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USE OF STEEL SLAG WASTE AS COARSE AGGREGATE IN CONCRETE PRODUCTION

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Abstract

This study presents an evaluation of performance of the mechanical properties of concrete using steel slag aggregate in concrete compared with typical crushed stone aggregate in concrete. Generally concrete contains more than 70% of aggregates due to the high demand in building construction material and due to increase in the amount of disposed waste material, suppliers and researcher are exploring the use of alternative materials which could preserve natural sources and save environment. As a result utilization of steel slag in concrete will save natural resources and clean environment. The results have show that slag aggregate concrete has better performance over the conventional aggregate concrete.

1.Introduction

Aggregate are the important constituents in concrete. Aggregate occupy 70-80% of the volume of concrete. They give body to the concrete. Aggregates is obtained from natural river beds and mining of rocks leading to reduction of natural resources. There is growing interest in using waste materials and significant research is made on the use of many different materials as aggregate substitutes such as coal ash, blast furnace slag and steel slag aggregate in concrete. The countries having limited resources of natural aggregate are thinking to save their natural resources for their future generation. A large area of land is utilized for the disposal of such solid wastes, producing by industries. Steel slag is a byproduct obtained from steel industry. Generally the steel slag is formed by a direct reduction of iron and electronic arc furnace. Because of the high disposal cost as a waste material and the overall positive features of steel slag, it has been declared a useful construction material, not an industrial waste by most of the developed country. The best management option for this by product is its recycling. This leads to reduction of landfills reserved for its disposal, saving the natural resources and attaining a potential environment.

As the aggregates can significantly control the properties of concrete, the properties of the aggregates have a great importance (Beshr et al., 2002). have indicated that the durability of steel slag cement concrete is better than the same for crushed limestone aggregate. Therefore, a thorough evaluation is necessary before using any waste material as aggregate in concrete.

The use of steel slag reduces the need of conventional coarse aggregate in concrete. Economic and environmental reasons have led to rapid development of slag utilization. Using this waste material to reduce the cost of the concrete

production. Steel slag is generated as a melt at about 1600°C during steelmaking from hot metal in the amount of 15%–20% per equivalent unit of steel.

2. Materials and methods

2.1 Specimens preparation

Aggregate materials used in this study are Steel slag shown in Fig.1, crushed stone sand and Slica fume . Steel slag obtained from local steel industry in Puducheery India. Using Jaw crusher the steel slag for 12 to 20 mm size of coarse aggregate are used as partial and fully replacement in concrete.

Fig.1 Aggregate materials used in this study

In this study concrete of M50 grade for a W/C ratio of 0.35. The total number of 60 cubes, cylinders and prisms were casted with steel slag as coarse aggregate for the replacement of 25%, 50%, 75% 100% and 100% steel slag with 10% of slica fume.. Test conducted on compressive strength, Modulus of Elasticity, flexural strength for concrete by 28 days curing.

2.2 Laboratory tests

To conduct compressive strength the size of the test specimens 150mm x 150mm x 150mm were prepared Each specimens aged 28 days was kept under the compression testing machine and was subjected to a gradually applied load till the failure stage. For testing of Modulus of Elasticity test the specimens were prepared in cylindrical form of size is 150mmx150mm 300mm .Then the cylindrical concrete specimens were tested for 28 days. The Flexural strength is conducted at 28 days of curing with the prism specimens having size of 100m x 100mm x 500mm is prepared for testing.

3. Results and discussion

The results of Compressive strength showed that for replacement of coarse aggregate by 25%, 50%, 75%, and 100% Steel slag and 100% steel slag with 8% of slica fume is 54.50 N/mm^{2,} 55.32 N/mm^2, 52.76 N/mm^2 and 53.90 N/mm^2 58.95N/mm^2,respectively. Similarly The Modulus of Elasticity of concrete test results are 34800 N/mm^2, 35600 N/mm^2, 32700 N/mm^2, and 33700 N/mm^2 36800 respectively. The Flexural strength results for replacement of 25%, 50%, 75%, and 100% Steel slag as coarse aggregate and 100% steel slag with 10% of slica fume is 4.78 N/mm^2, 4.95 N/mm^2, 4.59 N/mm^2, 4.69 N/mm^2 5.34 N/mm^2 respectively. The test results of Conventional concrete specimens for Compressive strength, Modulus of Elasticity, Flexural strength for 28 days were 57.78 N/mm^2, 36000 N/mm^2, and 5.12 N/mm^2 respectively.

