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Analysis on Mechanical Properties of Concrete with Double Blending Supplementary Materials

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Abstract:- *High Performance Concrete (HPC) is that concrete which meets extraordinary execution and consistency necessities that can't generally be accomplished by routine materials, typical blending, putting and curing rehearses. Unique performance prerequisites utilizing customary materials can be accomplished just by embracing low water fastener proportion, which require the utilization of high concrete substance. In any case, the expansion of concoction and mineral admixtures can lessen the bond substance and this outcome in the practical HPC. The impact of a mineral admixture on the quality of concrete shifts fundamentally with its properties and substitution levels. The utilization of mineral admixtures (Fly fiery remains and GGBFS) in concrete generation enhances the compressive quality, pore structure, and piousness of the concrete this is ascribed to the pozzolanic response. This approach will can possibly diminish costs, preserve vitality, and waste minimization. In this trial examination the quality properties of concrete for M40 review concrete at different substitution levels of Fly fiery remains and GGBS (20%, 30%, and 40%) was done. The impact of variety in quality parameters i.e., Compressive Strength, Split Tensile Strength and Flexural Strength were contemplated for various substitution extents was finished. The test outcomes demonstrated that higher elasticity and flexural quality than customary concrete and practically same compressive quality as traditional concrete.*

Keywords:- concrete, High Performance Concrete, mineral admixtures , GGBFS, Fly ash, pozzolanic reaction.

INTRODUCTION

Concrete is the key material utilized as a part of different sorts of development, from the ground surface of a cabin to a multi-storied skyscraper structures frame pathway to airplane terminal runway, from an underground passage and remote ocean stage to skyscraper smokestacks and TV Towers. In the most recent thousand years concrete has requesting prerequisites both as far as specialized execution and economy while extraordinarily changing from building perfect work of art to the least complex of utilities. It is the most generally utilized development material of development which is as adaptable as concrete.

Concrete is one of the flexible heterogeneous materials, structural building has ever known.

With the approach of concrete structural building has touched most astounding pinnacle of innovation. Concrete is a material with which any shape can be thrown and with equivalent quality or preferably more quality than the ordinary building stones. It is the material of decision where quality, changelessness, solidness, impermeability, imperviousness to fire and scraped spot resistance are required.

Bond concrete is one of the apparently basic regardless complex materials. The properties of concrete basically rely on upon the constituents utilized as a part of concrete making. The primary vital material utilized as a part of making concrete is bond, sand, smashed stone and water. Despite the fact that the maker ensures the nature of bond, it is hard to deliver a blame confirmation concrete. It is a direct result of the way that the building material is concrete and not just bond. The properties of sand, pulverized stone and water, if not utilized as indicated, cause significant inconvenience in concrete. Notwithstanding this workmanship, quality control and techniques for setting additionally assumes the main part on the properties of concrete.

HIGH PERFORMANCE CONCRETE

Concrete is considered as tough and solid material. Fortified concrete is a standout amongst the most mainstream materials utilized for development around the globe. Fortified concrete is presented to weakening in a few locales particularly in waterfront areas. There for scientists around the globe are coordinating their endeavors towards building up another material to beat this issue. Creation of extensive development plants and gear's the world over added to the expanded utilization of material. This situation prompted to the utilization of added substance materials to enhance the nature of concrete. As a result of the analyses and looks into bond based concrete which meets exceptional execution as for workability, quality and strength known as" High Performance Concrete" was created.

ADVANTAGES OF USING HPC

The upsides of utilizing high quality HPCs frequently adjust the expansion in material cost. The accompanying are the significant points of interest that can be proficient.

