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Recycling Of Demolished Concrete as Aggregate

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Abstract. *Construction industry generates huge amounts of debris that needs to be recycled and reused as recycled aggregates (RAs) for partial or total substitution of natural aggregates. Recycling reduces waste and reduces energy consumption and hence contributes to a more sustainable construction industry. In this chapter the need for recycling and the current situation worldwide are highlighted. RA properties are discussed. RAs have a relative density lower than that of virgin materials and higher water absorption. A state of the art RA concrete performance at the fresh and hardened state is summarized. RA concrete presents lower compressive and flexural strengths as well as lower modulus of elasticity and lower fracture because of the porous nature of the RA and the old adhered cement mortar on the surface of the aggregates. Bond strength and abrasion resistance are little affected. Shrinkage, water permeability and water absorption by capillary increase with increase in RA content. However, the lower performance can be mitigated by a good mix design using supplementary cementitious materials. Successful applications of RA in producing self-compacting and roller-compacted concrete are also discussed.*

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I. Introduction

The global demand for construction aggregates exceeds 26.8 billion tons per year [1]. In Egypt there is a significant increase in the use of natural aggregates due to infrastructure and construction development. The use of recycled aggregate in construction can be useful for environmental protection and economical terms; it started since the end of World War II by using a demolished concrete pavement as recycled aggregate in stabilizing the base course for road construction [2]. The annual amount of construction and demolition waste (CDW) in Egypt is 4.0 million tons [3] while the current method of managing such waste is through disposal in landfills causing huge deposits of CDW and becoming an environmental problem. In other developing countries, laws have been brought into practice to restrict CDW in the form of prohibitions or special taxes for creating waste areas. The heaviest materials found in CDW in Egypt are concrete, bricks, sand, mortar and tile residues in which concrete represents up to half of the total waste weight [4]. This situation leads to a question about the preservation of natural aggregate sources and environment.

One of the possible solutions to these problems is to recycle construction and demolition concrete waste to produce an alternative aggregate for structural concrete.

Recycled Aggregate (R.A)

Recycled aggregates have been increasingly considered for use in concrete, owing to the limited supply of natural aggregates coupled with the corresponding carbon footprint. However, despite the sustainability benefits of using recycled aggregates in concrete, its use in concrete is plagued with lower performance due to the physical properties of the recycled aggregates. One of the effective ways to improve the performance of concrete incorporating recycled aggregates is with the incorporation of fly ash (FA) which is also waste material. In this chapter the effect of FA on the mechanical properties of concrete incorporating recycled aggregates has been discussed. With the incorporation of FA in the recycled aggregate concrete mixture, various properties are enhanced, owing to the filler effects and pozzolanic reactivity of FA. Micropores in concrete are filled up with fine particles, and thus ensuring low permeability in the matrix as a result of the improved concrete microstructure.

Need for the use of R.A. in concrete.

Recycling of concrete is economical as it reduces the cost by 34%-41%. It also reduces Carbon Dioxide emission by 23%-28% as the cement can also be retrieved from the recycling process. Therefore the emission of CO2 in the production of new cement is less than before. As a result recycled aggregate is considered to be green construction material.

Source of R.A.

A huge amount of aggregates for recycling is available from different sources. Here are some examples

- Demolished waste generated due to natural disaster
- CDW generated for development of new buildings replacing old ones
- Tested specimen from laboratory
- Crushing of Portland concrete pavement
- Concrete debris generated from war destruction

Sources of recycled aggregate for **Recycled Aggregate Concrete (RAC)** Pexels.com

When a structure is demolished, the particles are of larger sizes. So to make the processing easier the particles need to be crushed down to 300mm.

Production of R.A.
RCA are produced in stationary recycling plants similar to those used for natural, crushed aggregate production. Processing usually includes two-stage crushing (primarily with jaw crushers and secondarily with impact crushers), removing the contaminants and screening.

Comparison of Recycled Aggregate and Natural Aggregate.
Recycled aggregates generally have densities slightly less than the original materials used. One main difference between recycled aggregates and natural aggregates is the higher water absorption due to the presence of old cement mortar adhered to the recycled aggregate particles.

II. Conclusion.

- The compressive strength of the cube for natural aggregate is achieved as 33.55N/mm
- .While replacing the natural aggregate by recycled aggregate the compressive strength are32.93 N/mm

, 27.63 N/mm

, 31.90 N/mm

replacement level.

- The compressive strength is maximum of 32.90N/mm

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at replacement of nominal coarseaggregate by recycled coarse aggregate.

- The compressive strength of the cube for nominal aggregate is less compared to replacingthe nominal aggregate by recycled aggregate.
- Use of recycled concrete aggregate conserves natural aggregate, reduces the impact onlandfill and creates cost savings in the transportation of aggregate, waste products and inwaste disposal. It reduces the impact on dwindling landfill space, reduces disposal costs,and may reduce overall projects costs.
- There are both environmental and economical benefits of using recycled concreteaggregate.