Abstract:

The recycled aggregate (RA) from construction and demolition waste (CDW) has high potential to be used as sustainable construction material for producing concrete from it. The conventional mix-design method used for natural aggregate may not be suitable for producing recycled aggregate concrete (RAC). In this context, identical mortar volume method is developed for producing improved properties of recycled aggregate concrete. This method accounts for the adhered mortar content (AMC) on the surface of RA which results in the reduction of total mortar content requirement and also defines the acceptable percentage of substitution of RA for preparing RAC. The present investigation is also an effort to obtain improved mechanical properties, durability properties and performance of recycled aggregate concrete by following equal mortar volume method in conjunction with different mixing approaches which are recommended in the open literature along with present proposed two stage mixing approach. The Identical Mortar Volume (IMV) mix design method along with proposed two stage mixing approach is adopted for preparing RAC which results further improvement in mechanical, durability properties. In this two stage mixing approach ($TSMA_{sic}$), silica fume of 7% of the cement content is taken to prepare a silica fume slurry and then RA is thoroughly mixed with it. This slurry fills up the weak areas in the RA and improves the interfacial transition zones (ITZs) resulting in higher strength and durability properties of RAC. The quantity of water for preparing the above slurry is found out by considering the water absorption capacity the RA. Proportional amount of cement and water are added in premixing stage and the mixing steps are followed. The experimental results of mechanical properties and durability properties of this RAC are observed to be equivalent to the properties of concrete prepared from the natural coarse aggregate. Similar performance is also noticed for shear performance of RAC beams. The IMV method of mix design along with proposed two stage mixing approach results improved shear capacity of RAC beam regardless of the shear-to-span depth ratio when compared with different empirical relations given in codes and published literature. Electron probe micro analyzer (EPMA) based microstructure analysis is carried out for the concrete prepared by developed mix design method to justify the reason for the enhancement of properties. Wavelength dispersive X-ray spectroscopy (WDS) and image analysis of backscattered secondary electron (BSE) images are used for quantitative analysis at ITZ and at paste.

Keywords: *Recycled concrete aggregate; Mechanical and Durability properties; TSMA; Microstructure;* Identical Mortar Volume method*; Shear Performance*.