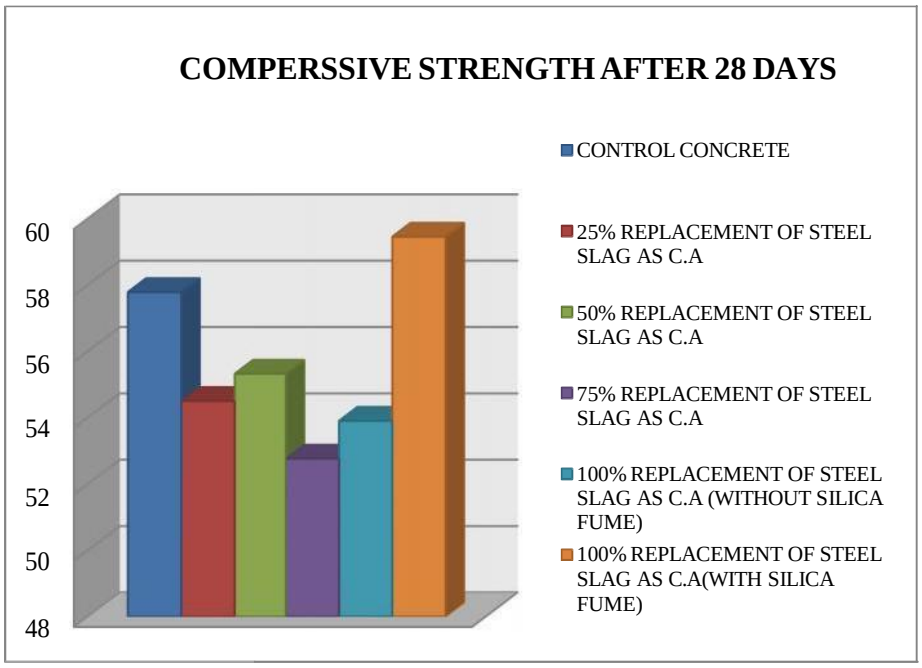

Fig. 2 Comperssive Strength After 28 Days

The variations of Compressive strength, Modulus of Elasticity, Flexural strength with control concrete for different percentage of replacement of steel slag in concrete is shown in Fig.2, Fig.3, and Fig.4 respectively. The Mechanical properties test results shows that 75% replacement of steel slag as coarse aggregate has less strength than other replacement percentages as well as Conventional concrete. In the overall Mechanical properties test results 100% steel slag with 10% slica fume has higher strength.

