Experimental Study On Properties Of Concrete With Eco-Sand And Demolished Concrete As Replacement To Fine Aggregate And Coarse Aggregate

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Abstract
The world's demand for natural resources increasing every year, at the same time waste generation from industries also increases simultaneously. The aim of this project is to utilize the industrial waste for construction purpose. This project deals with the experimental investigation on properties of concrete with eco sand and demolished concrete as replacement to fine aggregate and coarse aggregate. While considering the current scenario, only very little amount of demolished concrete is reused and recycled.

The disposal and dumping of demolished concrete in land is problematic. The eco sand is a by-product from cement manufacturing unit. For all the trail mixes 20% of the FA is replaced with eco-sand[11]. The intention of this project is to determine the optimum percentage of replacement of CA using demolished concrete aggregate. The fresh and hardened properties of different concrete mixes were compared with conventional concrete.

Keywords: Demolished concrete, M-sand, Eco sand, Sustainable environment, waste utilisation etc.

Introduction

Concrete is a construction material composed of cement, fine aggregates and coarse aggregates mixed with water which hardens with time. Aggregate is the granular material used to produce concrete or mortar. When the particles of the granular material are so fine that they pass through a 4.75mm sieve, it is called fine aggregate. Due to lack of availability of river sand the engineers has to look for alternative material like M-sand and eco-sand. Coarse aggregate are generally gravel and crushed stone which are greater than 4.75mm. Demolished concrete is available now a day in large quantity.

Utilization of industrial waste materials in concrete to compensates the lack of natural resources, to find alternative method to save the nature resources. There are a number of industrial wastes which can be used as fully replacement or partial replacement for coarse aggregate and fine aggregate.

Thus, in this paper the concept of replacement of coarse aggregate with demolished concrete and fine aggregate with eco sand and M sand is used to determine the optimum replacement.

Methodology

Literature related to utilisation of industrial wastes has been collected. Based on the literature review, the object of the project was defined. Ample no of the project has been alone utilising the demolished concrete aggregate as a replacement to coarse and fine aggregate in concrete.

Also, some project has been done by utilising the eco-sand as a replacement to fine aggregate in concrete. But none of the project has been done utilising both eco-sand and demolished concrete as a replacement to fine aggregate and coarse aggregate respectively.

After freezing the industrial wastes that is going to be used in the project, materials were collected and characterisation of the material has been done. Mix design was prepared followed by casting and testing fresh and hardened concrete properties.

Mix Proportion

Trial mixes were prepared by the proportion of replacement of course aggregate using demolished concrete aggregate. Based on the literature reviewed the optimum percentage of replacement of fine aggregate using eco-sand is twenty. Also, the replacementcoarse aggregate using demolished concrete aggregate has given acceptable results when its replacement percentage is in the range 5 to 30.

This paper deals with the experimental results obtained by varying the replacement percentage of coarse aggregate from 10 to 25 using demolished concrete aggregate.

Results and Discussion

A. Workability: As we are replacing the actual ingredient of concrete using industrial wastes, it is necessary to check the workability of the trial mixes.

Slump cone test was conducted and the slump values obtained are low.

Hence, compaction factor test was performed and the mix is found to be a stiff one. The results of the compaction factor test proved that the mixes are very stiff except that of the conventional M20 concrete.

Vee-Bee compaction was conducted to determine the compatibility of the mixes. The results confirmed that the mixes are very stiff.

B. Compressive Strength: The seven days compressive strength test of concrete cube of mix-1 is found to be greater than the M20 concrete by four percent. In case of mix-2 it is greater than nine percent; mix-3 is greater by ten percent; mix-4 is lesser by thirty percent.

