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Fresh and Harden Properties of Temperature Controlled Concrete with Replacement of 50%Ground Granulated Blast Furnace Slag.

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Abstract - *Currently there are well awareness created about using the supplementary cementitious material(scm) and now a days people are more flexible with considering the long term advantageous of sscm. considering the awareness the replacement of the scm is from 10% to 30% are accepted all over but when it comes to use it up to 50% still there are some lagging in confidence about the fresh and harden properties of concrete.so here understood the situation at the result of 50% replacement of GGBFS that too with fresh concrete temperature less than 30deg.the changes in fresh and harden properties is mentioned in this research paper.*

Key Words: **Concrete, GGBFS, Fresh properties, Hard properties, Flow 50% of OPC and 50% GGBFS& Temperature.**

1. INTRODUCTION

We as a human always thinks about to create something new and that help us to made new product. While creating new products carbon foot print also generated But there are always some by product of it and we have to take care of nature we have to eliminate or reduce the by product and there our creativity also help us to develop products with the by products. According to Wikipedia India is a world's second largest steel manufacturer India's Total production in 2019 111.2million metric tons. As production is high the byproduct that is slag. Ground granulated blast furnace slag(GGBFS).In construction industry there is cement is very important material and as every one know while generating cement carbon foot print generated.(cement is the source of about 8% of the world's carbon foot print. Considering social responsibility we can reduce cement percentage in concrete and instead of that use scm(GGBFS) so that we can reduce carbon footprint. GGBFS has similar chemical properties of cement (OPC).GGBFS also blend very well with cement(OPC) and gives High early strength also help to achieve excellent durability.

2. MATERIALS

2.1 Cement: Used cement is Ordinary Portland cement 53 grade. Confirms to IS code 12269:2015. Specific gravity 3.15,Fineness 307m2/Kg, Standard consistency 30%,Insoulable residue 1.5% by mass & Total LOI 2.57 % by mass.

2.2 Ground granulated blast furnace slag (GGBFS): Used GGBFS confirms to BS:6699. Specific gravity 2.91,Fineness 441m2/Kg Insoluble residue 0.36% by mass & Total LOI 0.26 % by mass.

2.3 Aggregate(Coarse+Fine): Used aggregate confirms to IS 383:1970 Maximum size of aggregate is used 20mm.specific gravity is 2.54 & Water absorption 1.67%.fine aggregate specific gravity is 2.6 & Water absorption 4.5%.

2.4 Admixture: Used admixture is High PC content. Specific gravity is 1.07.

2.5 Water: Used Water is construction water confirms to IS 456.

3. Mix details:

Mix details: As stated in the title it's a Temperature control GGBFS concrete so mix design is also with replacement 50% of GGBFS. Below mix design is selected for the experiment and at the end finally all result are fine tuned and reached the acceptance criteria. As mentioned in table no 1 the cementitious material is used 50% and OPC is used 50%. Aggregate to cement ratio is 4.02.Polycarboxylate admixture is used maximum 1.42%. Water cement ratio is 0.34%.out of which 50% is ice flex used and remaining 50% is used chilled water with temperature 4deg.

Table -1: Mix Design.

Cement(OPC 53) Kg/ m3	GGBFS Kg/m 3	Coarse Aggregate 10mm (Kg/m 3)	Coarse Aggregate 20mm (Kg/m 3)	Fine Aggregate Kg/m3	W/C Ratio	Water Litrs /m3	Admixture %
230	230	375	605	872	0.34	156	1.42

4. FRESH PROPERTIES: The fresh properties are checked after final mixing. Fresh properties are included i)Temperature

ii)Flow

4.1 Freshly mixed concrete temperature.

Below table no 2 shows the sample 10 no of concrete temperature result.

Table -2: Freshly mixed concrete temperature.

Sr.No	Batch No	Temperature in Deg.celsius(°C)
1	TRBCH 01	27.2
2	TRBCH 02	26.8
3	TRBCH 03	27.6
4	TRBCH 04	27.1
5	TRBCH 05	27.6
6	TRBCH 06	27.9
7	TRBCH 07	28.2
8	TRBCH 08	26.5
9	TRBCH 09	27.3
10	TRBCH 10	27.7

Photos of fresh concrete Temperature.

