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Study of Soil Nailing Using Plaxis 3d

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Abstract: *Nowadays, several transportation departments are in work progress, to cope up with the system growth by considering various major roadways construction plan in Ghat-section roadways, major infrastructure improvements to their highways. With the increasing population roadways are being expanded by area, roads are stream line to common connect. This becomes complex when irregular earth surface exists like Ghat section, hill station etc. to construct the roadways and other infrastructure. Earth retaining walls have been always supportive, to construct or rigidly hold the construction material or to give supportive form. This project helps in investigating of soil nailing while constructing a infrastructure by modelling & solving a Finite element analysis. The design of such system particularly, for the soil nail wall is done using computer program Plaxis 3d software, the prospective of this research study is to examine the adequacy of the current method recommended, also to develop a design procedure for the hybrid wall system, which will address the shortcomings in the currently used methods in practice. This project will be solved using finite element analysis which will address not only the stability of structure but also the deformation due to nailing in the wall when the force transfers in the reinforcement.*

Keywords *- Soil nailing system; nails characteristics; soil slope; surcharge loading; nails orientation*

I. INTRODUCTION

Soil nailing is method or technique emphases passive reinforcement commonly (reinforcing bars) insertion of slender elements to the retaining wall or soil slopes or excavation. Such element provides load to the ground in excavation reinforcement application called reinforcement. Soil nailing is done typically when the ground inclination is about 10-20 degree from horizontal surface, subjected to tensile stress.

Tensile stress will be applied to the nails in in response investigation of the deformation of the retained material during the process. Soil nailing is done to stabilize existing slopes were, top-bottom construction is advantageous, compared to other retaining walls. As the construction proceeds, concreate will be applied on the excavation face to provide continuity. Fig. 1.2 depicts cross section of a grouted nailed wall along with some field photographs of the same in Fig. 1.3. In the present era, soil nailing is being carried out at large in railway construction work for the stabilization of side lopes in existing track-road or laying of new tracks adjoining to an existing one (Fig. 1.4)