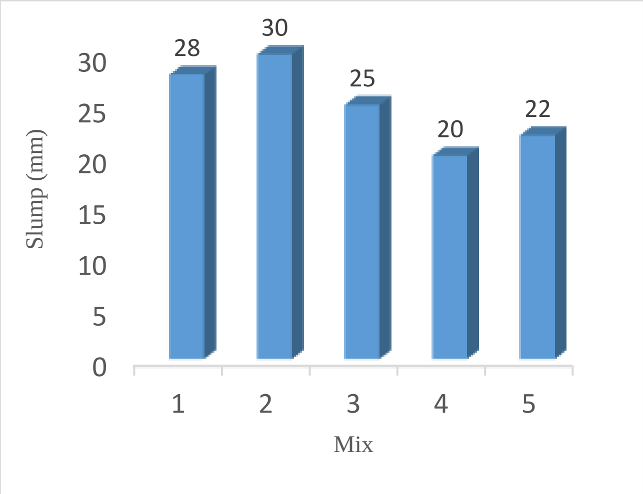

Fig. 1: Slump Cone Test

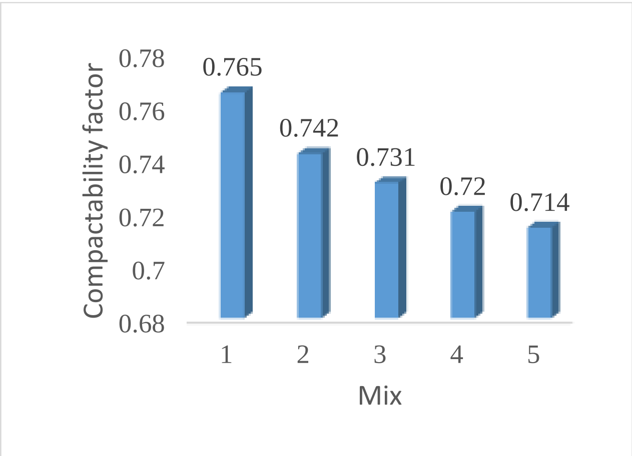

Fig. 2: Compaction Factor Test

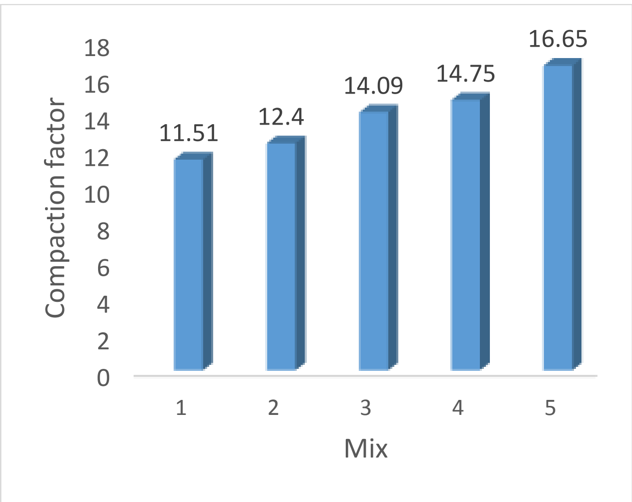

Fig. 3: Vee-Bee Compaction Test

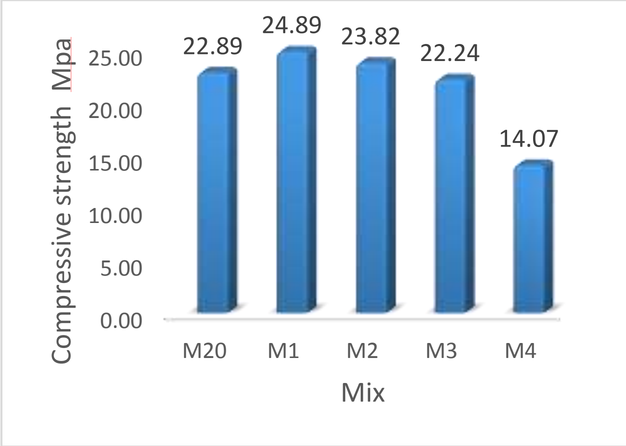

Fig. 4: 7 Days Compressive Strength

The fourteen days compressive strength test of concrete cube of mix-1 is found to be greater than the M20 concrete by five percent. In case of mix-2 it is greater than seven percent; mix-3 is greater by twenty-six percent; mix-4 is lesser by twenty eight percent.

