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Experimental Research on Triple Blended Concrete

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Abstract:-*Concrete is the most broadly utilized development material utilized for the development of different sorts of structures including structures, streets, bridges, dams and so forth. Since numerous hundreds of years, there have been a few negligible structures and some considerate designing wonders that have been built after some time everywhere throughout the world. Change has been a consistent parameter inside the concrete industry in perspective of expanding development activities and in particular an expanded push in high caliber yet economic structures. This change has in this manner, carried alongside it, diverse patterns in concrete innovation regarding the route in which it is seen and all the more actually, its structure, its taking care of, blending and so forth. .In any case, all through these progressions, the basic parameter to be considered for concrete is that of strength and durability. Keeping this in view, on account of colossal and broad technological improvements, we have today, extraordinary sorts of concretes, for example, triple blended concrete, self-compacted concrete, bacterial concrete and so on which have, in their own particular separate way, prevailing with regards to upgrading the serviceability of the structure with which they are worked, in contrast with standard concrete. In this report, we center and stress around Triple Blended Concrete, its importance, materials included, procedure of packaging, testing, notable elements are researched in this project.*

Keywords:- Concrete, silica fume, flyash, and fibre materials,Compressive strength, split tensile strength test.

Introduction

Concrete, is one of the key development materials having great compressive and, flexural strengths and solid properties among others. With similar ease produced using the absolute most broadly accessible components, it has discovered wide utilization. It is flexible, versatile and generally fireproof. The way that it is a designed material which fulfill any sensible arrangement of execution particulars, more than whatever other material as of now accessible has made it colossally prominent development material. Truth be told, each year more than 1 m3 of concrete is created per individual (more than 10 billion tones) around the world.

Strength (stack bearing limit) and durability (its imperviousness to breaking down organizations) of concrete structures are the most critical parameters to be considered while talking about concrete. The breaking down organizations might be concoction – sulfates, chlorides, CO2, acids and so on or mechanical causes like scraped spot, affect, temperature and so forth. The means to guarantee tough and solid concrete include auxiliary outline and specifying, blend extent and workmanship, satisfactory quality control at the site and decision of suitable elements of concrete. Kind of bond is one such component. In this paper, the hugeness and impact of the sort of bond on strength and durability of its relating concrete is centered around.

Contingent on the administration condition in which it is to work, a concrete structure may need to experience diverse load and introduction administrations. Keeping in mind the end goal to fulfill the performance necessities, bonds of various strength and durability qualities will be required. Up until this point, the improvement can be isolated into four phases. Viz; normal strength concrete (NSC) which is made out of just four essential parts (bond, water, fine totals and coarse totals). Increment in lodging needs as high ascent structures; long traverse bridges, and so forth., required higher compressive strength. Consequently, the following stage was that of building up a bond sort with a characteristic higher compressive strength i.e. the advancement of high strength concrete (HSC). Be that as it may, with time, it was understood that high compressive strength was not by any means the only critical figure to be viewed as the plan of concrete blends. Different parameters, for example, high durability, low porousness, high workability and so on were likewise learnt to be similarly quintessential. Along these lines, high performance concrete (HPC) was proposed and generally learned toward the finish of the most recent century. The last stage included the expansion of every one of these properties to the highest degree conceivable in an economical and condition neighborly way. Here, comes into picture, the idea of triple blended concretes.

What is Triple Blended Concrete?

Triple blended concretes have a place with that stratum of concretes where the strength and durability qualities are boosted to the highest degree conceivable, in contrast with different sorts of concretes, by unobtrusive fitting of its synthetic organization, fineness and molecule estimate dissemination. More prominent assortments are presented by the fuse of added substances like pozzolana, granulated slag or idle fillers. These prompt to various "particular" of bonds in national and global guidelines.

In straightforward words, triple blended concrete is portrayed by part supplanting of bond with mineral admixtures/added substances, for example, pozzolanic admixtures (fly slag, silica seethe) or dormant fillers. The comparing concrete is named as triple blended concrete. These admixtures are found to upgrade the physical, synthetic and mechanical properties of the concrete i.e. as far as its strength parameters (compressive and flexural) and in addition durability parameters.

We for the most part utilize high strength concretes in the accompanying conditions:

- To place concrete into administration at a significantly prior age, for instance opening the asphalt at 3 days

- To fabricate high ascent structures by decreasing segment sizes and expanding accessible space
- To fabricate superstructures of long traverse bridges and to improve the durability of the scaffold decks
- To fulfill the particular needs of exceptional applications, for example, durability, modulus of flexibility and flexural strength. Some of these applications incorporate dams, show off rooftops, marine establishments, parking structures and substantial obligation modern floors.

