Properties of Normal and High Strength Fiber Reinforced Concrete Using Recycled Aggregate and Different Fibers

By

ALSHIMAA ABD EL MONEM HUSSIEN

A thesis Submitted to the
Faculty of Engineering at Cairo University
In partial fulfillment of the
Requirements for the degree of
MASTER OF SCIENCE
IN
STRUCTURAL ENGINEERING

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Properties of Normal and High Strength Fiber Reinforced Concrete using Recycled Aggregate and Different fibers

Key Words : Recycled aggregate, normal strength concrete, high strength concrete, synthetic fibers, concrete properties.

Summary :

The aims of the current research are to determine the influence of using recycled aggregate on the properties of both normal and high-strength concrete and to investigate the effect of adding synthetic fibers to recycled aggregate concrete mixes in order to provide a solution for current application requirements and better performance. This investigation was carried out on forty mixes divided into two phases: phase-I of cement content 400 kg/m^3 for normal strength concrete and phase-II of cement content 600 kg/m^3 for high strength concrete. Four recycled aggregate replacement percentages (0%,25%,50%,100%) with different types and volume fractions of synthetic fibers (0.05%, 0.1%,0.2% of fibermesh300 and 0.1% polypropylene fiber) were used in the both phases. The experimental program included assessment of fresh and hardened concrete properties using tests of workability, air content, compressive strength, indirect tensile (splitting tensile) strength, flexural strength, static modulus of elasticity, impact resistance, abrasion resistance and drying shrinkage .

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ABSTRACT

In Egypt, the efficient use of the construction and demolition wastes by recycling would reduce the costs and definitely lead to conservation of the invaluable non-renewable sources of energy and hence it should be given considerable importance.

Nowadays, the rate of demolition and removal of existing structures is increasing due to various reasons i.e. reconstruction for achieving more economic gains , damages in structures due to natural disasters and wars. Also, there are countries as well as Egypt that rebuild and develop their cities for the purpose of revolution especially in the Middle East region. Therefore, recycled concrete aggregate produced by crushing demolished concrete can be easily obtained. There are already various applications of recycled aggregate concrete that has been extremely executed in the United States and European construction industries due to its economic and environmental benefits such as base or fill for drainage structures, bank protection, embankments and road construction or as noise barriers. Although, the use of recycled concrete aggregate is considered to be the prospective application in construction as a substitute for natural aggregates, this idea is still limited in most of the developing countries including Egypt as one of these nations.

Users of recycled concrete aggregate should take customary precautions to make sure that the material is suitable for the intended application. The aims of the current research are to determine the influence of using recycled concrete aggregate on the properties of both normal and high-strength concrete and to investigate the effect of adding synthetic fibers to recycled aggregate concrete mixes in order to provide a solution for current application requirements and better performance. This investigation was carried out on forty mixes divided into two phases: phase-I of cement content 400 kg/m^3 for normal strength concrete and phase-II of cement content 600 kg/m^3 for high strength concrete. Four recycled aggregate replacement percentages of (0%, 25%,50%,100%) with different types and volume fractions of synthetic fibers of (0.05%, 0.1%,0.2% of fibermesh300 and 0.1% polypropylene fiber) are used in the both

phases. The experimental program included assessment of fresh and hardened concrete properties using tests of workability , air content, compressive strength, indirect tensile (splitting tensile) strength, flexural strength, static modulus of elasticity, impact resistance , abrasion resistance and drying shrinkage .

Based on the findings, it was found that both normal and high strength recycled aggregate concretes, as the replacement percentage of recycled aggregate increases, the mechanical properties of concrete with and without fibers decrease. Also, it can be observed by increasing the cement content and reducing water/cement ratio the mechanical properties of conventional and recycled aggregate concrete significantly improved. However, most of the mechanical properties of high strength concrete decreased more by increasing the recycled aggregate content than the normal strength concrete. Thus, recycled concrete aggregate is more suitable to be used in lower grade concretes. On addition of fibers, the two types of synthetic fibers used in this research with volume fraction up to 0.2% enhanced the mechanical properties of both normal and high strength concrete mixes with natural and recycled coarse aggregate. However, research results indicate that the fibermesh300 performs better than polypropylene fibers in flexure strength, impact strength and controlling drying shrinkage of concrete at the same volume fraction.

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