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Rigid Pavement Concrete by Adding GGBS and River Sand in Accelerate Curing Method

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ABSTRACT

This method of concrete mix design consists of selection of optimum properties of ingredients, i.e., cement, mineral admixture, fine aggregate, coarse aggregate, water and chemical admixture if needed to produce concrete specified properties such as strength, workability and durability, etc. as economic as possible. The compressive strength of hardened concrete which is generally considered to be an index its properties depends upon its factor, e.g., quality, quality of cement, water, aggregate; placing, compacting and curing. The cost of concrete is made up of cost of material the variation in cost of material a rise in fact that in cement several time costly then aggregate thus the aim to produce a lean mix. In this paper, concrete pavement has designed by adding mineral admixture in reduction of cement content up to 32% and reduce the cost of concrete mix and also to attain its equal strength of concrete.

Keywords: *Ground granulated blast furnace slag, River sand.*

Introduction

A highway pavement is a structure consisting of superimposed layers of processed materials above the natural soil sub-grade, whose primary function is to distribute the applied vehicle loads to the sub-grade. The pavement structure should be able to provide a surface of acceptable riding quality, adequate skid resistance, favorable light reflecting characteristics, and low noise pollution. The ultimate aim is to ensure that the transmitted stresses due to wheel load are sufficiently reduced, so that they will not exceed bearing capacity of the sub-grade. Two types of pavements are generally recognized as serving this purpose, namely flexible pavements and rigid pavements. Our chapter gives an overview of Pavement quality concrete rigid pavement mix design.

PQC stands for Pavement Quality Concrete (PQC) Grade of PQC is Generally M40 and it is designed as per IRC:15-2002. PQC is used for the construction of Concrete roads as a top layer. Generally Top layer on the highway having thickness of 300 mm. We are going to discuss about mix design of PQC by adding 32% GGBS (replacing cement and thereby reducing cement content) and river sand.

Materials Used

- Ordinary Portland cement
- Ground Granulated Blast Furnace Slag
- Fine aggregate
- Coarse aggregate
- Super plasticizer
- Water

Ground-granulated blast-furnace slag (GGBS or GGBFS) is obtained by quenching molten iron slag (a by-product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder.

