

Usage potential of recycled aggregates in mortar and concrete

Subhash C. Yaragal* and Muhammad Roshan A.K.^a

Department of Civil Engineering, National Institute of Technology, Surathkal, Karnataka, India

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Abstract. With the rapid growth in construction sector, it becomes all the more important to assess the amount of Construction and Demolition (C&D) waste being generated and analyze the practices needed to handle and use this waste before final disposal. This serves waste management and disposal issues, paving way to waste utilization in construction industry from the sustainability point of view. C&D waste constitutes a major bulk of total solid waste produced in the world. In this work, an attempt is made to study the performance of concrete using water soaked Recycled Coarse Aggregates (RCA) in replacement levels of 0%, 25%, 50%, 75% and 100% to Natural Coarse Aggregates (NCA). Experiments were designed and conducted to study the performance of RCA based concrete. Further suitable performance enhancement techniques to RCA based concrete were attempted, to achieve compressive strength at least equal to or more than that for no RCA based concrete (control concrete). Performance enhancement study is reported here for 50% and 100% RCA based concretes. All four techniques attempted have given favorable results encouraging use of RCA based concretes with full replacement levels, to adopt RCA based concrete in structural applications, without any kind of concern to the stake holder. Further attempts have also been made to use Recycled Fine Aggregates (RFA) with appropriate modifications to serve as fine aggregates in mortar and concrete. Using RFA blended with river sand fractions as well as RFA with Iron Ore Tailings (IOT) fractions, have given good results to serve as fine aggregates to the extent of 100% replacement levels in mortars and concretes.

Keywords: recycled aggregates; recycled concrete; recycled mortar; performance; performance enhancement

1. Introduction

1.1 General

Severe demand for land to house alarming population increase needs in recent years, in India and all over the world, has resulted in remarkable waning of the natural aggregates resources day by day. On the other hand, millions of tonnes of Construction and Demolition (C&D) residues are generated all over the world in the last decade. Construction and demolition waste disposal has also emerged as a problem in India. C&D waste and more specifically concrete has been seen as a

*Corresponding author, Professor, E-mail: subhashyaragal@yahoo.com

^aPost Graduate Student

- Evangelista, L. and De Brito, J. (2007), "Mechanical behaviour of concrete made with fine recycled concrete aggregates", *Cement Concrete Compos.*, **29**(5), 397-401.
- Evangelista, L. and De Brito, J. (2010), "Durability performance of concrete made with fine recycled concrete aggregates", *Cement Concrete Compos.*, **32**(1), 9-14.
- Kou, S.C. and Poon, C.S. (2009), "Properties of self-compacting concrete prepared with coarse and fine recycled concrete aggregates", *Cement Concrete Compos.*, **31**(9), 622-627.
- Kou, S.C. and Poon, C.S. (2012), "Enhancing the durability properties of concrete prepared with coarse recycled aggregate", *Constr. Build. Mater.*, **35**, 69-76.
- Kou, S.C. and Poon, C.S. (2013), "Long-term mechanical and durability properties of recycled aggregate concrete prepared with the incorporation of fly ash", *Cement Concrete Compos.*, **37**, 12-19.
- Kou, S.C., Poon, C.S. and Agrela, F. (2011), "Comparisons of natural and recycled aggregate concretes prepared with the addition of different mineral admixtures", *Cement Concrete Compos.*, **33**(8), 788-795.
- Levy, S. and Helene, P. (2007), "Durability of concrete mixed with fine recycled aggregates", *Exacta*, **5**(1), 25-34.
- Manasseh, J. (2010), "Use of crushed granite fine as replacement to river sand in concrete production", *Leon. El. J. Pract. Technol.*, **9**(17), 85-96.
- Martinez-Lage, I., Martinez-Abella, F., Vazquez-Herrero, C. and Perez-Ordóñez, J.L. (2012), "Properties of plain concrete made with mixed recycled coarse aggregate", *Constr. Build. Mater.*, **37**, 171-176.
- Mueller, A. and Winkler, A. (1998), "Characteristics of processed concrete rubble", *Proceedings of the International Symposium: Use of Recycled Concrete Aggregate*, University of Dundee, November.
- Mukharjee, B.B. and Barai, S.V. (2014), "Influence of nano-silica on the properties of recycled aggregate concrete", *Constr. Build. Mater.*, **55**, 29-37.
- Mukharjee, B.B. and Barai, S.V. (2015), "Characteristics of sustainable concrete incorporating recycled coarse aggregates and colloidal nano-silica", *Adv. Concrete Constr.*, **3**(3), 187-202.
- Padmini, A.K., Ramamurthy, K. and Mathews, M.S. (2009), "Influence of parent concrete on the properties of recycled aggregate concrete", *Constr. Build. Mater.*, **23**(2), 829-836.
- Prusty, R., Mukharjee, B.B. and Barai, S.V. (2015), "Nano-engineered concrete using recycled aggregates and nano-silica: Taguchi approach", *Adv. Concrete Constr.*, **3**(4), 253-268.
- Qasrawi, H. (2014), "The use of steel slag aggregate to enhance the mechanical properties of recycled aggregate concrete and retain the environment", *Constr. Build. Mater.*, **54**, 298-304.
- Rahal, K. (2007), "Mechanical properties of concrete with recycled coarse aggregate", *Build. Environ.*, **42**(1), 407-415.
- Rao, A., Jha, K.N. and Misra, S. (2007), "Use of aggregates from recycled construction and demolition waste in concrete", *Res. Conserv. Rec.*, **50**(1), 71-81.
- Shaikh, F., Kerai, S. and Kerai, S. (2015), "Effect of micro-silica on mechanical and durability properties of high volume fly ash recycled aggregate concretes (HVFA-RAC)", *Adv. Concrete Constr.*, **3**(4), 317-331.
- Silva, R.V., De Brito, J. and Dhir, R.K. (2014), "Properties and composition of recycled aggregates from construction and demolition waste suitable for concrete production", *Constr. Build. Mater.*, **65**, 201-217.
- Tabsh, S.W. and Abdelfatah, A.S. (2009), "Influence of recycled concrete aggregates on strength properties of concrete", *Constr. Build. Mater.*, **23**(2), 1163-1167.
- Yaragal, S.C. Teja, D.C. and Shaffi, M. (2016), "Performance studies on concrete with recycled coarse aggregates", *Adv. Concrete Constr.*, **4**(4), 263-281.
- Yaragal, S.C., Vivek, V.B., Padmini, M., Jacob, M., Niveditha, J. and Pillai, A.K. (2015), "Potential use of recycled coarse aggregates in concrete", *Mag. Mast. Build.*, 60-64.
- Zhu, Y.G., Kou, S.C., Poon, C.S., Dai, J.G. and Li, Q.Y. (2013), "Influence of silane-based water repellent on the durability properties of recycled aggregate concrete", *Cement Concrete Compos.*, **35**(1), 32-38.