical Representation for tensile strength of cylinders

4.3 Flexural Strength Test

The Flexural tensile strength of concrete is evaluated indirectly using the flexural test. It determines if an unreinforced concrete slab or beam can resist bending or flexural failure. The results of a bending or flexural test on the concrete are represented in M.Pa. as a modulus of rupture.

Now **flexural strength(F.S.) = FL/wd2**

Where F = load, L = length of specimen beam, W = width of specimen beam,

D = depth of specimen beam

Figure 4.5 Flexural test on concrete beam

Table: 4.3 Flexural Test results

SI.NO	Mix	Description of Mix	7 Days	28Days
1.	M.1.	O.P.C. 53 grade (100%)	3.13	3.84
2.	M.2.	O.P.C. 53 grade (95%) M.D(5%)	3.16	3.98
3.	M.3.	O.P.C. 53 grade (90%) M.D(10%)	3.15	4.16
4.	M.4.	O.P.C. 53 grade (85%) M.D(15%)	3.22	4.34
5.	M.5.	O.P.C. 53 grade (80%) M.D(20%)	3.25	4.78
6.	M.D.5	O.P.C. 53 grade (95%) M.D(5%) S.F.(0.2%) Admixture (0.6%)	5.40	7.22
7.	M.D.10	O.P.C. 53 grade (90%) M.D(10%) S.F.(0.2%) Admixture (0.6%)	5.63	7.43
8.	M.D.15	O.P.C. 53 grade (85%) M.D(15%) S.F.(0.2%) Admixture (0.6%)	5.84	7.48

9.	**M.D.20**	**O.P.C. 53 grade (80%) M.D(20%)** **S.F.(0.2%) Admixture (0.6%)**	5.96	7.62

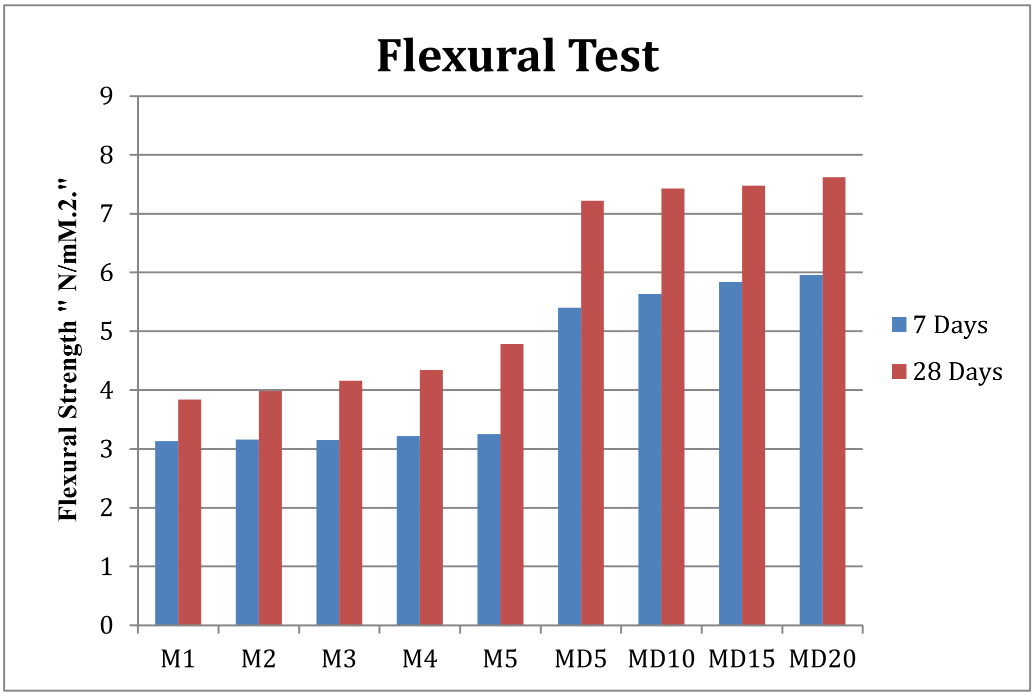

Figure 4.6 Chart OF flexural strength Test

4.4 Pictures of tested concrete specimens

Figure 4.7 Tested concrete cylinder

Figure 4.8 Tested concrete beam

CONCLUSION

1. Comprressive strength has been increased from M.1. to M.D.20 for both 7days and 28days, can be clearly observed from the fig. 4.2.

2. Split Tensile Strength has been increased from M.1. to M.D.20 for both 7days and 28days, can be clearly observed from the fig. 4.4.

3. Flexural Strength has been increased from M.1. to M.D.20 M.D.20 for both 7days and 28days, can be clearly observed from the fig. 4.6.

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