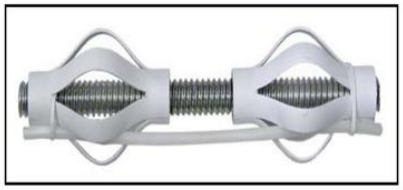

Figure 1.1.1 soil nail with centralizers

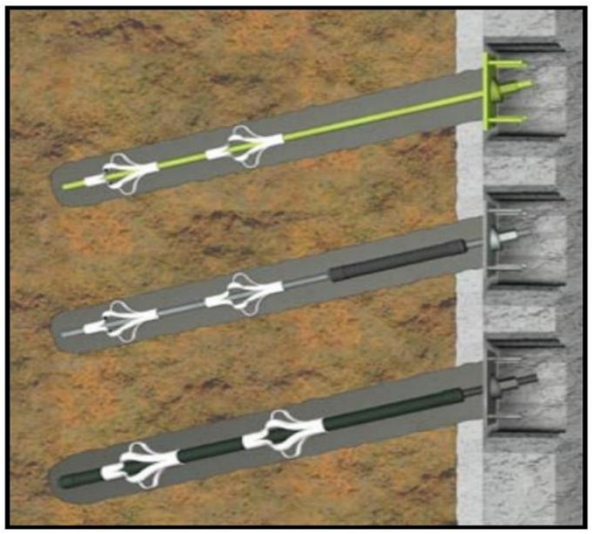

Figure 1.1.2 cross-section of grouted soil nailed wall

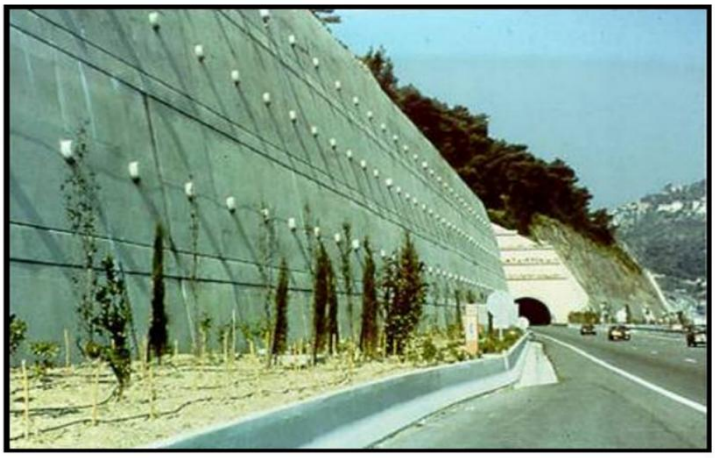

Figure 1.1.3 application of soil nailed wall

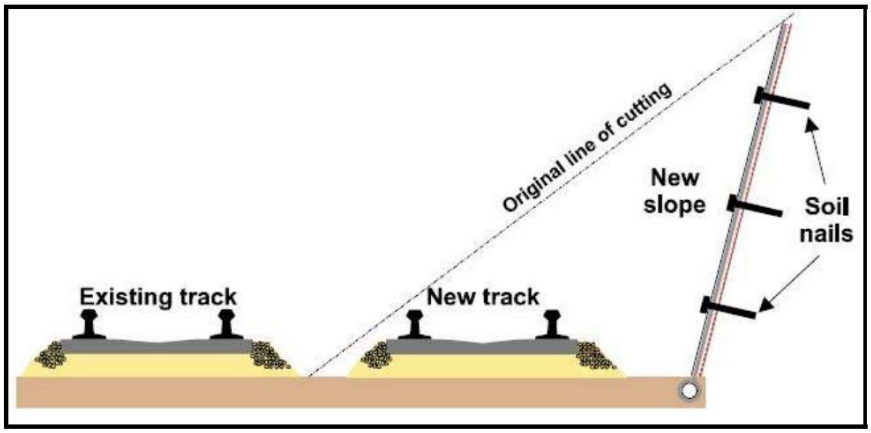

Figure 1.1.4 soil nailing in railway construction for laying new tracks adjoining1.1 various types of soil nailing

1.2 Various types of soil nailing methods are employed in the field

1. Grouted nail
2. Driven nail
3. Self-drilling soil nail
4. Jet-grouted soil nail
5. Launched soil nail

1.3 Elements of nailed structure

1. Steel reinforcing bars
2. Centralizers
3. Grout
4. Nail head
5. Hex nut, washer, and bearing plate
6. Temporary and permanent facing
7. Drainage system
8. Corrosion protection

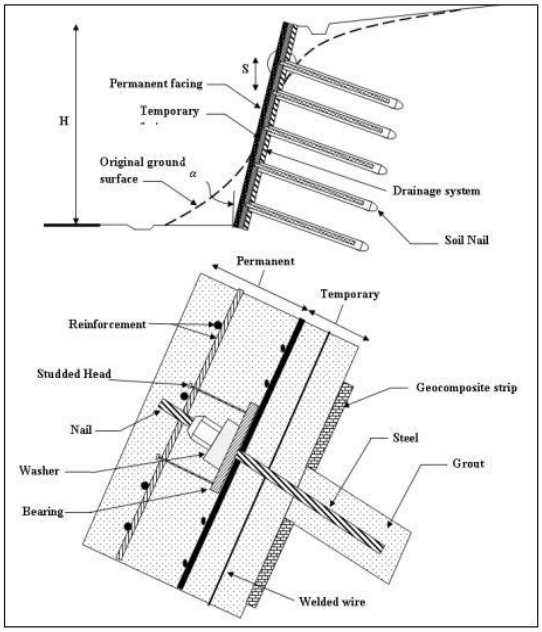

Figure 1.3 typical cross-section of a drilled soil nail wall

1.4.0 Advantage and disadvantage of soil nailing

Some of the advantages & limitation of the soil nailing procedure are listed below.

1. Less disruptive.
2. Installation is really fast & required less construction material.
3. It has field adjustment & less expensive
4. Soil nails requires smaller right of way compared to ground anchors.
5. More economical than conventional gravity walls.

1.4.1 Disadvantages are.

1. Required soil deformation to mobilize resistance.
2. This technique is not suitable for grounds with high ground water.
3. To install this the ground, need to be drilled, hence there is chance of damaging buried water pipes, underground cables and drainage systems

1.5 Various issues affecting soil nailed slope

There are several factors which affect feasibility and stability of nailing in ground.
Favorable ground condition
External stability
Internal stability

1.6 Construction procedure of nailed structure

Soil nailed structures are generally constructed in stages and it involves following steps:

- Excavation till the depth where nails will be installed at a particular level
- Drilling nail holes
- Nail installation and grouting
- Construction of temporary shotcrete facing

1.7 Testing and inspection

Soil nailing for slope or excavation involves various tests and monitoring at different stage of construction.

- Before construction-
- During construction-
- Performance monitoring

1.8 Problem Statement

Soil nailing is method of facilitating the stabilization of an inclined slope wall. With the fast-growing development in the field of infrastructure, transportation & other structures, our land has become scarce. Hence, the utilization of weak & unstable ground wall needs to be nailed for high strength rigidity. Accordingly, most of the techniques has been came in to market for this situation but none cancan counters this problem.

1.9 Scope of project

This paper is an investigation in knowing soil nailing process in inclined slope of a wall with different types available against conventional soil nails which are being used from last years. To achieve these 3 different variations of soil nails will manufactured named as

Smooth, screw & helical soil nails.