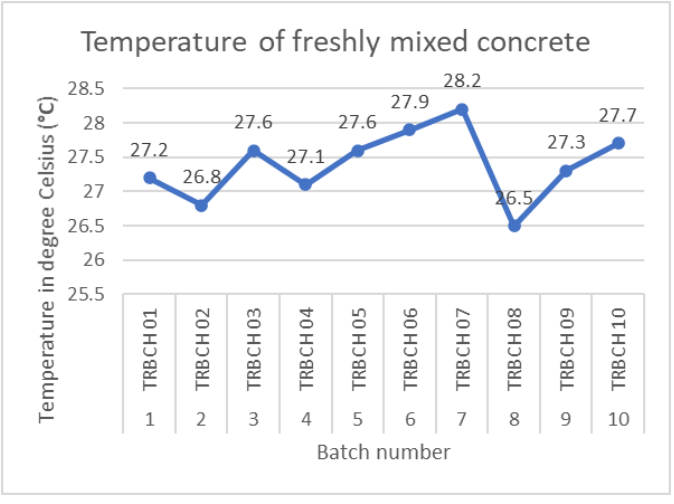

Chart -1: Temperature of freshly mixed concrete.

As you can see in the table no 2 there are 10 batches observations are mentioned this shows the concrete temperature variation between 10 different batch.Least temperature is 26.5 °C and maximum temperature is 28.2 °C.As per research with the help of limiting less initial water temperature and ice flex.Initial concrete temperature limited within 28.5°C

4.2 Freshly mixed concrete flow :

Below table no 3 shows that 10 same sample flow results

Table -2: Freshly mixed concrete Flow.

Sr.No	Batch No	Flow in mm
1	TRBCH 01	630
2	TRBCH 02	640
3	TRBCH 03	610
4	TRBCH 04	590
5	TRBCH 05	570
6	TRBCH 06	620
7	TRBCH 07	625
8	TRBCH 08	600
9	TRBCH 09	630
10	TRBCH 10	645

Photos of fresh concrete Temperature.

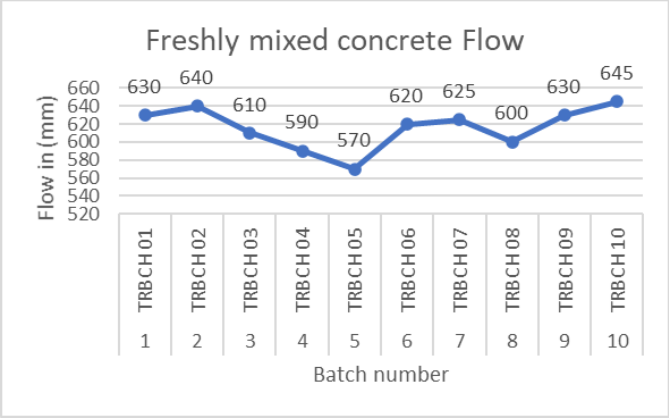

Chart -2: Flow of freshly mixed concrete.

As you can see in the table no 4 there are 10 batch observations are mentioned this shows the concrete temperature variation between 10 different batch.Least flow is 570mm.and maximum flow is 645mm.As per research with the help of limiting less Initial concrete temperature achieved the flow between 570 to 645mm.

4.3 Harden properties: In this section Harden properties of 50% GGBFS replacement with OPC can be seen the 3,7,28 and 56 days cube strength.

Table -2: Freshly mixed concrete Flow.