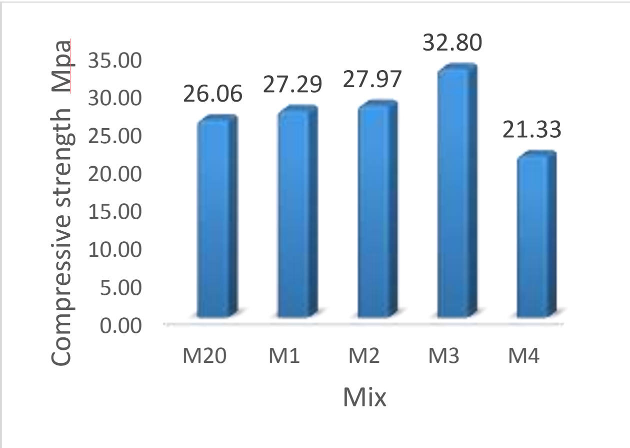

Fig. 5: 14 Days Compressive Strength

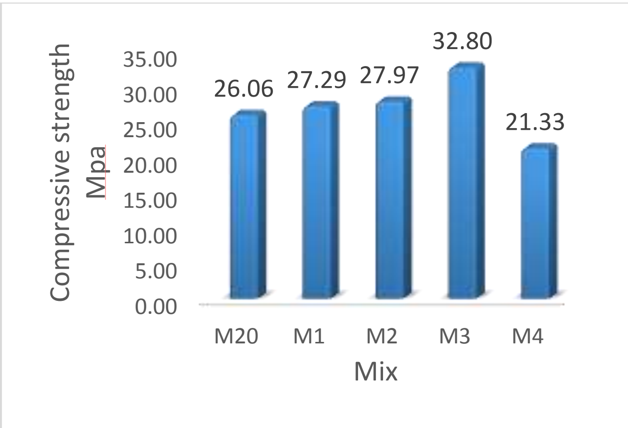

Fig. 6: 27 Days Compressive Strength

The twenty-eight days compressive strength test of concrete cube of mix-1 is found to be greater than the M20 concrete by two percent. In case of mix-2 it is greater than four percent; mix-3 is greater by nine percent; mix-4 is lesser by thirty percent.

The reason for the reduction in compressive strength values of mix-4 is that the hydration of cement is not completed due to the lack of water. The cementitious material present in demolished concrete aggregate absorbs water and so the workability of the mixes are too low.

Compressive strength of the concrete and workability can be improved if and only if high range water reducing admixtures are used.

Conclusion

From this experimental study it is found that beyond twenty percent replacement of coarse aggregate using demolished concrete aggregate, the compressive strength decreases.

The workability of the concrete mixes are found to be stiff which in turn makes the concrete tough for practical application. To overcome the challenge of poor workability, suitable chemical admixture can be used. When the workability is improved, these mixes will help in lessening the usage of river sand which avoids depletion of the same. Moreover, without admixtures these concrete mixes can be used for shallow sections and road pavement work as it has true slump range.

The optimum replacement percentage of the coarse aggregate using demolished concrete aggregate is found to be twenty percent.

References

1. Wagih Ashraf M., El-Karmoty Hossam Z., Ebid Magda and Okba Samir H., Recycled construction and demolition concrete waste as aggregate for structural concrete, *HBRC Journal*, **9**, 193-200 **(2013)**

2. Harikrishna S. and Siva Kumar Prasad C., A Study on Compressive Strength Characteristics of High Strength Concrete Using Demolished Aggregate and Silica Fume, *IOSR Journal of Mechanical and Civil Engineering*, **14**, 66-69 **(2017)**

3. Monish Mohd, Srivastava Vikas, Agarwal V.C., Mehta P.K. and Kumar Rakesh, Demolished waste as coarse aggregate in concrete, *Journal of Academia and Industrial Research*, **1**, 540-542 **(2013)**

4. Gupta Shubham and Indira M., An Experimental study of concrete on Effect of Eco sand as a partial replacement of Fine Aggregates, *International Journal of Innovative Technology and Exploring Engineering*, **8**, 465-469 **(2019)**

5. Suri Nandini and Anandh Babu Y., Experimental investigations on partial replacement of steel slag as coarse aggregates and eco sand as fine aggregate, *International Journal of Civil Engineering and Technology*, **7**, 322–328 **(2016)**

6. Selina Ruby G., Vignesh M., Mangala Sankarraj G., Kishorekumar M. and Ajith A., Investigation on Eco sand Concrete, *International Journal of Scientific Research and Review*, **7**, 243-249 **(2018)**

7. Sharma Jitender and Singla Sandeep, Study of Recycled Concrete Aggregates, *International Journal of Engineering Trends and Technology*, **13**, 123-125 **(2014)**

8. Lochan Teja K., Teja Sai, Surya M. and Gokulnath V., Partial Replacement of Course Aggregate with Demolished Waste along with Adding of Admixture, *International Journal of Advance Research, Ideas and Innovations in Technology*, **4**, 286-289 **(2018)**

9. Kalpavalli Anagha and Naik S.M., Use of Demolished Concrete Wastes As Coarse Aggregates in High Strength Concrete Production, *International Journal of Engineering Research & Technology*, **4**, 1040-1044 **(2015)**

10. Loganathan D. and Nithyalakshmi B., Experimental investigation's on rich mineral silica (Eco sand) in concrete (RMSC), *International Journal of Engineering Sciences & Research Technology*, **5**, 474-479 **(2017)**

11. Prabu M., Logeswaran S. and George Sunilaa, Influence of GGBS and Eco Sand in Green Concrete, *International Journal of Innovative Research in Science, Engineering and Technology*, **4**, 4519-4527 **(2015)**.