Methodology

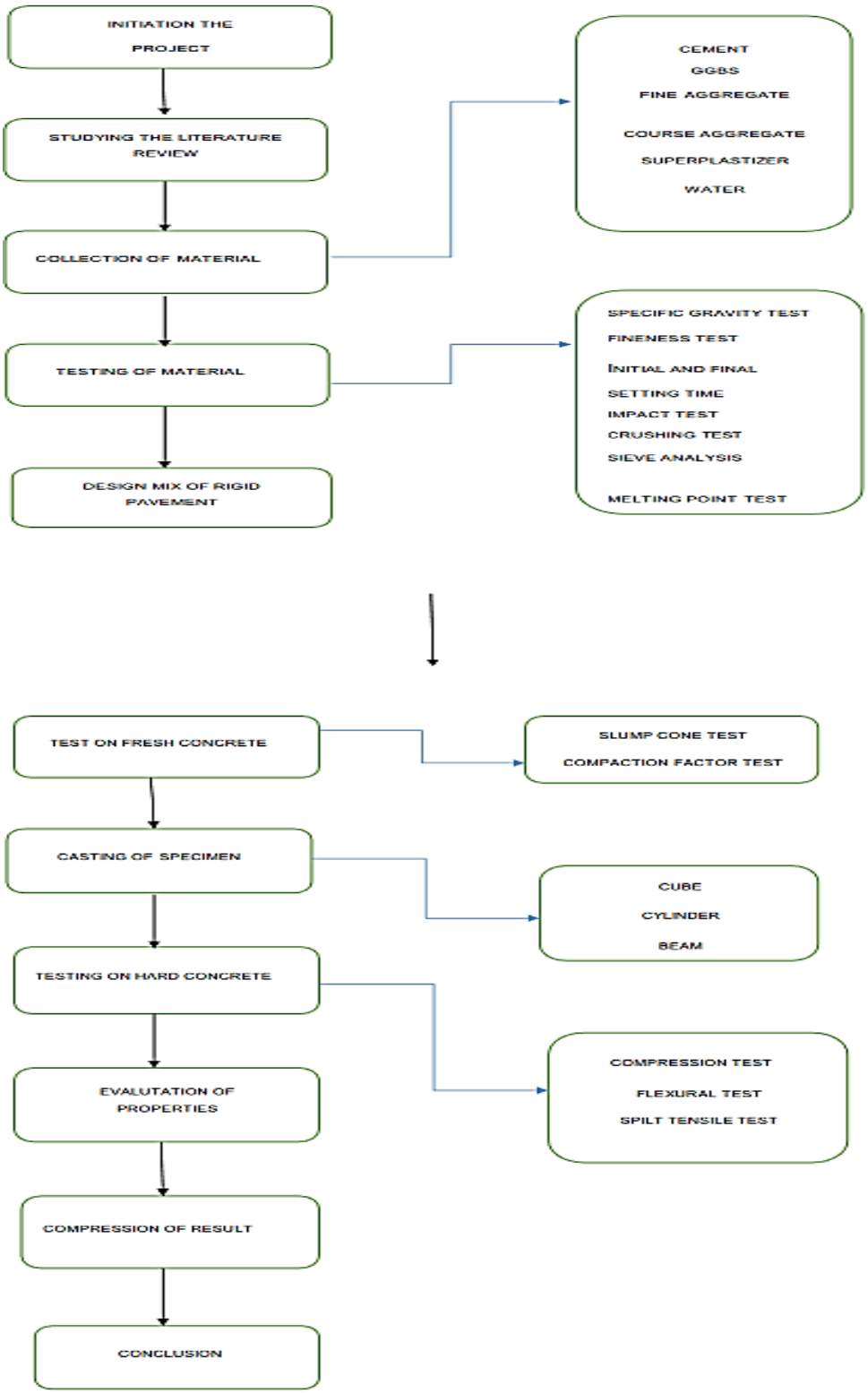

Fig.1. Flow chart of the research

Test Results & Discussions

A compressive strength study of concrete mix is carried out to find the effect of MINERAL ADMIXTURE as GGBS without super plasticizer. Properties of GROUND GRANUATED BLAST FURNACE SLAG mix concrete can be obtained by identifying the test results of compressive strength, splitting tensile strength and flexural strength have been studied and the results are as follows. Compressive strength - It is the most common of all test of concrete is the compressive strength test because of the intrinsic importance of the compressive strength of concrete in construction. Three test specimens shall be made from each sample for testing 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7 and 28 days. It could be seen from the figure that the compressive strength was reduced significantly by 40% when replacing of crumb rubber. Compressive strength of partially replaced by GGBS The test result of M40 grade of concrete compressive strength of GGBS mix with concrete are given in table.

Accelerated Curing Method

Determining Concrete Compressive Strength By Accelerated Curing Test (IS: 9013) As per BIS (IS 516) the compressive strength of a concrete mix is determined by curing concrete cubes (150mm) for 28 days, temperature maintained at 27+/- 2 deg Celsius. The test will be determines the grade of concrete. But under special requirements (time constraints) to determine grade of concrete it may not be feasible to wait as long as 28days, BIS recommended accelerated curing test to determine the grade of concrete in about in 28hrs, governed by IS: 9013. Although, indicative strength can be achieved by testing the cubes after 3days (50% of 28 days strength) and 7days (60% of 28 days strength) and 7days (60% of 28 days strength) from casting, a more standard method is commonly called accelerated curing test. Accelerated curing is a method used to get high early compressive Strength in concrete structure. Accelerate curing is mostly used in precast industry where high early strength. Accelerate curing is mostly used in precast industry where high early strength reduces cost, by decreasing the formwork removal time, also repair works are accelerated curing, in order to make its functional at early age. Raising the temperature of curing water speeds up the cement hydration process, thereby both curing of concrete and achieving high early compressive strength.

