

STUDY OF SOIL STABILIZATION BY SOIL NAILING
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Abstract

Soil nailing is a ground stabilization method that can be used for stabilization of side face of soil slopes. It is an alternative for retaining wall. This method includes drilling for inserting bars. Soil nailing is an in-situ reinforcement technique by steel bars which can withstand tensile forces, bending moments and shear moments. This method is used for retaining walls structure and also for slope stabilization in natural as well as in excavation pits. In this technique, the soil nail is then grouted with grout mix and it is cover with shotcrete layer. So for overcome the process of landslides in various respected areas, this method is widely used and impleted. Soil nail techniques can reduce landslides problems by inserting steel tendons bars into the soil and anchoring them to the soil strata. It is depending on the complexity of the construction work, soil nailing method can be ranging in between \$80 per square feet and up to \$200 per SF. contractors and engineers will use a software known as Snail Plus for determination of design and layout.

Keywords: Soil Nailing, Snail plus, Software

INTRODUCTION
1.1 General

Soil nailing is a method used to reinforce the soil ground and strengthen existing natural ground or other manmade construction like excavation pits etc. Soil nailing includes installing closely spaced nail bars into a slope or excavation as construction proceeds from top down. This process is effective in respected soil type i.e cohesive soil type, broken rocky soil, face conditions of hill sides. It is an effective and economical method of constructing retaining wall for excavation support, hill cuts, sides of bridge abutments and also high ways. Soil nailing technique evolved from the New Austrian Tunneling method of construction which is a system for underground excavations in rocky and other soft ground. This process includes passive steel nail reinforcement with shotcrete/grouting has also been applied for stabilization of rock slopes. The first application of soil nailing was implemented in 1972 for a railroad widening project near Versailles, France. The technique included installing high-density, grouted soil nails into a 60-ft.-high

1.2 Origin and development

Soil nailing Tunnelling Method is one of the first applications of soil nailing was in 1972, 1960, for a railroad widening project near Versailles, France 60 ft high. The origin of soil nailing can be traced to a support system for underground excavations in rock referred to as the New Austrian cut-slope in sand was stabilized using soil nails. In Germany, the first use of a soil nail wall was in 1975. In India, this technique is gradually increasing and guidelines have been made by IRC with

the help of Indian Institute of Science, Bangabre and now a days this technique is successfully implemented in respected areas.



Fig. 1: Soil Nailing

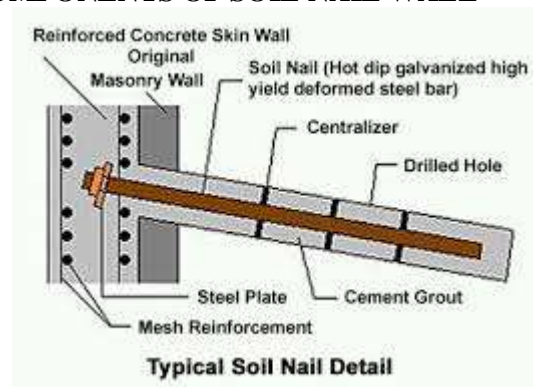
2. COMPONENTS OF SOIL NAIL WALL


Fig 2: Soil Nail Details

2.1 Nail Bars: Steel reinforcing bars used for soil nails are commonly threaded and may be either solid or hollow.



Fig. 3: Nail Bars

2.2 Nail Head: The nail head comprises two main components, the bearing-plate, hex nut, and washers; and the headed-stud. The bearing plate is made steel and is typically square 200- to 250-mm side dimension and 19-mm thick.

2.3 Grout: Grout for soil nails is commonly a neat cement grout, which fills the annular space between the nail bar and the surrounding ground. Sand-cement grout can also be used in conjunction with open hole-drilling



Fig.4: Grout Mix and Mixer

2.4 Centralizers: Centralizers are devices made of polyvinyl chloride (PVC) or other synthetic materials that are installed at various locations along the length of each nail bar to ensure that a minimum thickness of grout completely covers the nail bar. They are installed at regular intervals, typically not exceeding 2.5 m



Fig. 5: Centralizers

3 TYPES OF SOIL NAIL

The types of nails used in the construction of soil nailed walls are as follows:

Drilled and grouted soil nail

Driven soil nails

Launched soil nails

Jet-grouted soil nails

These are explained as follows:

3.1 Drilled and grouted soil nail: In this type of soil nailing, the holes are drilled in walls or slope face and then nails are inserted in the pre-drilled holes. Then the hole is filled with grouting materials such as concrete, shotcrete .

3.2 Launched soil nails: Nails sizes are available between 25 and 38 mm in diameter and having 6 m length.

3.3 Driven soil nails: Driven nailing is used for temporary stabilization of soil slopes in excavation pits i.e. side slopes.. In this techniques , the nails bars are driven in the slope face of existing ground surface area during excavation process. This technique is very fast as compare to

3.4 Jet-grouted soil nails: In this process, jets are utilize for eroding the soil surface for creating holes in the side face of slope surface. Steel nail bars are then installed in this hole and it is grouted

4. EQUIPMENTS USED IN SOIL NAILING:

The following tools or machineries are used for soil nailing:

Drilling Equipments

Grout Mixer Equipments

Shotcreting and Guniting Equipments

Compressor Equipments

They can be broadly explained as below:

4.1 Drilling Equipments: Its air-flushed and water-flushed system. It includes hammer with a tricone bit. It is important to procure drilling equipments with a sufficient requires power



Fig.6 :Drilling Equipment

4.2 Grout Mixer Equipments: This equipment is used to produce uniform grout mix and then it is utilize to cover the drilling holes.