- Increase in Girder ranges.
- Increasing the dividing between braces.
- Permeability of concrete diminished (expanded toughness).
- Further, it is anticipated that a HPC brace would not require web shear support with the exception of a sum required to interface the cast set up deck chunk to the support.
- Reduction in part measure, bringing about increment in plinth region or useable range and direct funds in the concrete volume spared.
- High quality permits the utilization of littler sections and, in this way, a decrease in weight and, consequently, a lower stack on the establishment.
- Reduction in the self-weight and super-forced dead load with the going with sparing because of littler establishments.
- Reduction in shape work region and cost with the going with decrease in shoring and stripping time because of high early-age pick up in quality.
- Reduced hub shortening of pressure supporting individuals.
- Reduction in the quantity of backings and the supporting establishments because of the expansion in ranges.

• Superior long haul benefit execution under static, element and exhaustion stacking.

• Low crawl and shrinkage.

• Greater firmness thus of a higher modulus.

• Higher imperviousness to solidifying and defrosting, compound assault, and fundamentally enhanced long haul sturdiness and break spread.

• Smaller deterioration as a settled cost. High Performance Concrete (HPC) is widely used as a construction and repair material in the civil infrastructure.

MIX DESIGN

Material properties

1. Cement

Type :53Grade OPC

Specific Gravity :3.1

2. Fine Aggregate

Type : locally available river sand

Specific Gravity : 2.65

3. Coarse Aggregate

Maximum size :12.5 mm

Specific Gravity : 2.75 mm

4. Water

pH value :7.00

5. mineral Admixture

Fly ash (Specific Gravity) : 2.1

GGBS(Specific Gravity) : 2.9

6. Chemical Admixture

Super –plasticizer: GLENIUN B233

Type : modified polycarboxylic ether

Specific Gravity : 1.09

Total Solids Content: 34 % by weight

STEP 1: TARGET STRENGTH FOR MIX PROPORTIONING

$$f''_{ck} = f_{ck} + 1.65S$$

f'_{ck}= target average compressive strength at 28 days

f_{ck}= characteristic compressive strength at 28 days,

S= Standard deviation

From Table 1 of IS262:2009, standard deviation, S=4

$$f'_{ck} = 40+1.65x5$$

$$= 48.25MPa$$

STEP 2: SELECTION OF WATER CEMENT RATIO

From Table 5 of IS 456, maximum water cement ratio=0.45

W/C = 0.35 <0.45 (hence ok)

STEP 3: SELECTION OF WATER CONTENT

For Non-Air Entrained concrete this is not subjected to severe weather conditions

From Table 3 of IS Water Content = 175 kg/m^3

STEP 4: CALCULATION OF CEMENT CONTENT

Water Cement ratio=0.35

Cement content = = 500 kg/m^3

STEP 5: DETERMINATION OF AGGREGATE CONTENT

Maximum size of aggregate =12.5mm

Fineness modulus of sand =2.65

Fineness modulus of CA=2.75

Volume of coarse aggregate per m^3 of concrete =0.59

Weight of coarse aggregate = 0.59x1600

=944 kg/m^3

STEP 6: MIX DESIGN

The mix calculations per unit volume of concrete shall be as follows:

a) Volume of concrete = 1 m^3

b) Volume of cement = x

=x = 0.1613m^3

c) Volume of water = x

= x = 0.175m^3

d) Volume of C.A = x

=0.343m^3

e)Total volume of dry sand =(1000-679.57)x10^3

= 319.42 x10^3

Weight of fine aggregate =319.42 x 2.65 = 846.48 kg /m^3

W/C	CEMENT	F.A	C.A
0.35	1	1.69	1.88

MIXING

Firstly, the weights of Fine Aggregate, Coarse Aggregate, Cement, Fly ash, GGBS, Water and super plasticizer are weighted according Mixing was carried out in a pan mixer machine. The mixing methodology adopted was as follows:

- 25 percent of total water, coarse aggregates and admixtures were added to the mixer machine and allowed to mix for 1 minute.
- Cement and 50 percent water were then added to the mix and mixed for 1 minute.
- Super plasticizer was blended with the balance 25 percentage water and then added to the mix. Mixing was continued for 5 minutes after adding the blend.
- Total mixing time was 7 minutes.