Fig.2. Accelerated curing tank used in laboratory for concrete testing

The following two method can be used for accelerated curing test determining compressive strength concrete.

1. Warm-water method.
2. Boiling water method.

Accelerated curing by boiling water method:

1. Test specimens are to be casted and left undisturbed for 23 hours +/- 15 mins in most air of atleast 90% humidity and at a temperature of 27 +/- 2deg Celsius.

2. The test specimens are lowered into the curing tank and totally immersed in water for a period 3.5 hours +/- 5 mins. The water in the curing tank should be maintained at a temperature of 100 deg C.

3. After curing for 3.5 hours in the curing tank, the test specimens are to be Removed from the boiling water and cooled by immersing them in a cooling tank with water at temperature of 27 +/-2 deg celsius for 2hours.4. The cubes are to be demoulded once cooled.

Compressive strength testing & analysis of result:

1. The specimens once removed from the curing tank are to be tested for their compressive strength in accordance to IS: 516.2. Based on the correlation obtained between normally cured concrete and accelerated cured concrete, the following formula are derived for 28 days compressive strength of concrete mix R28 (Strength at 28 days) = 8.09 + 1.64 Ra Where Ra is the average compressive strength of concrete test specimens used in the accelerated curing test. The 28 days compressive strength of concrete mix can be calculated by using the following formula.

Value of compressive strength

Batch No	*Cube No*	*Ra value*	*28th days Compressive Strength N/mm²*	*Remarks*
1	1	21.5	43.35	
	2	20.7	42.03	
	3	22	44.17	
2	7	22.2	44.5	
	8	21.5	44.44	
	9	24	47.45	
3	13	20	40.9	
	14	23	45.81	
	15	21	42.53	
4	19	22.5	44.99	
	20	23.8	47.12	
	21	21	42.53	
5	25	20	40.89	
	26	22.7	45.3	
	27	23	45.81	
6	31	22.8	45.48	
	32	24	47.45	
	33	23	45.81	
Average			**44.48**	

Conclusion and Recommendation

The strength of the specimen on 28 days of age is summarized. The strength can be obtained by the tests are Compressive strength, Split tensile strength and flexural strength of concrete is depended on the materials

used for the concrete mixture with adding of 32% of GGBS instead of cement. In general the strength was reduced with increased percentage of wastes replacing in cement concrete. From the experiment we found that the compressive strength, split tensile strength and flexural strength increases while compare with nominal concrete strength.

- The compressive strength of waste rubber concrete mixes of M40 grade shows the maximum of 32.23 N/mm² at the age of 7 days and 43.30N/mm² at the age of 28 days with reference to normal mix.
- The split tensile strength of waste rubber concrete mixes of M40 grade shows the maximum of 1.753 N/mm² at the age of 7 days and 2.648 N/mm² at the age of 28 days with reference to normal mix.
- Then, the flexural strength of waste rubber concrete mixes of M40 grade shows the maximum of 5.09 N/mm² at the age of 7 days and 7.29 N/mm² at the age of 28 days with reference to normal mix.

The strength of the concrete is more than conventional concrete and it can arrest the cracks generated during mechanical failure of concrete. The unit cost of concrete is reduced. Major the cost of concrete has reduced by adding mineral admixture and River sand and strength is also achieved as much we need. So the project has successful. And the equivalent strength attained in accelerated curing method is the age at the time shall be 28hours+or–20minutes.We can able to achieve 28 days compressive strength of concrete normal curing by this method. Average compressive strength for 28 days 44.48 N/mm².

Declarations

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Consent for publication

Authors declare that they consented for the publication of this research work.

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