CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

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Project Number

S0330

Project Title

Rubberized Concrete: An Integration of Dynamic Performance and Environmental Protection

Abstract

Objectives/Goals

Evaluating the dynamic properties of rubberized concrete including the damping ratio and the seismic response will enable us to identify its niche applications. Investigating the effects of rubber crumb and silica fume on the compressive strength will help us assess the strength and deformation properties, understand the bonding mechanism between rubber crumb and cement paste, and thus optimize the mixing process. Furthermore, utilizing the recycled crumb rubber and silica fume for concrete structure opens up a new field for the green technology.

Methods/Materials

Rubberized silica fume concrete was designed by replacing coarse aggregate in concrete. To evaluate the dynamic properties of rubberized silica fume concrete, free vibration and shaking table tests were conducted to measure the damping ratio and seismic response. To assess the ductility of rubberized concrete structural members, experiments on compressive strength, Young's modulus, and deformation were conducted. Rubber particles were also coated with nano-porous thin films (NPTF) to observe the bonding interface between rubber and cement paste using a scanning electron microscope (SEM).

Results

The experimental results showed that the average damping ratio of the rubberized concrete columns is 7.7 compared to 4.7 for the normal concrete columns. The peak response acceleration of the rubberized concrete columns in the shaking table tests was 26% less than that of the normal concrete columns. The compressive strength of the rubberized concrete at 20% replacement dropped as much as 57%; however, adding silica fume improved compressive strength significantly. The SEM images confirmed the absence of bonding at the rubber-cement interface. Coating NPTFs on the rubber crumbs unveiled little improvement on bonding.

Conclusions/Discussion

The rubberized concrete demonstrated superb dynamic properties in free vibration and seismic shaking tests. Introducing silica fume on the aggregate#s surface is an effective way to improve compressive strength and elasticity. The SEM images unveiled reasons for the compressive strength loss. Overall, the experimental results show that the proposed rubberized silica fume concrete is promising. As a new construction material, it has its niche because of its superior performance in absorbing kinetic energy and reducing impact. Furthermore, the rubberized silica fume concrete is a future green material.

Summary Statement

Rubberized silica fume concrete shows potential as a new construction material based on its superior dynamic performance in absorbing energy and reducing impact.

Help Received

Used lab equipment at University of California, Irvine under the supervision of Dr. Masanobu Shinozuka