Analysis and Review on soil Nailing

Arman Ansari[1], Devendra Peshne[2], Shivam Tikle[3], Dinesh Gaidhane[4], Chetan Kapgate[5], Asst. Prof. Kushal Yadav[6]

[1-6]Department of Civil Engineering, Wainganga College of Engineering And Management Wardha Road, Dongargaon, Nagpur, Maharahstra – 44114

Abstract: Slope failure is mainly occur due to natural disaster. This calamity occurs mainly due instability of either slopes or soil. The soil nailing be used in many geotechnical applications. Hence stabilization of such slopes for the safety of people and property are important. It was found that the vertical cut stability improved due to the reinforcing effect of nails. This paper gives an information about how to minimize the risk of landslides by reinforcing the slopes with steel bars .After that shotcreting will be provided on the surface to improve soil nails in the slopes. Its advantage need to be exploited on a large scale in infrastructure projects.

Keywords : Soil Nailing, Shotcreting, Stabalization

Introduction :-

The Dump loose soil either from deposited excavated material are likely to failed. These slopes can be stabilized by providing anchorage to the soil in the form of nail. This soil nailing technique is economical and it is use to stabilize existing slopes and to construct retaining wall from the top down. The soil reinforcement process uses steel tendons which are drilled and grouted into the soil to create a composite mass similar to a gravity wall. After that stability of the ground nails can be provide by surface skin often a thin layer of shotcrete reinforced with wire mesh. The grout is applied to protect the steel bars from corrosion and to transfer the load efficiently to nearest stable ground. It has been alternative technique to other conventional supporting system as it offers flexibility, rapid construction & competitive cost. In India use of soil nailing technology is gradually increasing and guidelines have been made by IRC with the help of Indian Institute of Science, Bangalore. In Germany, the first use of a soil nail wall was in 1975 (Stocker etal. 1979). The first major research program on soil nail walls was undertaken in Germany from 1975 through 1981 by the University of Karlsruhe and the construction company Bauer. (Gassler and Gudehus1981; Schlosser and Unterreiner 1991).

1. Advantages of Soil Nailing

The existing data according to preformed projects and investigations on building of slopes defines following advantages of soil nailing.

a. It has little damage to the environment and is environmentally friendly

b. Its use requires little construction materials

c. It is more economical than other methods
d. It is more stable than other techniques against seismic load

e. Nails angle, size and location can be adjusted easily in soil Nailing structure

f. Need less space for installation.

1.1 Limitations of Soil Nailing

a. Can't use soil nailing Technique in every location
b. Soil nailing technique needs experienced labor
c. In the areas with high level of water it's not compatible**1**
d. Gravel and Sand may not be compatible with this method
e. The metal nail is rotten after long term
f. Soil nail may not be good option for permanent adjustment

1.2 Components of Soil Nailing

Soil nailing comprises of following components:

a.Tendons
b.Grout
c.Centralizers
d.Facing
e.Drainage
f. Connection components

2. Various methods of soil nailing :-

- Drilled and grouted soil nailing –Holes are drilled in walls or slope faces. Then, nails are inserted into the pre-drilled holes. After that, hole is filled with grouting materials such as concrete, shotcrete etc.
- Driven soil nailing – This method is considerably fast and will be used for temporary stabilization of soil

slopes. In this method, nails are driven in slope face during excavation. But it doesn't provide corrosion protection.

- Self-drilling soil nailing – Hollow bars are drilled into the slope surface, grout also injected simultaneously during the drilling process. It provides more corrosion resistance to the nails than driven nails.
- Jet grouted soil nailing – In this method, jets are used for creating holes on the slope surface. And then, steel bars are installed in the holes and grouted with concrete. This method provides good corrosion protection for the steel bars.
- Launched soil nailing – In this method, the nails are forced into the soil with a single shot using compressed air mechanism. And so, installation of soil nails is fast, but penetration of over length bars is difficult.

