Self-sensing capacity of ultra-high performane fiber-reinforced concrete with coductive nano-fillers

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This study investigated the feasibility of using ultra-high-performance fiber-reinforced concrete (UHPFRC) with conductive nano-fillers as a self-sensing material. To this end, functional fillers should be incorporated into UHPFRC. Four different types of conductive fillers, such as carbon black (CB), nickel powder (NP), graphite powder (GP), and steel slag powder (SP), were considered, and they replaced the mechanical filler, quartz powder (QP) by weight ratios of 5% and 10%. The results showed that overall conductive fillers caused reductions in the tensile strength. Furthermore, the higher the conductive filler's contents, the more strength reduction. This phenomenon was more pronounced in UHPFRC with CB. This was because a number of CB particles with lower density than QP were incorporated in the replacement system by weight ratio. However UHPFRC with 5% of SP and GP showed no significant difference compared to pristine UHPFRC. In the case of self-sensing capacity, 10% of NP and SP showed self-sensing capability in the direct tensile behavior. As a result, 5% of GP was suggested based on the facts of sufficient self-sensing performance and no significant strength reduction. To demonstrate the self-sensing behaviors, the empirical model based on the obtained FCR by nonlinear regression analysis was suggested. This model showed suitable prediction for the pre-peak tensile behaviors. The predicted pre-peak tensile behaviors had smaller errors compared to the experimentally obtained tensile behaviors.