

GIS-Based geotechnical microzonation mapping using Analytic Hierarchy Process (AHP), a case study in Shire-Endasilasie city, Tigray, Ethiopia

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Abstract

Shire-Endasilasie City is chosen as a study area and this city is one of the rapidly growing cities in Tigray, Northern Ethiopia. As a result of the increase in population number in the city, there is a higher demand on new residential areas and people are moving to hillsides and previous farm lands on the city sides and are constructing several residential buildings prior to evaluation of geotechnical factors which determine the suitability of the foundation of residential areas. The main objective of this study is to develop a Geographic Information System (GIS) based geotechnical microzonation model/map using Analytic Hierarchy Process (AHP). The geotechnical influencing factors considered as model inputs are (i) slope gradient, (ii) bed rock and soil type, (iii) swelling potential of soil and (iv) depth to groundwater level. The factors and the classes within each factor are assigned weight and rank values respectively. To avoid subjectivity, the assignment of weight and rank values and the analysis are done by the application of multicriteria decision analysis model, namely, Analytic Hierarchy Process (AHP) method. From the weight and rank values of the data layers, geotechnical suitability indices were calculated using a Weighted Linear Combination (WLC) model in GIS. These continuous numerical index values have been divided into different classes depending on their suitability as foundation for residential areas and result in a geotechnical suitability map with three classes, namely, (i) less suitable for foundation of a settlement area, (ii) moderately suitable for foundation of settlement area, and (iii) more suitable for foundation of settlement area. The classification result implies that the less suitable zone represents areas requiring detailed geotechnical investigation to be used as foundations for residential area; the moderately suitable zone is a provisional settlement area, whereas the more suitable zone is very suitable for settlement.

Keywords: Shire-Endasilasie; Geographical Information Systems (GIS); Analytic Hierarchy Process (AHP); Geotechnical microzonation model