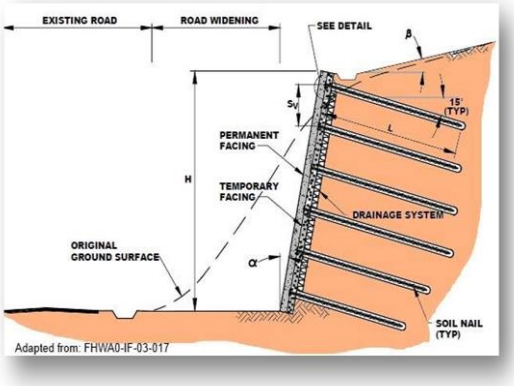

Figure: Typical Soil Nailing

Figure: Wire Mesh Cover on Slope

3. Literature Review :-

G.L. Sivakumar Babu, Vikas Pratap Singh (2009) A study was conducted regarding soil nail walls designed on basis of conventional procedure given by FHWA (2003). Various design parameters were compared which were obtained from conventional design and numerical simulation. Appraisal of all this was done based on close monitoring of in-situ numerical simulation and full scale laboratory study. It's derived that conventional design method provided the safe design.

Sanat Pokharel, Robert L. Parsons, Jie Han, Isaac Willems (2011) Reinforced concrete facing was compared to reinforced flexible facing using 3D finite difference modelling. Physical testing of a 1.5m*1.5 m unit cell of a soil nail wall in clay was done. When a surcharge of 5Psi was applied, it was noted that flexible facing performed well strength wise but showed commendable horizontal and vertical deformation along with significant settlement in surface. So, it was recommended that flexible facing in clay as a substitute to reinforced concrete should not be extended to the areas other than the ones where large deformations are acceptable.

Jian-Hua Yin, Cheng Yu Hong, Wan Huan Zhou (2012) the motive of this research is calculation of maximum shear stress at soil nail interface, a parametrical study was conducted which took whole radius, overburden pressure, dilation angle and grouting pressure into consideration for analysis of their effects. It was observed that in the absence of grouting pressure, maximum shear stress increased with increasing overburden pressure, dilation angle or decreased drill hole radius Also, larger grouting pressure values resulted in greater influence of overburden pressure and consequently, larger was the maximum shear stress at soil nail interface.

Siavash Zamiran, Hadi Ghojavand, Hamidreza Saba (2012) With the help of FLAC3D, models were built to perform seismic analysis and also static and dynamic analysis were performed on the same model. It was found out that side long displacement of wall in seismic condition was 60-95% larger than the lateral displacement of wall in ordinary condition. Whereas in case of static and dynamic analysis, it was found that nearest value of static and dynamic maximum nail force occurs in the mid nail row at mid of wall (53%).

S. Loghu Prasath, P. Malini, Mohanchandru, N. Nataraj, M. Mohanraj (2019) The aim of this research was to observe the stability and behavior of less cohesive soil with and without Nails. Soil Nails of 10mm diameter were embedded at 10° and 20° inclination with horizontal in (2H:1V) slopes. It was observed that the slope model sustained at any force not more than 6.7 KN and the same model with nails installed at 20° couldn't withstand force >11.2 KN and that inclined at 20° failed at 20.22 KN. With this it was clearly concluded that nails embedded at 10° can withstand higher loads.

Figure: Collected Materials

5. CONCLUSIONS

a. From the above results, it is concluded that soil slope reinforced with nails can offer higher strength and stability to the slope than normal slope without nails. So the reinforcing the nails in the slopes could prevent the landslides and failure of less cohesive soil effectively. This method of slope stabilization is economical as well as time saving when compared to other soil stabilization techniques. Reinforcing the soil mass will increase the shear strength of the soil. As the shear strength gets increased, the slope will provide more resistance to the failure. Shotcreting the slope surface should prevents the failure due to shear.

b. The previous projects in conventional method that conventional design of soil nailing through FHWA provides safe design.
c. Soil nailing method is more economical than other classical method for improvement and repairing of old slopes, and can reduce cost up to 30%.
d. Flexible facing performs well against loads and has acceptable strength, but has commendable horizontal and vertical deformation. It's better to use Rigid facing in comparison to flexible facing in areas with large deformations specially in clay soil.
e. Finite element method shows soil nailing is more effective in greater slopes, and slopes with 60°inclination has more load carrying capacity than 45°.
f. Inclusions can increase shear strength in soil nailing slopes, and reduce horizontal deformation. Vertical inclusion should be extended to a depth zone in sufficient numbers**.**

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