Significance of triple blended concrete

Albeit concrete has been serving people to give pleasantries, the administration accompanies a huge cost. Concerning gigantic measure of concrete generation every year, it impactsly affects nature. Utilization of endless measure of common assets, arrival of very nearly one tone of CO2 into the air from the creation of each tone of Portland Cement are two noteworthy ecological issues. Around the world, the concrete industry alone is assessed to be in charge of around 7% of all CO2 produced. In addition, paying little respect to water supply deficiencies in many parts of the world, the generation of concrete requires a lot of water. At long last, the devastation and need of transfer of concrete structures, asphalts and so forth., makes another natural weight. Development and destruction trash delivers an extensive part of strong waste in created countries.%.

What is listed above indicates that concrete has become the victim of its own achievements but for sure it is still one of the most practical building materials in the world. The challenges that this industry is facing are more of a result of Portland cement production. So, the most effective remedy to solve the problem is to use less Portland cement which means to replace as much Portland cement as possible by supplementary cementitious materials in place of natural resources. Different efforts have been made to reduce the drawbacks of concrete on environment such as aggregates and binders. Furthermore, the partial replacement of Portland cement with mineral admixtures proves itself to be an economical and cost-effective proposition. This is because, the cost of these admixtures, obtained as industrial bi-products, is much lesser than that of cement. And hence, the cost of any triple blended concrete mix is substantially lesser than that of its corresponding ordinary concrete. It is believed that the adverse effects of cement, CO2 emission, may be minimized if mineral admixtures are applied; as they reduce cement consumption, energy and cost. In eco cement, large amounts of Portland cement clinker (up to 70%) are replaced by available mineral additives such as natural pozzolanic materials, sand, limestone, granulated blast furnace slag, fly ash, silica fume, glass cullet and ceramic wastes. A case study reveals that a reduction of up to 67% of the energy requirements and 80% in the cementing of pozzolanas added, energy requirements may drop by 33% and cost by 20%.

Furthermore, the most imperative indicate be noted as far as centrality of triple blended bonds is that, concretes to which supplementary cementitious materials as mineral admixtures are included, have upgraded strength and durability parameters. This is the essential introduce on the premise of which the idea of triple mixing is thought to be the need of great importance in structural designing. This paper concentrates on mineral admixtures utilized as a supplementary

Cementitious material to decrease Portland bond and how they improve the properties of the relating concrete. Our venture spins around the utilization of triple blended high strength concrete in which the supplementary mineral admixtures utilized are that of fly fiery remains and silica smolder. Notwithstanding these, we are additionally blending concrete with steel filaments to upgrade its flexural strength parameter. Portrayal of the materials included is managed in resulting parts.

An experimental study is conducted to find out the compressive strength and flexural strength of concrete at 28days. In concrete the partial replacement of cement by Fly ash and Silica fume are varied from (0+5)%,(20+5)%, (40+5)%, (0+10)%, (20+10)%, (40+10)%, (0+15)%, (20+15)%, (40+15)%, by weight.

MATERIALS:

Cement : OPC 53 grade

Coarse aggregate: crushed stone

Fine aggregate : natural river sand

PARAMETERS:

Assume standard deviation = 5 N/mm^2

Assume slump of concrete = 75 mm

DESIGN OF M35 GRADE HIGH STRENGTH CONCRETE BY B.I.S.METHOD:

Materials:

Cement : OPC 53 grade

Coarse aggregate : crushed stone

Fine aggregate : natural river sand

Properties of materials:

Cement : specific gravity =2.99

Coarse aggregate : Fineness modulus=7.14

Bulk specific gravity=2.64

Absorption characteristic=0%

Fine aggregate : Fineness modulus=2.78
Absorption characteristics=1%

Parameters:

Assume standard deviation = 6.3 N/mm²

STEP-1:

Target mean strength = (specific characteristic strength) +
(Standard deviation * risk factor)
= 35 + (6.3*1.65) = 45.395mPa

STEP-2:

W/C for 45.395mPa = 0.34

STEP-3:

Maximum size of aggregate = 20mm
Entrapped air = 2%
Absolute volume = 100-2%
= 98%

STEP-4:

