Developing a Predictive Model of Concrete Performance with Fly Ash and Steel Fiber Using Machine Learning Algorithm

Edgardo S. Cruz *
School of Civil, Environmental, and Geological Engineering, Mapua University, 658 Muralla St., Intramuros, Manila, 1002 Metro Manila, Philippines

Miguel Andrine P. Lagarto
School of Civil, Environmental, and Geological Engineering, Mapua University, 658 Muralla St., Intramuros, Manila, 1002 Metro Manila, Philippines

Jonathan J. Madrazo
School of Civil, Environmental, and Geological Engineering, Mapua University, 658 Muralla St., Intramuros, Manila, 1002 Metro Manila, Philippines

Fay Denise C. Morales
School of Civil, Environmental, and Geological Engineering, Mapua University, 658 Muralla St., Intramuros, Manila, 1002 Metro Manila, Philippines

Abstract

The research paper aims to develop an AI model that predicts the performance of concrete containing Fly Ash and Steel Fiber. Fly Ash is a byproduct of coal combustion in electric power plants, causing environmental concerns due to its sizeable global production. Steel Fiber is a specialized reinforcement material for concrete used in various applications. The study addresses the lack of international guidelines for evaluating concrete with Fly Ash and Steel Fiber performance. The model uses machine learning algorithms and neural networks to forecast key performance metrics such as compressive strength, cracking behavior, and bending stress. The objectives include assessing these properties and building a network model for analysis. This research promotes construction practices by reducing carbon emissions and endorsing Fly Ash and Steel Fiber as eco- substitutes for traditional Portland cement. The AI predictive model can optimize concrete mix designs, predict long-term performance trends, and evaluate environmental factors influencing behavior. It seeks to improve project outcomes, lower testing costs, and advance construction methods. The study examines concrete strength and split tensile strength with Fly Ash and Steel Fiber, emphasizing machine learning techniques for modeling. It also explores how machine learning methods like networks can predict concrete compressive strength. Theoretical frameworks like networks and ensemble learning theory are introduced to enhance accuracy. The methodology section provides insights into research design elements, data collection procedures, instruments used, and statistical analyses applied in developing the model. A quantitative approach was used to gather data and conduct analyses. The research took place at Mapua University laboratory using a Universal Testing Machine and AI tools.

Keywords

Machine Learning, Algorithm, Confusion Matrix, Multivariate Regression, Fly Ash, Steel Fiber.