Pan mixer

RESULTS

In this chapter, Results of strength studies such as compressive strength, split tensile strength and flexural strength tests conducted for M40 grade of concrete considering partial replacement of cement by Fly ash and GGBS with different proportions (20%, 30% and 40%) are presented.

6.2 COMPRESSIVE STRENGTH

SI.NO.	PROPORTIONS OF FA&GGBS		COMPRESSIVE STRENGTH(MPa) 7 DAYS	COMPRESSIVE STRENGTH(MPa) 28 DAYS
	FLY ASH	GGBS		
1	0	0	30.0	44.7
2	20	0	22.8	34.3
3	15	5	28.0	41.6
4	10	10	29.5	44.0
5	5	15	27.3	40.7
6	0	20	28.14	42.3

Compressive strength of M40 concrete

Compressive strength results for M40 grade concrete by 20% replacement

28 days compressive strength results for M40 grade concrete by 20% replacement

From the above results (10+10) replacements of cement by fly ash &GGBS gives the maximum compressive strength for 7 and 28 days curing.

SI.NO.	PROPORTIONS OF FA&GGBS		COMPRESSIVE STRENGTH(MPa) 7 DAYS	COMPRESSIVE STRENGTH(MPa) 28 DAYS
	FLY ASH	GGBS		
1	0	0	29.9	44.7
2	30	0	23.9	35.7
3	20	10	29.0	43.3
4	10	20	31.2	46.6
5	15	15	27.7	41.4
6	0	30	28.5	42.6

Compressive strength of M40 concrete

Compressive strength results for M40 grade concrete by 30% replacement

28 days compressive strength results for M40 grade concrete by 30% replacement

From the above results (10+20) replacements of cement by fly ash &GGBS gives the maximum compressive strength for 7 and 28 days curing

SI.NO.	PROPORTIONS OF FA&GGBS		COMPRESSIVE STRENGTH(MPa) 7 DAYS	COMPRESSIVE STRENGTH(MPa) 28 DAYS
	FLY ASH	GGBS		
1	0	0	29.9	44.7
2	40	0	27.2	40.6
3	25	15	32.2	48.1
4	20	20	32.8	49
5	15	25	28.7	42.9
6	0	40	30.2	45

Compressive strength of M40 concrete

Compressive strength results for M40 grade concrete by 40% replacement

28 days compressive strength results for M40 grade concrete by 40% replacement

From the above results (20+20) replacements of cement by fly ash &GGBS gives the maximum compressive strength for 7 and 28 days curing

SPLIT TENSILE STRENGTH:

SI.NO.	PROPORTIONS OF FA&GGBS		SPLIT TENSILE STRENGTH(MPa) 7 DAYS	SPLIT TENSILE STRENGTH(MPa) 28 DAYS
	FLY ASH	GGBS		
1	0	0	2.3	3.28
2	20	0	1.5	2.1
3	15	5	0.9	1.3
4	10	10	2.6	3.8
5	5	15	1.4	2.0
6	0	20	1.8	3.1

Split tensile strength of M40 concrete

Fig 6.4 Split Tensile strength results for M40 grade concrete by 20% replacement

28 days Split Tensile strength results for M40 grade concrete by 20% replacement

From the above results (10+10) replacements of cement by fly ash &GGBS gives the maximum split tensile strength for 7 and 28 days curing

Split tensile strength of M40 concrete

SI.NO.	PROPORTIONS OF FA&GGBS		SPLIT TENSILE STRENGTH(MPa) 7 DAYS	SPLIT TENSILE STRENGTH(MPa) 28 DAYS
	FLY ASH	GGBS		
1	0	0	2.2	3.28
2	30	0	1.5	2.11
3	20	10	1.1	1.55
4	10	20	2.7	4.01
5	15	15	1.9	2.77

6	0	30	2.1	3.39

28 days split tensile strength results for M40 grade concrete by 30% replacement

From the above results (10+20) replacements of cement by fly ash &GGBS gives the maximum split tensile strength for 7 and 28 days curing

SI.NO.	PROPORTIONS OF FA&GGBS		SPLIT TENSILE STRENGTH(MPa) 7 DAYS	SPLIT TENSILE STRENGTH(MPa) 28 DAYS
	FLY ASH	GGBS		
1	0	0	2.3	3.28
2	40	0	2.2	3.31
3	25	15	2.4	3.63
4	20	20	3.1	4.66
5	15	25	2.4	3.60
6	0	40	2.3	3.34

split tensile strength of M40 concrete

Split tensile strength results for M40 grade concrete by 40% replacement

From the above results (20+20) replacements of cement by fly ash &GGBS gives the maximum split tensile strength for 7 and 28 days curing.