Size of aggregate	Water Content Per Cubic Metre Of Concrete (Kg)	Sand as % of total aggregate by total volume
20 mm	186kg	35%

STEP-5:

ADJUSTMENT

Change of conditions	Water Content	Percent of sand (p) %
ZONE-I	0	**+1.5%**
COMPACTION FACTOR	**-3%**	**0**
WATER CEMENT RATIO	**0**	**-5.2%**
TOTAL	**-3%**	**-3.7%**

FOR COMPACTION FACTOR:

C.F = 0.80-0.70

= 0.1

From table, in compaction factor by 0.1 less than it will be -3%

FROM WATER/CEMENT RATIO:

W/C = 0.60-0.34

= 0.26

NOW, X= 0.26*0.01/0.05

= 5.2%

Where it is decreased so we take as negative value the original value

Where,

WC= (186-186*3/100)

= 180.5 kg/m3

WHERE,

P = 35- 3.7%

= 31.3%

STEP-6:

FOR CALCULATION OF CEMENT,
W/C = 0.34
Where, w= 180.5 kg/m3 from above lines
NOW,
C= 530.64 KG/M3
STEP-7:

FOR FINDIND OF COARSE AGGREGATE AND FINE AGGREGATE,
Fine aggregate volume,
V= [W+C/SC+1/P*(FA/SFA)]1/1000

98% = [180.42+530.64/2.99+100/31.3*FA/2.64]

FA= 555.45 KG/M3

For finding of coarse aggregate volume,

V= [W+C/SC+1/1-P*(CA/SCA)]1/1000

CA= 1110 KG/M3

<u>ESTIMATED QUANTITIES IN 1M^3 OF CONCRETE:</u>

Cement **= 530.64 kg**

= 514.13 kg

Coarse aggregate = 1110 kg

Water = 180.5 kg

The ratio comes out to be 1 : 1.04 : 1.55

Cement	Fine aggregate	Coarse aggregate
1	1.04	1.55

BATCHING:

Volume batching in 1m3 of concrete

DATA:

Characteristic strength = 35 MPa

Target mean strength = 45.395Mpa

Standard deviation = 6.3 MPa

Volume estimation for a cube = 150mm x 150mm x 150mm

= 3.375 x 10^{-3}m3

TOTAL QUANTITY = CEMENT + FINE AGGREGATE+ COARSE AGGREGATE+ WATER

= (530.64+514.13+1110+180.5)

= 2335.27 Kg

Absolute volume = total quantity of concrete mix x volume of cube

= 2335.27 x 3.375 x 10^{-3}

= 7.88 kgs

Calculation of quantities:

Water = 7.88/2335.27 x 180.5 = 0.609 kgs

Cement = 7.88/2335.27 x 530.64 = 1.79 kgs

Fine aggregate = 7.88/2335.27 x 514.13

= 1.73

Coarse aggregate = 7.88/2335.27 x 1110

=3.74 kgs

Where as we have been seen that the project relate to the replacement of cement in the different proportions.

We have been explaining the amount of weight replaced by cement by **silica fume, fly ash and fibre.**

Silica fume has been replaced by cement with 5% and 10% in different mixing proportion.

Silica fume = 1.79 x 5%(since the mould wt of cement is 1.79)

= 0.0 895 kgs

Silica fume= 1.79 x 10%

= 0.179kgs

Flyash has been replaced by cement with 20% and 40% in different mixing proportion.

Flyash = 1.79 x 20%

= 0.358 kgs

Flyash = 1.79 x 40%

= 0.716 kgs

We replacing very small amount of fibres by 0.5%, 1%

Fibres = 1.79 x 1%
= 0.0179 kgs

Fibres = 1.79 x 0.5%
= 8.95×10^{-3} kgs

M35 grade of concrete is designed according to B.I.S.method.

The effect of partial replacement of cement by Fly ash and Silica fume (% by weight) on strength and workability of concrete are investigated.

The cement is tested for the aforementioned properties as per IS code. The results on cement are shown in table

Calculation

The measured compressive strength of the specimen was calculated by dividing the maximum load applied to the specimen during the test by the cross-sectional area, calculated from the mean dimensions of the section and are expressed to the nearest kg per sq.cm. Average of the obtained values have been taken as the representative of the batch that is when the individual variation was not more than ± 15 percent of the average.

