MOBILISATION OF NEGATIVE SKIN FRICTION THROUGH SOFT SOIL SANDWICHED BETWEEN STIFF RESIDUAL SOIL LAYERS

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Negative skin friction (NSF) is a common problem for a pile foundation in soft soil arises when soil settles more than the pile. Negative skin friction induces an additional compressive axial force (Drag load) and an additional settlement (Down drag). This would lead to structural and serviceability problems. The drag load depends on the location of the neutral plane(NP) and the distribution of negative skin friction throughout the pile. Negative skin friction is influenced by many factors. This research is based on the investigation of the mobilization of negative skin friction with the change of soil layer thicknesses, for a soil profile of soft soil overlying a stiff residual soil (TOP) & soil profile of soft soil sandwiched between stiff residual soil layers (SANDWICHED). A two-dimensional axisymmetric model is built using the finite element program, PLAXIS 2D. Pile was modelled as a volume element and a wished-in-place pile. The verification of the model was conducted using a known case by Indraratna et al., (1992) which was conducted for soft Bangkok clay. The position of the neutral plane and the magnitude of drag load is analyzed with the change of soft soil layer thickness for different pile diameters, with and without an axial load on the pile.

The position of NP varies within 0.85T -1T (where T is the soft soil layer thickness) with the change of soil layer thickness in both soil profiles when an axial load is applied on the pile. When the pile is not loaded NSF mobilizes through the residual soil layer as well. i.e. the NP lies at the residual soil layer. There is not a significant variation in the position of NP for a particular layer thickness with the change in the diameter of the pile. NP and the distribution of NSF do not have a significant effect on the change in the magnitude of the axial load applied, if the axial load $\neq 0$. The model results have a deviation in a range of 10-48% with the values obtained from the guidelines proposed in CIDA for the soil profile of soft soil overlying a stiff residual soil (TOP) and the deviation is less than 20% for the & soil profile of soft soil sandwiched between stiff residual soil layers (SANDWICHED).

The settlement of the pile is smaller when a load is not applied on the pile. Hence, the settlement of soil is significant. When a load is applied on the pile both the settlement and axial shortening of the pile are significant compared to the settlement of the residual soil layer. Thus, the NP occurs within the soft soil layer.

Bituminous coatings can be used to reduce the mobilization of NSF. Since both the NP and drag load can be reasonably obtained from the FEM model, the effectiveness of bituminous coating can also be assessed using FEM. It can be stated that the FEM analysis can be used to predict the variation of NSF with reasonable accuracy.

Keywords: Negative Skin Friction; Soft soil; Residual soil; Layer thickness; Finite Element Method; PLAXIS 2D

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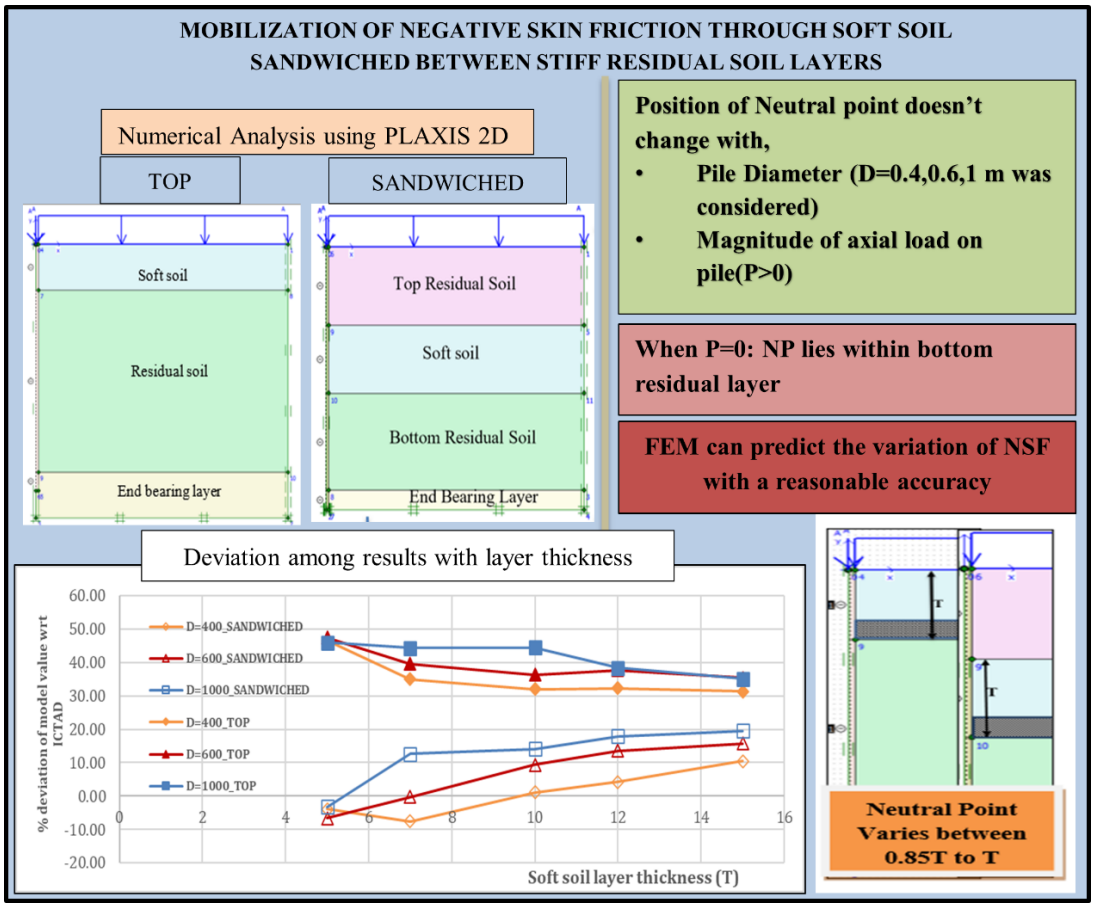
MOBILIZATION OF NEGATIVE SKIN FRICTION THROUGH SOFT SOIL SANDWICHED BETWEEN STIFF RESIDUAL SOIL LAYERS
Numerical Analysis using PLAXIS 2D
TOP
SANDWICHED
Soft soil
Residual soil
End bearing layer
Top Residual Soil
Soft soil
Bottom Residual Soil
End Bearing Layer
Position of Neutral point doesn't change with,
• Pile Diameter (D=0.4,0.6,1 m was considered)
• Magnitude of axial load on pile(P>0)
When P=0: NP lies within bottom residual layer
FEM can predict the variation of NSF with a reasonable accuracy
Deviation among results with layer thickness
% deviation of model value wrt ICTAD
Soft soil layer thickness (T)
D=400_SANDWICHED
D=600_SANDWICHED
D=1000_SANDWICHED
D=400_TOP
D=600_TOP
D=1000_TOP
T
Neutral Point Varies between 0.85T to T