1.10 Objective

1) Designing and calculating the dimensional stability of Soil Nailing

2) Find the value of Safety Factor for the stability for Soil Nailing using software

3) To design of soil nailed wall is affected by the following factors: Nail properties (length, spacing and inclination) ,Soil properties (shear strength parameters) ,Wall inclination ,Bond strength of the grout

1.11 Presentation of Research Work

The study undertaken for this dissertation has been covered in five chapters.

Chapter l: Introduction

The first chapter is of introduction and description is presented on various types of soil nailing, its elements, construction methods, testing and field inspection method. Advantage, disadvantage and applicability of soil nailing are also discussed.

Chapter 2: Literature Review

The second chapter is of literature review in which research work done on soil nailing Analysis is presented

Chapter 3: Methodology

This chapter deals with the parametric details of the model, configuration and plan layout of the structures and parameters for analysis.

Chapter 4: Results and Discussions

This chapter contains details about the results obtained from the analysis and their interpretation in the form of tables and graphs.

Chapter 5: Conclusions

This chapter contains the conclusions of the various results obtained from the analysis along with scope for future work.

References

This contains the references which have been used in the present study.

Research gap

Several paper have been read & idea of implementing soil nailing for vertical inclined walls has been propagated.

II. METHODOLOGY

1. Finite element analysis
a. PLAXIS 3D design & solution
2. Soil layer & structural elements
a. Soil layers
b. Fixed end anchor element
c. Beams
d. Plates
e. Interfaces

2. Procedure used for Simulation and Analysis of Project

Following flowchart explains procedure adopted for the simulation of each model having unique position of tunnel with respect to pile foundation of building.

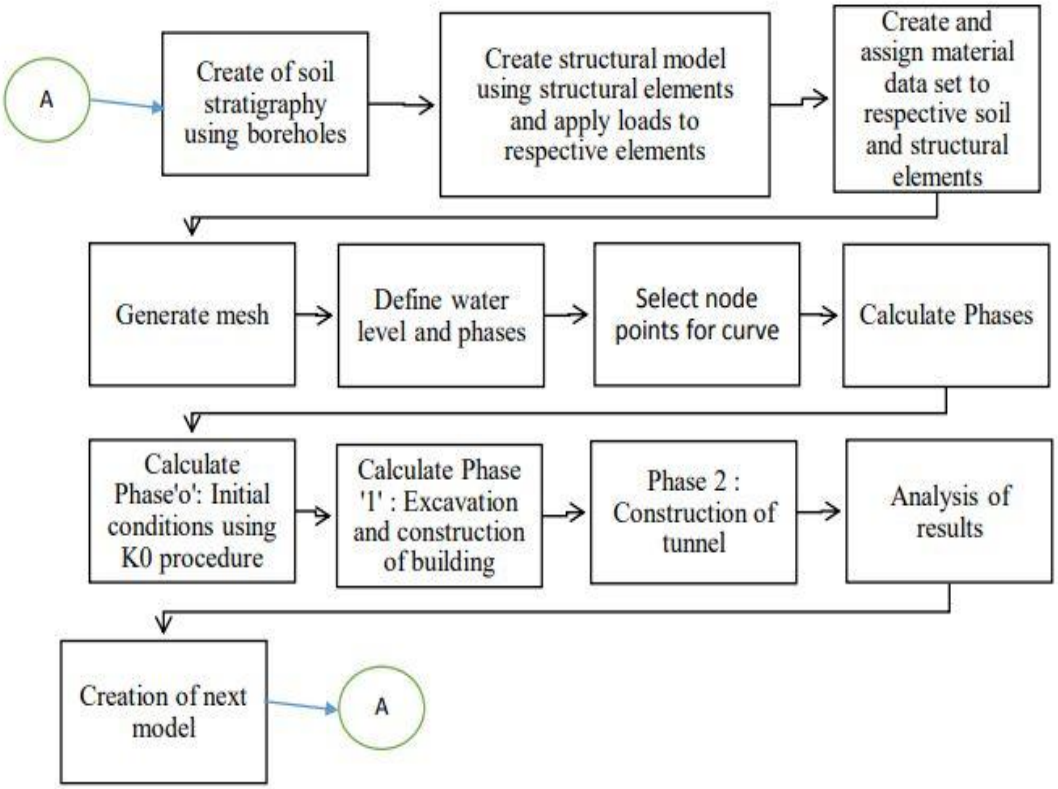

Figure 3.1 Flow chart showing procedure used for Simulation and Analysis of Project

2.2 Details of Current Model

The soil model created for model closely resembles with soil stratigraphy found in Pune region. Pune city soil is mostly made of sandy clay, loam and the fractured basalt rock. The clay properties vary along with depth up to 30 m deep, then starts fractured basalt rock extending to a large depth

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