Sr No	Batch no	Average Comp strength (N/mm2)			
		3Days	7Days	28Days	56Days
1	TRBCH 01	13.53	20.18	35.18	44.3
2	TRBCH 02	14.05	21.04	36.07	45
3	TRBCH 03	12.58	19.6	35.7	45.5
4	TRBCH 04	13.07	21.84	36.5	43.6
5	TRBCH 05	12.18	18.56	34.56	41.4
6	TRBCH 06	15.3	22.45	37.06	43.57
7	TRBCH 07	14.63	22.78	35.6	45.18
8	TRBCH 08	12.82	21.69	36.17	43.17
9	TRBCH 09	12.93	20.62	35.92	43.92
10	TRBCH 10	13.86	21.68	35.37	44.63

Photos of doing compressive strength test.

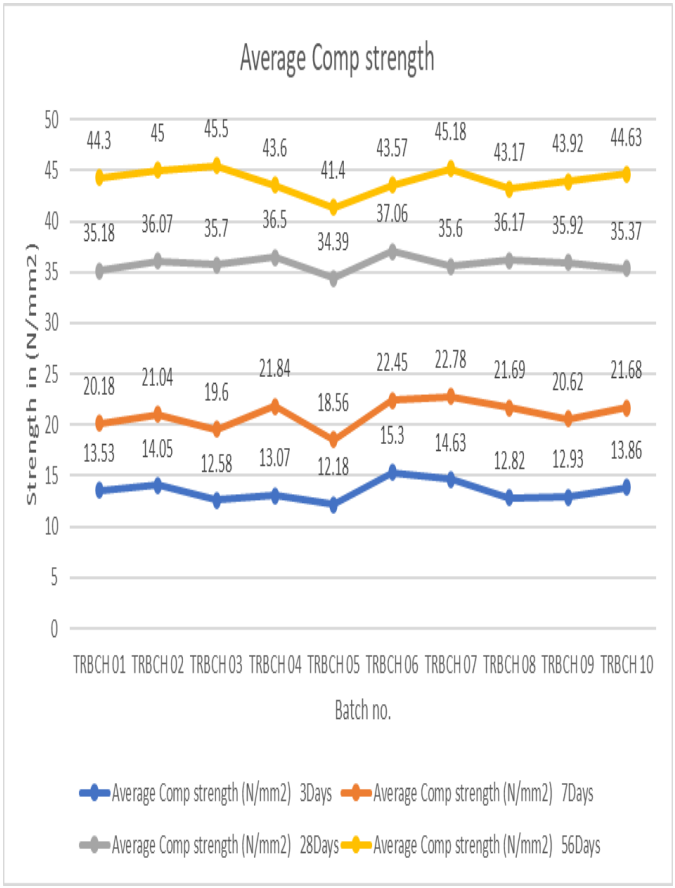

Chart -2: Average compressive strength.

5. RESULTS AND DISCUSSION:

In above mix design ingredients used Cement (OPC53)230 Kg/m3, GGBFS 230 Kg/m3, Coarse Aggregate 10mm 375Kg/m3, Coarse Aggregate 20mm 605Kg/m3. Fine Aggregate 872Kg/m3. W/C Ratio 0.34, Water 156Litrs/m3 &Admixture 1.42 %..Looking at the temperature of all 10 batches lower temperature is 26.5°C to 28.2°C.and flow found between 570 to 645mm.All 10 samples average cube strength for 3 days minimum average strength achieved is 12.18N/mm2 and maximum average strength achieved is

15.3N/mm2,7days minimum average strength achieved is 18.56N/mm2 and maximum average strength achieved is 22.78N/mm2,28days minimum average strength achieved is 34.39N/mm2 and maximum average strength achieved is 37.06N/mm2 and 56days minimum average strength achieved is 41.40N/mm2 and maximum average strength achieved is 45.50N/mm2

6. CONCLUSIONS:

- As stated in paper mix has 50% of OPC and 50% GGBFS with temperature control in fresh properties maximum temperature found 28.2°C.that mean easily can achieve below 30 °C.
- In fresh properties it is found that minimum flow is 570mm which is reasonably very good
- The initial comp. strength is for 7 days is reasonably good.28 days comp. strength is 37.06N/mm2 Maximum strength achieved at 56 days is 45.50 N/mm2.
- Percentage of GGBFS can be replaced with 50% for structural concrete and result can be achieved.

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BIOGRAPHIES

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