Optimization of Different Properties of Ultra-High Performance Concrete Mixes for Strengthening Purposes

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The current research's purpose is to examine how Ultra-High Performance Fiber Concrete (UHPFC) holds up in terms of strength and durability for strengthening purposes. For this reason, the experimental and the theoretical studies in this research attempted to assess different fresh and hardened properties of a variety of ultra-high performance combinations. Steel fibers were utilized to differentiate all of the program's combinations at percentages of0.25 %, 0.5 %, 0.75 %, 1%, and 1.25 % by volume. Mini flow slump, compressive and flexural strength, ultrasonic pulse velocity, water absorption, and porosity tests were all used to examine the performance of the strength and durability of the material. The findings of this study's trials showed that steel fibers increased the strength of UHPFC. The steel fiber ratio of 1% gave the maximum compressive strength, whereas 1.25 percent yielded the highest flexural strength. Because the fibers function as a bridge, preventing internal breaking, the tensile test results were improved as the proportion of steel fiber rises. Through the use of the multi-objective optimization approach, the optimal ratio of fibers was chosen at the end of the laboratory work since it has the best durability and strength characteristics. Statistical software (Minitab 2018) was used to find the optimal combination of UHPFC that meets all of the requirements. The theoretical selected optimum ratio of0.77% of fibers obtained from the optimization was evaluated and validated experimentally. The optimized mix provided 90.28 MPa, 14.6 MPa, and 20.2 MPa for compressive, splitting tensile and flexural tests respectively with better durability performance compared to other mixes prepared in this investigation.