Announcing the Final Examination of Mohammad Khawaji for the degree of Doctor of Philosophy

Time & Location: November 4, 2019 at 8:00 AM in ENG-2 211P  
Title: MECHANICAL STUDY ON EDGE-OXIDIZED GRAPHENE OXIDE (EOGO) REINFORCED CONCRETE

This study experimentally investigates not only effects of edge-oxidized graphene oxide (EOGO) on properties of concrete as additive but also mechanical performance of EOGO-fiber reinforced concrete. It was known that superior mechanical properties of graphene oxide (GO) can significantly enhance mechanical properties of cement composites. However, conventional graphene oxide (GO) produced by Hummer’s method has been limited to small-scale research but not concrete applications due to their high cost and the large volume of concrete. The EOGO is a low-cost carbon-based nanomaterial produced by a mechanochemical process with ball milling and non-toxic oxidizing agent. This low cost of EOGO enables its use in practical concrete structures. In this study, EOGO was applied to concrete to investigate both mechanical and workability performance of EOGO reinforced concrete. Interestingly, it was observed that addition of EOGO to normal concrete improves the workability of concrete, which is opposite to the conventional GO study on cement paste. To maximize the benefit of increased workability, EOGO was then applied to fiber reinforced concretes (FRCs) to compensate their low workability. Two different types of fibers were used: basalt fibers and steel fibers. The test results indicate that the EOGO is not effective on basalt fiber reinforced concrete (BFRC) probably due to the high absorption of basalt fibers. On the other hand, adding EOGO to steel fiber reinforced concrete (SFRC) show significant enhancement in both workability and strength compared with control specimens. Subsequently, the effect of EOGO on flexural fatigue behavior of cement composite mixtures (cement mortar and concrete) was investigated. The flexural fatigue results show that adding EOGO to cement composites enhances their flexural fatigue performance. Lastly, the impact of EOGO on pavement structure was investigated with respect to service life and design thickness based on Mechanistic-Empirical Design Guide (MEPDG). The results show the EOGO reinforced concretes significantly extend the service life and minimize the required thickness of surface layer.

Major: Civil Engineering

Educational Career:
Bachelor's of Civil Engineering, BS, 2005, King Saud University
Master's of Civil Engineering, MS, 2012, King Saud University

Committee in Charge:
Boo Hyun Nam, Chair, Civil, Environmental, and Construction Engineering
Manoj Chopra, Civil, Environmental, and Construction Engineering
Ricardo Zaurin, Civil, Environmental, and Construction Engineering
Kawai Kwok, Mechanical and Aerospace Engineering

Approved for distribution by Boo Hyun Nam, Committee Chair, on October 14, 2019.

The public is welcome to attend.