The cube specimens cured as explained above are tested as per standard procedure after removal from the curing tank and allowed to dry under shade. The cube specimens tested under digital compression testing machine of 2000 KN capacity. The results are tabulated in table No.4.1. The compressive strength test the test cube specimen was placed with the cast faces of the cubes atRight angles to that as cast in the compression testing machine. According to the standard specifications the load on the cube was applied at standard constant rate up to the failure of the specimen and the ultimate load was noted. Cube compressive strength was tested and the results were tabulated.

The process of casting involves weighing of materials, mixing, casting, compacting and curing. All these stages are in strict compliance to IS: 516 – 1959 which comprises the specifications for all the above stages of casting as well as testing.

The IS code includes a clause that specifies the procedure for making and curing compression test specimens of concrete in the laboratory where accurate control of the quantities of materials and test conditions are possible and where the maximum nominal size of aggregate does not exceed 38 mm. the method is specially applicable to the making of preliminary compression tests to ascertain the suitability of the available materials or to determine the suitable mix proportions.

PHYSICAL PROPERTIES OF PORTLAND CEMENT 53 GRADES

S .No	PROPERTY	TEST RESULTS
1.	Normal consistency	28.66%
2.	Specific gravity	2.99
3.	Initial setting time Final setting time	30 min 160 min
4.	Soundness (expansion) lechatlier Method	2 min
5.	Fineness of cement	3050
6.	Compressive strength of cement mortar cubes a) 7 days b) 28 days	 33 N/mm^2 52 N/mm^2

Average compressive strength in N/mm^2 for all the combinations

Beam	Fibre%	CSF%	Fly ash %	Cement %	Average compressive strength (MPa)
A1,1	0	0	0	100	32.24
A1,2		0	20	80	32.59
A1,3		0	40	60	32.12
A2,1	0	5	0	95	32.89
A2,2		5	20	75	33.5
A2,3		5	40	55	33.26
A3,1	0	10	0	90	33.94
A3,2		10	20	70	34.48
A3,3		10	40	50	34..19

Compressive strength of M35 grade concrete cubes with various percentages of Fly ash, Silica Fume & Fibre:

Variation of compressive strength at 28 days with addition of 0% fibre by volume of concrete and with various % of Silica Fume and Fly ash

S.NO	% SILICA FUME	% FLY ASH	28 DAYS COMPREESIVE STRENGTH IN MPA		
			STRENGTH	% INCREASE OVER 0%	% INCREASE OVER PRECEDING
1	0	0	31.24		
2	5	0	33.89	2.16	2.16
3	10	0	33.94	3.54	1.34
4	15	0	33.42	2.85	-0.65
5	0	20	32.59	1.77	-1.05
6	5	20	33.50	2.96	1.17
7	10	20	34.48	4.24	1.24
8	15	20	34.25	3.94	-0.28
9	0	40	32.12	1.15	-2.68

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Variation of compressive strength at 28 days with addition of 0.5% fibre by volume of concrete and with various % of Silica Fume and Fly ash

S.NO	% SILICA FUME	% FLY ASH	28 DAYS COMPREESIVE STRENGTH IN MPA		
			STRENGTH	% INCREASE OVER 0%	% INCREASE OVER PRECEDING
1	0	0	32.21		
2	5	0	33.94	2.24	2.24
3	10	0	34.47	2.92	0.67
4	15	0	34.15	2.51	-0.40
5	0	20	33.14	1.20	-1.27
6	5	20	34.59	3.08	1.85
7	10	20	34.96	3.56	0.46
8	15	20	34.56	3.04	-0.50
9	0	40	32.83	0.80	-2.17

Variation of compressive strength at 28 days with addition of 1% fibre by volume of concrete and with various % of Silica Fume and Fly ash

S.NO	% SILICA FUME	% FLY ASH	28 DAYS COMPREESIVE STRENGTH IN MPA		
			STRENGTH	% INCREASE OVER 0%	% INCREASE OVER PRECEDING
1	0	0	34.69		
2	5	0	35.23	0.67	0.67
3	10	0	35.68	1.24	0.56
4	15	0	35.29	0.75	-0.48
5	0	20	35.17	0.60	-0.14
6	5	20	35.78	1.36	0.76
7	10	20	36.20	1.89	0.51
8	15	20	35.64	1.19	-0.68
9	0	40	34.98	0.36	-0.81

