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### Predicting the splitting tensile strength of manufactured-sand concrete containing stone nano-powder through advanced machine learning techniques

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#### Abstract

The extensive utilization of concrete has given rise to environmental concerns, specifically concerning the depletion of river sand. To address this issue, waste deposits can provide manufactured-sand (MS) as a substitute for river sand. The objective of this study is to explore the application of machine learning techniques to facilitate the production of manufactured-sand concrete (MSC) containing stone nano-powder through estimating the splitting tensile strength (STS) containing compressive strength of cement (CSC), tensile strength of cement (TSC), curing age (CA), maximum size of the crushed stone (Dmax), stone nano-powder content (SNC), fineness modulus of sand (FMS), water to cement ratio (W/C), sand ratio (SR), and slump (S). To achieve this goal, a total of 310 data points, encompassing nine influential factors affecting the mechanical properties of MSC, are collected through laboratory tests. Subsequently, the gathered dataset is divided into two subsets, one for training and the other for testing; comprising 90% (280 samples) and 10% (30 samples) of the total data, respectively. By employing the generated dataset, novel models were developed for evaluating the STS of MSC in relation to the nine input features. The analysis results revealed significant correlations between the CSC and the curing age CA with STS. Moreover, when delving into sensitivity analysis using an empirical model, it becomes apparent that parameters such as the FMS and the W/C exert minimal influence on the STS. We employed various loss functions to gauge the effectiveness and precision of our methodologies. Impressively, the outcomes of our devised models exhibited commendable accuracy and reliability, with all models displaying an R-squared value surpassing 0.75 and loss function values approaching insignificance. To further refine the estimation of STS for engineering endeavors, we also developed a user-friendly graphical interface for our machine learning models. These proposed models present a practical alternative to laborious, expensive, and complex laboratory techniques, thereby simplifying the production of mortar specimens.