FLEXURAL STRENGTH

SI.NO.	PROPORTIONS OF FA&GGBS		FLEXURAL STRENGTH(MPa) 7 DAYS	FLEXURAL STRENGTH(MPa) 28 DAYS
	FLY ASH	GGBS		
1	0	0	5	7
2	20	0	4.7	7
3	15	5	3.9	5.8
4	10	10	5.3	7.8
5	5	15	4.1	6.3
6	0	20	4.0	6

Table.6.7 Flexural strength of M40 concrete

Flexural strength results for M40 grade concrete by 20% replacement

28 days Flexural strength results for M40 grade concrete by 20% replacement

From the above results (10+10) replacements of cement by fly ash &GGBS gives the maximum flexural strength for 7 and 28 days curing

SI.NO.	PROPORTIONS OF FA&GGBS		FLEXURAL STRENGTH(MPa) 7 DAYS	FLEXURAL STRENGTH(MPa) 28 DAYS
	FLY ASH	GGBS		
1	0	0	4.9	7
2	30	0	5.4	8
3	20	10	4.0	6

4	10	20	5.5	8.2
5	15	15	4.6	6.8
6	0	30	4.3	6.6

Table.6.8 flexural strength of M40 concrete

Split tensile strength results for M40 grade concrete by 30% replacement

28 days split tensile strength results for M40 grade concrete by 30% replacement

From the above results (10+20) replacements of cement by fly ash &GGBS gives the maximum flexural strength for 7 and 28 days curing

flexural strength of M40 concrete

SI.NO.	PROPORTIONS OF FA&GGBS		FLEXURAL STRENGTH(MPa) 7 DAYS	FLEXURAL STRENGTH(MPa) 28 DAYS
	FLY ASH	GGBS		
1	0	0	4.9	7
2	40	0	5.1	7.6
3	25	15	4.5	6.6
4	20	20	5.5	8.1
5	15	25	5.3	7.8
6	0	40	4.0	6.0

Flexural strength results for M40 grade concrete by 30% replacement

28 days Flexural strength results for M40 grade concrete by 30% replacement

From the above results (20+20) replacements of cement by fly ash &GGBS gives the maximum flexural strength for 7 and 28 days curing

CONCLUSION

In view of the broad trial examinations did on the Fly ash and GGBS as the fractional substitutions in the bond the fallowing conclusion has been drawn. It is watched that the Replacements of bond (20%) by Fly Ash and GGBS with individual extents of (10+10) % (Fly Ash+GGBS) separately builds the Compressive Strength, Flexural Strength and Split Tensile Strength of concrete around 1.09%,7.8%, 10.6% and 1.56 %,11.42 %, 15.85 % individually at 7 days and 28 days quality. Substitutions of bond (30%) by Fly Ash and GGBS with individual extents of (10+20)% (Fly Ash+GGBS) separately builds the Compressive Strength, Flexural Strength and Split Tensile Strength of concrete around 2.85%, 11.5%, 15.10% and 4.25 %,17.14 %, 22.25 % individually at 7 days and 28 days quality. Substitutions of bond (40%) by Fly Ash and GGBS with individual extents of (20+20)% (FlyAsh+GGBS) separately builds the Compressive Strength, Flexural Strength and Split Tensile Strength of concrete around 6.43%, 10.52%,27.6% and 9.61 %,15.71 %, 42.07 % individually at 7 days 28 days quality.

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