

## Numerical Analysis and Parametric Study of Granular Anchor Pile on Expansive Soil Using Finite Element Method: Case of Addis Ababa, Bole Sub-City

**Authors :** Abdurahman Anwar Shfa

**Abstract :** Addis Ababa is among the fastest-growing urban areas in the country. There are many new constructions of public and private condominiums and large new low rising residential buildings for residents. But the wide range of heaving problems of expansive soil in the city become a major difficulty for the construction sector, especially in low rising buildings, by causing different problems such as distortion and cracking of floor slabs; cracks in grade beams, and walls, jammed or misaligned Doors and Windows; failure of blocks supporting grade beams. Hence an attractive and economical design solution may be required for such type of problem. Therefore, this research works for publicizing a recent innovation called Granular Anchor Pile system for the reduction of the heave effect of expansive soil. This research is written for the objective of numerical investigation of the behavior of Granular Anchor Pile under the heave using Finite element analysis PLAXIS 3D program by means of studying the effect of different parameters like length of the pile, Diameter of Pile and Pile group by applying prescribed displacement of 10% of pile diameter at the center of granular pile anchor. An additional objective is examining the suitability of Granular Anchor Pile as an alternative solution for heave problems in expansive soils mostly for low rising buildings found in Addis Ababa city, especially in Bole Sub-City, by considering different factors such as the Local availability of construction materials, Economy for the construction, Installation process condition, Environmental benefit, Time consumption and performance of the pile. Accordingly, the performance of the pile improves when the length of the pile increases. This is due to an increase in the self-weight of the pile and friction mobilized between the pile and soil interface. Additionally, the uplift capacity of the pile decreases when increasing the pile diameter and spacing between the piles in the group due to a reduction in the number of piles in the group. But, few cases show that the uplift capacity of the pile increases with increasing the pile diameter for a constant number of piles in the group and increasing the spacing between the pile and in case of single pile capacity. This is due to the increment of piles' self-weight and surface area of pile group and also the decrement of stress overlap in the soil caused by piles respectively. According to the suitability analysis, it is observed that Granular Anchor Pile is sensible or practical to apply for the actual problem of Expansive soil in a low rising building constructed in the country because of its convenience for all considerations.

**Keywords :** expansive soil, granular anchor pile, PLAXIS, suitability analysis

**Conference Title :** ICACE 2024 : International Conference on Architectural and Civil Engineering

**Conference Location :** Rome, Italy

**Conference Dates :** October 10-11, 2024