GRAPHS

4.4 Graphs depicting results for compressive strength

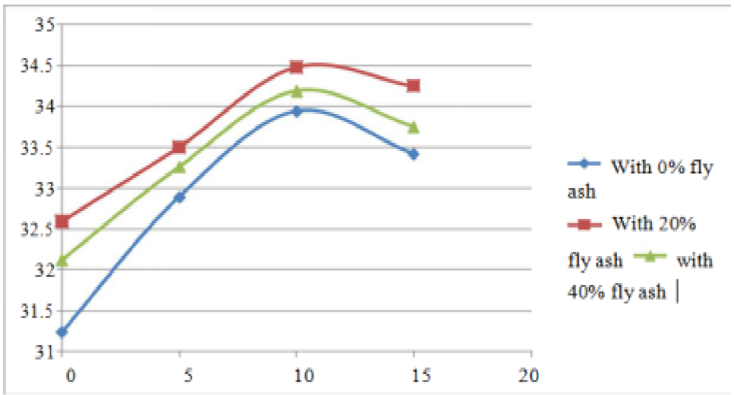

Fig1: variation of compressive strength with various percentages of Fly ash and Silica Fume with 0% fibre

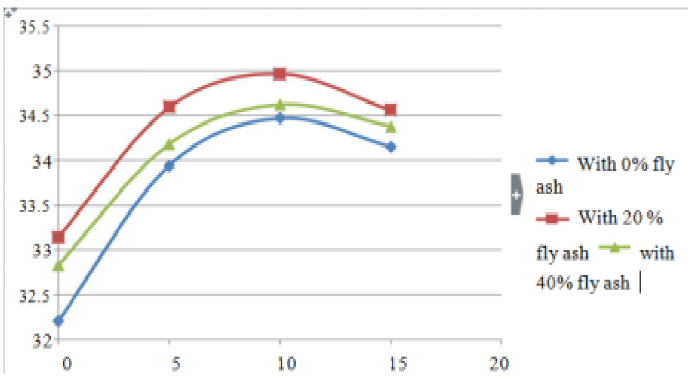

Fig2: variation of compressive strength with various percentages of Fly ash and Silica Fume with 0.5% fibre

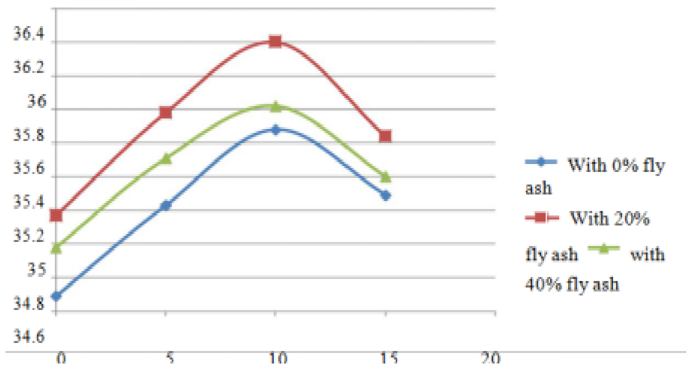

Fig3: variation of compressive strength with various percentages of Fly ash and Silica Fume with 1% fibre

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RESULTS

The present experimental investigation on the strength properties of triple blended steel fibres reinforced mixes has been carried out. The results obtained are shown by means of graphs and tables. The tables present the values of 28days compressive strength for various percentages of Silica Fume and Fly ash used as a replacement to cement in M80 grade concrete mix used in present investigation. Different steel fibres percentages like 0%, 0.5% & 1% were used in each case respectively. The same are plotted and shown under graphs. Similarly flexural strength results are presented in tables and are plotted under graphs.

COMPRESSIVE STRENGTH RESULTS:

The compressive strength results are given for 3 fibre percentages and various percentages of silica fume and fly ash considered. In general it is found thatCompressive strength is getting reduced with fly ash replacement and getting increased with silica fume replacement. With steel fibres present in the mix, it is also observed that there is marginal increase in the compressive strength.

