

Improvement & Performance of Cement Concrete Pavement Using Steel Fibers & Cementing Waste Material (GGBFS)

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Abstract: The main objective of this investigation work is to study the behaviour of rigid pavement (concrete). When ordinary Portland cement is replaced by GGBFS, concrete cubes were casted with and without steel fibres and was compared with normal concrete of M40 grade. In this study concrete cubes and beams were prepared of 4 partial GGBFS replacement ratios (0%, 15%, 30% and 45%) with water cement ratio 0.38. Super plasticizer was used to keep constant workability in concrete. The cubes and beams are tested at the age of 7, 28 and 56 days with continuous water curing condition. The comparisons are made between normal concrete, GGBFS and with steel fibres concrete are made. After testing it has been found that when cement is replaced by 15 and 30% GGBFS compressive strength increases. But higher the ratio gives low compressive strength, but flexural strength decreases by increasing percentage of GGBFS so to increase the flexural strength having aspect ratio (40) was used and was added 1 and 1.5% of total weight of concrete. Thus the flexural and compressive strength up to considerable limit.

1. INTRODUCTION

Ground granular blast furnace slag is a by product of steel industry in India we produce about 7.8 million tons of GGBFS. It is a non-hazardous and non-metallic waste consisting essentially of silicates and aluminates of calcium and other bases. It helps to improve the properties of concrete like compressive strength, workability etc.. The disposal of such slag even as a waste fill is problem and may cause serious environmental hazards. It is seen that high volume eco-friendly replacement by such slag leads to the development of concrete which not only utilises industrial waste but also saved a lot of natural resources and energy. This inturns reduces the consumption of cement.

2. CONCRETE MIX DESIGN

As per IRC 44:2008 (recommended guidelines for concrete pavement mix design) concrete mix design was made for M40. Table 1 shows the mix proportion for M40 mix.

Table 1- Quantity for 1m³ concrete

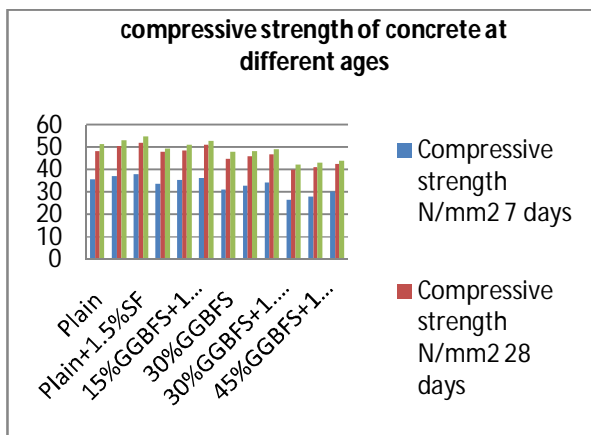
Grade of Concrete	M40	M40+15 %GGBFS	M40+30 %GGBFS	M40+45% GGBFS
Cement	392	366	307	240
Water content	160	160	162	162
Fine aggregate	676	643	660	658
Coarse aggregate	1225	1219	1165	1161
w/c or water /binder	0.38	0.345	0.345	0.345
Super plasticizer (0.6%)	3.02	3.02	3.02	3.02
GGBFS(Kg/m ³)		65	131	197
Steel fibers (wt of concrete)	1&1.5%	1&1.5%	1&1.1	1&1.5

Table 2- compressive strength of concrete at different ages.

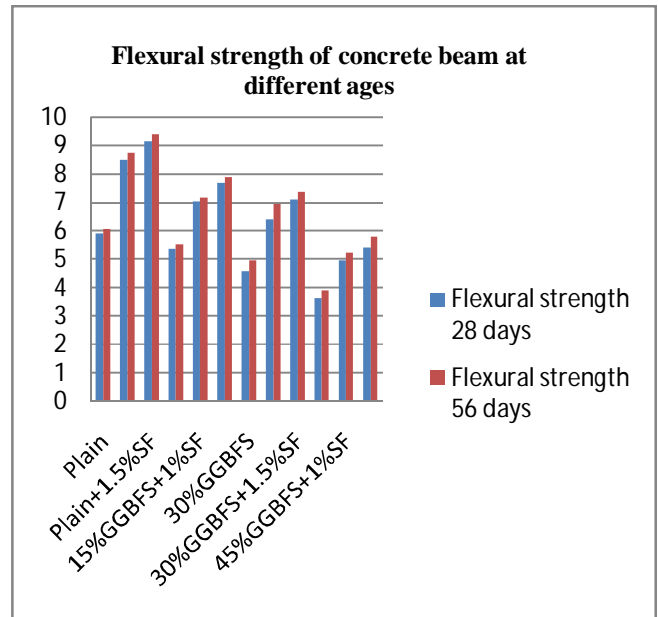
concrete	Compressive strength N/mm ²		
	7 days	28 days	56 days
Plain	35.55	48.2	51.2
Plain+1%SF	37.1	50.3	53.1
Plain+1.5%SF	38	51.9	54.7
15%GGBFS	33.81	47.9	49.3
15%GGBFS+1%SF	35.4	48.4	51
15%GGBFS+1.5%SF	36.2	50.8	52.9
30%GGBFS	31.26	44.8	47.7
30%GGBFS+1%SF	33	46	48.2
30%GGBFS+1.5%SF	34.2	46.8	48.9
45%GGBFS	26.68	39.7	42.3
45%GGBFS+1%SF	28	41	43.2
45%GGBFS+1.5%SF	30.1	42.7	44.1

Table 3- Flexural strength of concrete at different ages

Concrete	Flexural strength	
	28 days	56 days
Plain	5.92	6.07
Plain+1%SF	8.51	8.76
Plain+1.5%SF	9.17	9.40
15%GGBFS	5.38	5.54
15%GGBFS+1%SF	7.05	7.18
15%GGBFS+1.5%SF	7.7	7.91
30%GGBFS	4.6	4.97
30%GGBFS+1%SF	6.42	6.97
30%GGBFS+1.5%SF	7.11	7.38
45%GGBFS	3.65	3.91
45%GGBFS+1%SF	4.96	5.23
45%GGBFS+1.5%SF	5.42	5.8



Graph 1



Graph 2

3. CONCLUSIONS

From the experimental investigations conducted on the behaviour of concrete with GGBFS as a partial replacements for cement the following conclusions can be drawn

- 1) GGBFS% goes on increasing the compressive and flexural strength of concrete decreases.
- 2) We can get maximum compressive strength by replacing 15% GGBFS.
- 3) Flexural strength goes on decreasing by increasing the % of GGBFS.
- 4) It was observed that the earlier strength of the GGBFS concrete mix were lower than that of Portland cement concrete mixes.
- 5) Maximum 30% replacement of GGBFS with cement can be done by adding 1% of steel fibres.

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