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Section Information

Civil Engineering once encompassed all non-military engineering and, as such, is a very wide-ranging subject area. Today, it covers all things big—bridges, buildings, foundations, dams, rivers, water distribution networks, roads, transportation networks and a significant element of general technical management. This Section welcomes original contributions to all relevant subject areas of Applied Sciences. As there are already specialist journals in many of these areas, we particularly welcome contributions that do not easily fall into any one discipline or emerging areas that do not yet have their own journals.

In recent decades, there has been a surge in computing power while the cost of electronics and sensing technologies has fallen. We particularly welcome contributions that exploit the opportunities that these developments have made possible.

Selected Papers

DOI:10.3390/app122211734

Normal-Weight Concrete with Improved Stress–Strain Characteristics Reinforced with Dispersed Coconut Fibers

Authors: Evgenii M. Shcherban', Sergey A. Stel'makh, Alexey N. Beskopylny, Levon R. Mailyan, Besarion Meskhi, Alexandr A. Shilov, Andrei Chernil'nik, Yasin Onuralp Özkılıç and Ceyhun Aksoylu

Abstract: According to the sustainable development concept, it is necessary to solve the issue of replacing fiber from synthetic materials with natural, environmentally friendly, and cheap-to-manufacture renewable resources and agricultural waste. Concrete is the primary material for which fibers are intended. Therefore, the use of vegetable waste in concrete is an essential and urgent task. Coconut fiber has attracted attention in this matter, which is a by-product of the processing of coconuts and makes it relevant. This work aims to investigate the experimental base for the strength properties of dispersed fiber-reinforced concrete with coconut fibers, as well as the influence of the fiber percentage on the mechanical, physical, and deformation characteristics. The samples were made of concrete with a compressive strength at 28 days from 40 to 50 MPa. The main mechanical characteristics such as strength in compression (cubic and prismatic) and tension (axial and bending), as well as the material's compressive and tensile strains, were investigated. The percentage of reinforcement with coconut fibers was taken in the range of 0% to 2.5% with an increment of 0.25 wt.%. Tests were carried out 28 days after the manufacture. The microstructure of the resulting compositions was investigating using the electron microscopy method. The most rational percentage of coconut fibers was obtained at 1.75%. The increase in mechanical indicators was 24% and 26% for compression and axial compression, respectively, and 42% and 43% for tensile bending and axial tension, respectively. The ultimate strains in compression were raised by 46% and in tension by 51%. The elastic modulus was increased by 16%.

DOI:10.3390/app12125992

Landslide Susceptibility Assessment by Using Convolutional Neural Network

Authors: Shahrzad Nikoobakht, Mohammad Azarafza, Haluk Akgün and Reza Derakhshani

Abstract: This study performs a GIS-based landslide susceptibility assessment using a convolutional neural network, CNN, in a study area of the Gorzineh-khil region, northeastern Iran. For this assessment, a 15-layered CNN was programmed in the Python high-level language for susceptibility mapping. In this regard, as far as the landside triggering factors are concerned, it was concluded that the geomorphologic/topographic parameters (i.e., slope curvature, topographical elevation, slope aspect, and weathering) and water condition parameters (hydrological gradient, drainage pattern, and flow gradient) are the main triggering factors. These factors provided the landside dataset, which was input to the CNN. We used 80% of the dataset for training and the remaining 20% for testing to prepare the landslide susceptibility map of the study area. In order to cross-validate the resulting map, a loss function, and common classifiers were considered: support vector machines, SVM, k-nearest neighbor, k-NN, and decision tree, DT. An evaluation of the results of the susceptibility assessment revealed that the CNN led the other classes in terms of 79.0% accuracy, 73.0% precision, 75.0% recall, and 77.0% f1-score, and, hence, provided better accuracy and the least computational error when compared to the other models.