Influence of silica fume on the mix:

Referring to the tables and graphs it can be seen that silica fume contributes towards increase in the compressive strength. 10% silica fume is found to be optimum in all the cases with and without fibres.Highest compressive strength was obtained at 10% CSF with 20% fly ash and 1% fibre. This value is 81.2mPa. The compressive strength of the reference mix without any mineral admixtures and without fibre was obtained as 76.24mPa. There is an increase of nearly 7% in compressive strength over the reference mix. For this combination of 10% silica fume with 20% fly ash the compressive strength has shown an increase from 2 to 7 % with various percentages of fibre

Influence of Fly ash on the mix:

It can be seen from the tables that as the Fly ash percentage increases, the compressive strength is gradually decreasing. This happened in the case of all other combinations.As discussed earlier the optimum percentage of mineral admixture is obtained as 20% fly ash with 10% CSF. 20% fly ash generates marginal increase in strength. To compensate for the loss of strength when higher percentages of fly ash is used silica fume is added. Fly ash is pozzolanic in nature and slowly reacting and it requires longer curing periods even beyond 28 days to generate high strength particularly when percentage is more

Influence of steel fibres on mix:

In present investigation steel fibres was employed at percentages of 0%,0.5%,1%. It can be seen from tables and graphs as the percentage of steel fibre is increased there is marginal increase in the compressive strength for all the combinations. Steel fibres are mainly employed to contribute towards tensile and flexural strengths. There are also advantages like denser concrete, elimination of micro cracks etc in concrete. In addition , steel fibres contribute towards impact strength and shock absorption and other advantages.

Influence of silica fume on the mix:

Referring to the tables and graphs it can be seen that silica fume contributes towards increase in the flexural strength. 10% silica fume is found to be optimum in all the cases with and without fibres.Highest flexural strength was obtained at 10% CSF with 20% fly ash and 1% fibre. This value is 8.4mPa. The flexural strength of the reference mix without any mineral admixtures and without fibre was obtained as 6.4mPa. There is an increase of nearly 31.5% in flexural strength over the reference mix. For this combination of 10% silica fume with 20% fly ash the compressive strength has shown an increase from 15 to 31.5 % with various percentages of fibre

Influence of Fly ash on the mix:

It can be seen from the tables that as the Fly ash percentage increases, the flexural strength is gradually decreasing. This happened in the case of all other combinations.As discussed earlier the optimum percentage of mineral admixture is obtained as 20% fly ash with 10% CSF20% fly ash generates increase in strength. To compensate for the loss of strength when higher percentages of fly ash is used silica fume is added. Fly ash is pozzolanic in nature and slowly reacting and it requires longer curing periods even beyond 28 days to generate high strength particularly when percentage is more.

Influence of steel fibres on mix:

In present investigation steel fibres was employed at percentages of 0%,0.5%,1%. It can be seen from tables and graphs as the percentage of steel fibre is increased there is increase in the flexural strength for all the combinations. Steel fibres are mainly employed to contribute towards tensile and flexural strengths. There are also advantages like denser concrete, elimination of micro cracks etc in concrete. In addition , steel fibres contribute towards impact strength and shock absorption and other advantages.

NEED FOR TRIPLE BLENDING

In the present experimental investigation, triple blending of ordinary Portland cement was carried out so as to arrive at a mix with optimum properties. With the increase in fly ash percentage beyond 20% 28 days strength decreased and with the increase of silica fume % up to an optimum of 10% strength gets increased.On the overall, strength loss with the higher percentages of fly ash is compensated by silica fume. Thus an optimum high strength concrete mix possessing optimum strength properties can be obtained resorting to triple blending.

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CONCLUSSION

In light of the present trial examinations the accompanying conclusions are drawn: Higher doses of super plasticizer are required for high strength concrete blends especially when mineral admixtures and filaments were utilized to look after workability. For this mix of 10% silica smolder with 20% fly fiery remains the compressive strength has demonstrated an expansion from 2 to 7 % with different rates of fiber 20% fly powder creates minor increment in strength. To adjust for the loss of strength when higher rates of fly cinder is utilized silica smoke is included Fly powder is pozzolanic in nature and gradually responding and it requires longer curing periods even past 28 days to create high strength especially when rate is more As the rate of steel fiber is expanded there is minimal increment in the compressive strength for every one of the mixes. For this mix of 10% silica seethe with 20% fly fiery remains the compressive strength has demonstrated an expansion from 15 to 31.5 % with different rates of fiber. As the rate of steel fiber is expanded there is higher increment in the flexural strength for every one of the blends. An ideal high strength concrete blend having ideal strength properties can be acquired falling back on triple mixing. On account of triple blended bond concrete blends, including certain rates of steel strands would help in producing ideal basic concrete blends having all the strength and durability properties.

To conclude the title of triple blended concrete, where we have been experienced that replacement of cement with three materials is also giving same amount of strength, it is reducing carbon dioxide emission effect and finally it is reducing the economical budget of the structure.

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