Fig.7: Grout Mixer

4.3 Shotcreting and Guniting Equipments: Dry mix method will require a valve at the nozzle outlet to control the amount of water injecting into the high pressurized flow of sand/cement mix). Fig. 7.

4.4 Compressor: This compressor shall have minimum capacity rate to delivered shotcrete/ at the minimum rate of 9m³/min .



Fig.7: Shotcreting process with compressor

5.MATERIAL USED IN SOIL NAILING

This presents information on construction materials used for the construction of a soil nailed wall. They are:

5.1 Steel Reinforcements: Steel reinforcements are used in the construction of soil nailed walls. For corrosion protection; all steel component shall be galvanized. If machine threading after galvanization is unavoidable, then proper zinc based coating shall be applied onto the thread. For double corrosion protection, the PVC corrugated pipe used shall be of good quality and adequate thickness

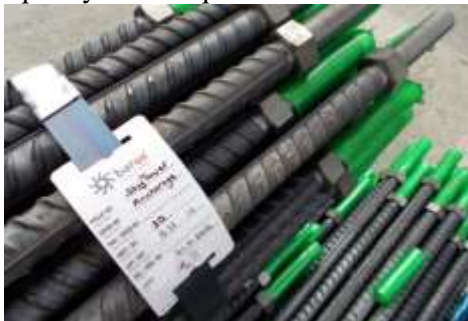


Fig. 8 : Soil Nail Bars

5.2 Grout Mix: Grout is a particularly fluid form of concrete used to fill gaps. Grout is generally a mixture of water, cement, and sand, and is employed in pressure grouting, embedding rebar in masonry walls, connecting sections of pre-cast concrete, filling voids, and sealing joints such as those between tiles

5.3 Shotcrete/Gunite: Shotcrete or gunite can be continuous flow of mortar or concrete mixes projected at high speed perpendicularly onto the exposed ground surface by means of pneumatic air blowing for dry mix or spraying for wet mix.

6.CONSTRUCTION SEQUENCE

The sequence of construction for typical soil nail walls was described in and consisted of:

- a. Excavation
- b. Drilling of nail holes
- c. Installation and grouting nails
- d. Construction of temporary shotcrete facing

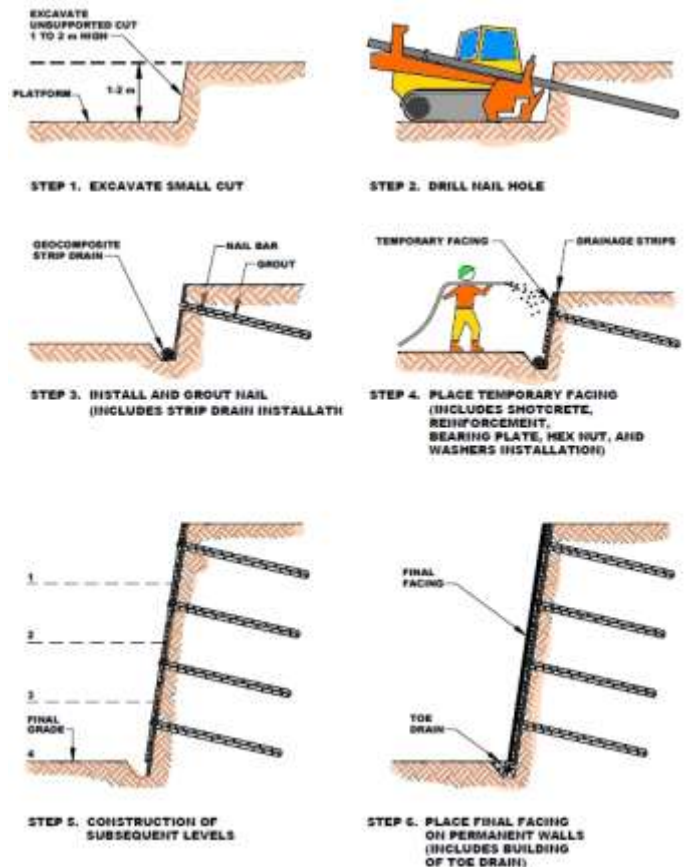


Fig.11: Construction sequence

7.ADVANTAGES :

Soil nails exhibits numerous advantages .some of these advantages are described below:

a) Construction:

1. Installation of soil nail walls is relatively rapid and uses typically less construction materials
2. Less disruptive to traffic and causes less environmental impact compared to other construction techniques

3. Soil nailing is advantageous at sites with remote access because smaller equipment is generally needed

b) Performance:

1. Total deflections of soil nail walls are usually within tolerable limits
2. Soil nail walls are relatively flexible and can accommodate relatively large total and differential settlements

C) Cost:

1. Shotcrete facing is typically less costly
2. Soil nail walls are typically equivalent in cost or more cost-effective than ground anchor walls
3. Soil nail walls are more economical

8.CONCLUSION

Soil nailing is a better solution of landslide problems as it is economical, easy and also successfully implemented in earthquake zones areas .In India also due to its simple and straightforward construction process and it is maintenance free. This method has gained popularity in India for highway , railways, tunnelling and also hillside development construction projects.

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