DOI:10.3390/app122211744

Composition Component Influence on Concrete Properties with the Additive of Rubber Tree Seed Shells

Authors: Alexey N. Beskopylny, Evgenii M. Shcherban', Sergey A. Stel'makh, Besarion Meskhi, Alexandr A. Shilov, Valery Varavka, Alexandr Evtushenko, Yasin Onuralp Özkılıç, Ceyhun Aksoylu and Memduh Karalar

Abstract: The growth in the volume of modern construction and the manufacture of reinforced concrete structures (RCSs) presents the goal of reducing the cost of building materials without compromising structures and opens questions about the use of environmentally friendly natural raw materials as a local or full replacement of traditional mineral components. This can also solve the actual problem of disposal of unclaimed agricultural waste, the features of which may be of interest to the construction industry. This research aimed to analyze the influence of preparation factors on concrete features with partial substitution of coarse aggregate (CA) with rubber tree (RT) seed shells and to determine the optimal composition that can make it possible to attain concrete with improved strength features. CA was replaced by volume with RT seed shells in an amount from 2% to 16% in 2% increments. Scanning electronic microscopy was employed to investigate the structure of the obtained concrete examples. The maximum increase in strength features was observed when replacing coarse filler with 4% RT seed shell by volume and amounted to, for compressive and axial compressive strength (CS) and tensile and axial tensile strength (TS) in twisting, 6% and 8%, respectively. The decrease in strain features under axial compression and under axial tension was 6% and 5%, respectively. The modulus of elasticity increased to 7%. The microstructure of hardened concrete samples with partial replacement of CA with RT seed shells in the amount of 2%, 4% and 6% was the densest with the least amount of pores and microcracks in comparison with the structure of the sample of the control composition, as well as samples with the replacement of CA with RT seed shells in an amount of more than 6%. The expedient effective replacement of CA with RT shells led to a reduction in battered stone of up to 8%.

DOI:10.3390/app12042126

Geospatial Modeling Based-Multi-Criteria Decision-Making for Flash Flood Susceptibility Zonation in an Arid Area

Authors: Maaz Amjad, Irshad Ahmad, Mahmood Ahmad, Piotr Wróblewski, Paweł Kamiński and Uzair Amjad

Abstract: The major criteria that control pile foundation design is pile bearing capacity (Pu). The load bearing capacity of piles is affected by the various characteristics of soils and the involvement of multiple parameters related to both soil and foundation. In this study, a new model for predicting bearing capacity is developed using an extreme gradient boosting (XGBoost) algorithm. A total of 200 driven piles static load test-based case histories were used to construct and verify the model. The developed XGBoost model results were compared to a number of commonly used algorithms—Adaptive Boosting (AdaBoost), Random Forest (RF), Decision Tree (DT) and Support Vector Machine (SVM) using various performance measure metrics such as coefficient of determination, mean absolute error, root mean square error, mean absolute relative error, Nash–Sutcliffe model efficiency coefficient and relative strength ratio. Furthermore, sensitivity analysis was performed to determine the effect of input parameters on Pu. The results show that all of the developed models were capable of making accurate predictions however the XGBoost algorithm surpasses others, followed by AdaBoost, RF, DT, and SVM. The sensitivity analysis result shows that the SPT blow count along the pile shaft has the greatest effect on the Pu.

DOI:10.3390/app12031374

Composition Component Influence on Concrete Properties with the Additive of Rubber Tree Seed Shells

Authors: Younes Hamishebahar, Hong Guan, Stephen So and Jun Jo

Abstract: The application of deep architectures inspired by the fields of artificial intelligence and computer vision has made a significant impact on the task of crack detection. As the number of studies being published in this field is growing fast, it is important to categorize the studies at deeper levels. In this paper, a comprehensive literature review of deep learning-based crack detection studies and the contributions they have made to the field is presented. The studies are categorised according to the computer vision aspect and at deeper levels to facilitate exploring the studies that utilised similar approaches to address the crack detection problem. Moreover, the authors perform a comparison between the studies which use the same publicly available data sets, in order to find the most promising crack detection approaches. Critical future directions for research are proposed, based on these reviewed studies as well as on trends and developments in areas similar to the crack detection area.

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