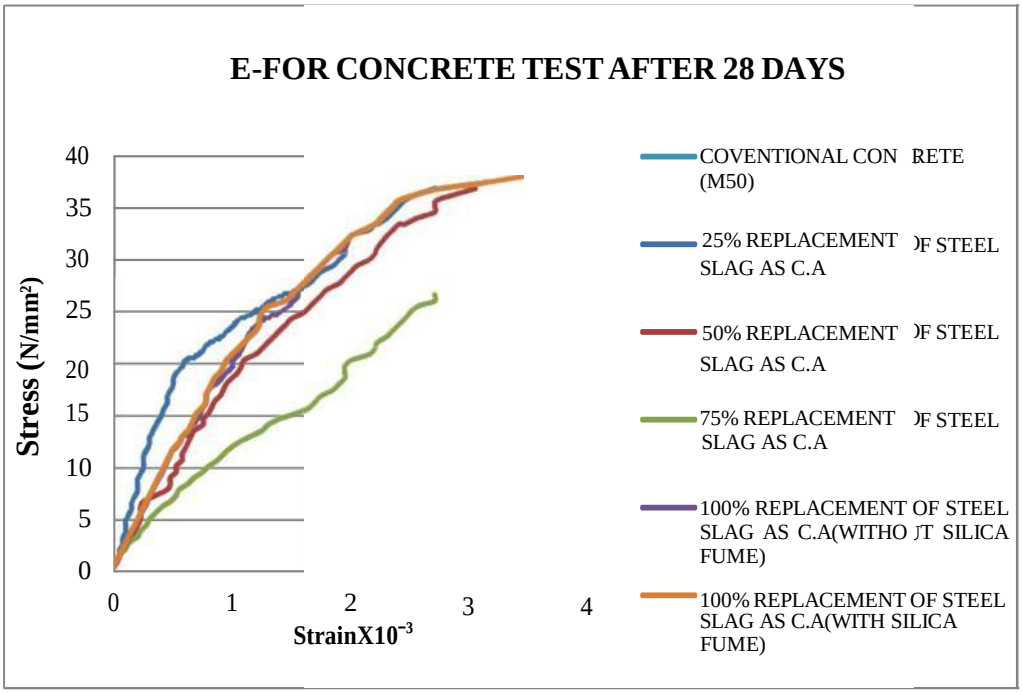

Fig. 3 E-FOR concrete test after 28 days

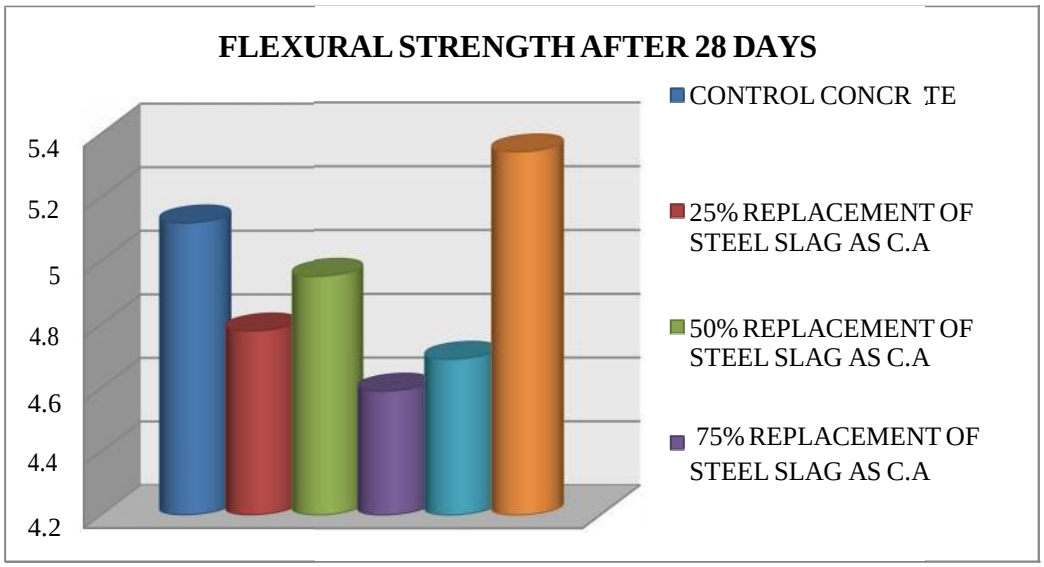

Fig. 4 Flexural Strength After 28 Days

4. Conclusions

(1) In the physical properties test results the Specific gravity of steel slag is 13.24% higher than that of crushed stone coarse aggregate

(2) Crushing value and Impact value test results of steel slag aggregate have 18.23%, and 18.90% higher than of crushed stone coarse aggregate.

(3) The 100% replacement of steel slag as coarse aggregate in concrete was less workability when compared to crushed stone coarse aggregate concrete.

