STUDY ON THE PARTIAL REPLACEMENT OF SOFT SOILS UNDER SHALLOW FOUNDATIONS

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Soft soil replacement is a widely used technique in ground improvement to enhance the subsurface conditions beneath shallow foundations which involves replacing weak and unstable soil types like peat, organic soils, and soft clay with more reliable and competent materials such as crushed concrete, granular soil, or rock boulders. By implementing a soil replacement approach, the bearing capacity of the footing is increased, while the expected settlement is reduced. This leads to improved overall stability and performance of the foundation system. However, there are many instances where the depth to the hard layer is significant and replacing the entire weak soil is not feasible, because of the high costs involved. For relatively small-scale projects, using other ground improvement techniques or deep foundations might not be cost-effective. So partial replacement is a feasible solution.

This paper presents the research on partial soft soil improvement under shallow foundations varying the width and depth of the replacement, soft soil properties, and replacement materials. A two-dimensional plane strain model is developed using the finite element (FE) program, PLAXIS 2D. To ensure its accuracy, the model is initially validated by comparing its results with known cases by Zukri et al., (2018). The constitutive model chosen to represent the soil's behaviour was the Mohr-Coulomb model. The replacement depth is changed to 1B, 2B, and 3B, while the replacement width is adjusted to 1.25B, 1.5B, and 2B. In this context, B represents the width of the footing, which is 1 meter. Then settlement values were obtained from the model. Rock boulders and granular soil were taken as fill materials to evaluate the effect of the replacement material. To examine the influence of the characteristics of the soft soil, Young's modulus, cohesion, and friction angle of the soft soil were adjusted and stiff clay was utilised in place of soft clay.

The introduction of partial replacement techniques leads to a decrease in settlement. Based on the obtained results, it is concluded that increasing the width and depth of the replacement leads to a decrease in settlement. By comparing settlement values, it indicates that there is a significant reduction in the settlement when the replacement width is increased up to 1.25 times the footing width. So, increasement beyond 1.25B will not affect more. Therefore, replacement should be conducted at least up to 1.25B. Increasing the depth of partial replacement results in the reduction of the settlement. However, there is a significant reduction in settlement when the ground depth is improved up to 2 times the footing width (2B). Further improvements beyond 2B do not have a significant impact. Therefore, it is recommended to carry out replacement up to a depth of 2B. The foundation's condition can be enhanced by replacing some of the soft soil with more competent materials, such as granular soil or rock boulders.

Keywords: Partial Replacement, Shallow Foundations, Ground Improvement, Finite Element Method, PLAXIS 2D

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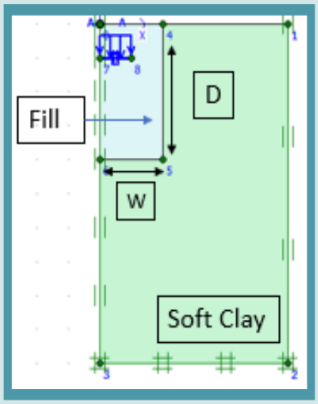
MAIN AIM:

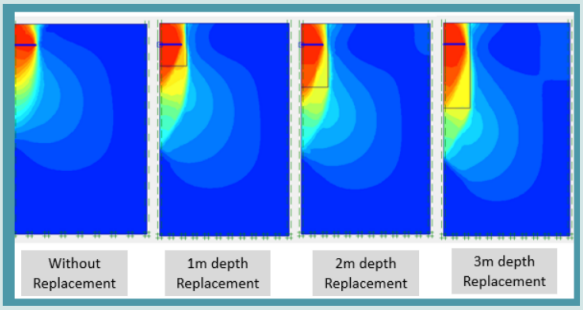
Proposing a set of guidelines/recommendations for partial replacement of soft soils under shallow foundations

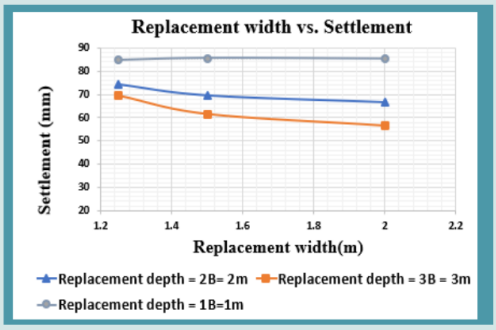
Literature Review → **FE Model Validation** → **Developing FE Models varying** - Depth and width of replacement -Replacement material - Soft soil properties → **Conclusion & Recommendations**

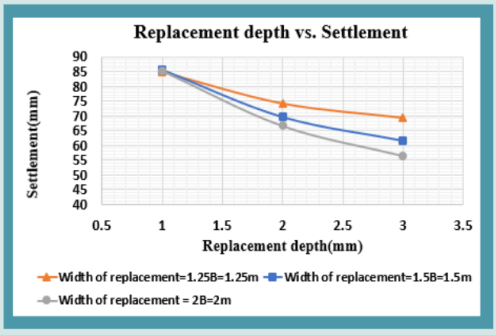


FE Model

- PLAXIS 2D software
- 2m strip footing - Plane strain idealization
- Footing - 01m below the ground level
- Water table - below the footing level







Recommendations

- replacement width of 1.25 times and replacement depth of 2 times the width of the footing
- granular soil or rock boulders as replacement materials