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 (EGO) REINFORCED CONCRETE

This study experimentally investigates not only effects of edge-oxidized graphene oxide (EGO) on properties of concrete as additive but also mechanical performance of EGO-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 EGO is a low-cost carbon-based nanomaterial produced by a mechanochemical process with ball milling and non-toxic oxidizing agent. This low cost of EGO enables its use in practical concrete structures. In this study, EGO was applied to concrete to investigate both mechanical and workability performance of EGO reinforced concrete. Interestingly, it was observed that addition of EGO 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, EGO 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 EGO is not effective on basalt fiber reinforced concrete (BFRC) probably due to the high absorption of basalt fibers. On the other hand, adding EGO to steel fiber reinforced concrete (SFRC) show significant enhancement in both workability and strength compared with control specimens. Subsequently, the effect of EGO on flexural fatigue behavior of cement composite mixtures (cement mortar and concrete) was investigated. The flexural fatigue results show that adding EGO to cement composites enhances their flexural fatigue performance. Lastly, the impact of EGO on pavement structure was investigated with respect to service life and design thickness based on Mechanistic-Empirical Design Guide (MEPDG). The results show the EGO reinforced concretes significantly extend the service life and minimize the required thickness of surface layer.

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

The public is welcome to attend.