(4) In the mechanical property test results the50% replacement of steel slag as coarse aggregate in concrete is optimum percentage of replacement and is very nearer conventional control concrete test results.

(5)As a result steel slag is suitable as coarse aggregate in the production of concrete.

References

[1] **A**kin Altun.I, Ismail Yilmaz (2002). Study on steel furnace slags with high Mgo as additive in Portland cement. *Journal of Cement and concrete research*, Vol.32, pp 1247-1249.

[2] Beshr.H, Almusallam.A.A, Maslehuddin.M (2002). Effect of coarse aggregate quality on the mechanical properties oh high strength concrete. *Journal of Construction and building materials*, Vol.17, pp 97-103.

[3] Dr.Chinnaraju.K, Ramkumar (2013). Study on Concrete Using Steel Slag as Coarse Aggregate Replacement and Eco sand As Fine Aggregate Replacement. *International Journal of Research in Engineering & Advanced Technology*, Vol.1, pp 1-6.

[4] IS 10262:2009 - Concrete mix proportioning-Guideline. Bureau of Indian Standard, New Delhi, India.

[5] IS 456:2000 - Plain and Reinforced Concrete Code of Practice. Bureau of Indian Standard, New Delhi, India.

[6] IS 1229:1913 - Specification for 53 grade ordinary Portland cement

[7] IS 383:1996 - Specification for coarse and fine aggregate from natural sources for concrete. Bureau of Indian Standard, New Delhi, India.

[8] Jafari Ani.O, Shafabakhsh.G.H, Talebsafa.M (2015). Artificial neural network modeling (ANN) for predicting rutting performance of nano-modified asphalt mixtures containing steel slag. *Journal of Construction and building materials*, pp 136-143.

[9] Khalid Raza, Sharda Sharma, Ritesh Mall and Patel (2014). Comparative Strength Analysis Of Concrete By Using Steel Slag As An Alternative To Normal Aggregates (Coarse) In Concrete. *International Journal of Civil Engineering*, Vol.3, pp 53-57.

[10] Manoj.N, Mrs.N.Nandhini (2014). Experimental Investigation of Fibre Reinforced Concrete with Partial Replacement of Coarse Aggregate by Steel Slag. *International Journal of Innovative Research in Science, Engineering and Technology*, Vol.3, pp91-95.

[11] Maslehuddin.M, AlfarabiM.Sharif, Shameem, Ibrahim and Barry (2002). Comparison of properties of steel slag and crushed limestone aggregate concretes. *Journal of Construction and Building Materials*, Vol.17, pp 105-112.

[12] Mohammed Nadeem, Arun Pofale (2012). Experimental Investigation Of Using Slag As An Alternative To Normal Aggregates (Coarse And Fine) In Concrete. *International Journal of Civil and Structural Engineering*, Vol.3, pp 117-127.

[13] Palanisamy.S,P, Maheswaran.G, Annaamalai1 M.G.L, Vennila.P (2015*).* Steel Slag to Improve the High Strength of Concrete. *International Journal of ChemTech Research,* Vol.7, pp 2499-2505.

[14] Saravanan.J and Suganya.N (2014). Mechanical properties of concrete using steel slag aggregate. *International Journal of Engineering Inventions*, Vol.4, pp 07-16.

[15] Sultan Tarawneh, Emhaidy Gharaibeh and Falah M. Saraireh (2014). Effect of Using Steel Slag Aggregate On Mechanical Properties Of Concrete. *American Journal of Applied Sciences*, pp 700-706.

[16] Verapathran Maruthachalam, Murthi Palanisamy (2014). High performance concrete with steel slag aggregate. *International Journal of Civil and Structural Engineering,* Vol.66, pp 605-612.

[17] Vijaya Sekhar Reddy.M, Ramana Reddy.I.V, Madan Mohan Reddy.M, Nataraja.M.C and Krishna Murthy.N (2012*).* Durability aspects of high performance concrete containing supplementary cementing materials. *International Journal of Civil and Structural Engineering research*, Vol.1, pp 51-59.