Strengthening of Foundation Soil Using Geogrid & Soil nailing; A Case study

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Abstract: Buildings are one of the important infrastructures all over the world. With increasing population, land use plays an important role which requires efficient usage of available land. Geogrids and soil nailing are two important techniques available for the strengthening of existing soil. In the present study, geogrids and soil nailing techniques are adopted to strengthen the soil adjacent to the excavated soil at the site. It is observed that geogrids and soil nails of 10mm diameter bars with a grout mix of 1:2 is used effectively to retain the structure and strengthen the sub structure of a building.

1. Introduction

Soil nailing is a construction technique that can be used as a remedial measure to treat unstable natural soil slopes or as a construction technique that allows the safe over-steepening of new or existing soil slopes. The technique involves the insertion of relatively slender reinforcing elements into the slope – often general purpose reinforcing bars (rebar) although proprietary solid or hollow-system bars are also available. Solid bars are usually installed into pre-drilled holes and then grouted into place using a separate grout line, whereas hollow bars may be drilled and grouted simultaneously by the use of a sacrificial drill bit and by pumping grout down the hollow bar as drilling progresses. Kinetic methods of firing relatively short bars into soil slopes have also been developed. Bars installed using drilling techniques are usually fully grouted and installed at a slight downward inclination with bars installed at regularly spaced points across the slope face. A rigid facing (often pneumatically applied concrete, otherwise known as shot Crete) or isolated soil nail head plates may be used at the surface. Alternatively a flexible reinforcing mesh may be held against the soil face beneath the head plates. Rabbit proof wire mesh and environmental erosion control fabrics and may be used in conjunction with flexible mesh facing where environmental conditions dictate.

2. Study area and Problem Statement

![Fig. 1 Study area](image)

Strengthening of soil for the safe existence of building adjacent to another building is shown in figure 1.

3. METHODOLOGY

The methodology adopted in the present project work is shown in figure 2.

- Site location
- Excavation
- Geogrids
- Reinforcement
- Plates
- Spraying of shot Crete
- Grouting

![Fig. 2 Methodology](image)
Excavation:

The removal of earth, usually to allow the construction of a foundation or basement. Excavation is carried out up to the hard strata. Excavation is done by using JCB, tippers etc. as shown in figure 3. The average depth of excavation is 27’6”.

Geogrids:

A geogrid (as shown in figure 4.) is geosynthetic material used to reinforce soils and similar materials. Geogrids are commonly used to reinforce retaining wall as well as sub bases or subsoil’s below roads or structures. Soils pull apart under tension. Compared to soil, geogrids are strong in tension. Geogrids are commonly made of polymer materials, such as polyester, polyvinyl alcohol, polyethylene or polypropylene. They may be woven or knitted from yarns, heat-welded from strips of material or produced by punching a regular pattern of holes in sheets of material, then stretched into a grid.

Reinforcement:

Reinforcement is a steel bar which has tensile strength and stabilizes the any structure. Commonly used from 6mm diameter bars. Reinforcement is shown in figure 5.

Spraying of Shot Crete:

Short Crete is concrete (or sometimes mortar) conveyed through a hose and pneumatically projected at high velocity onto a surface, as a construction technique. It is reinforced by conventional steel rods, steel mesh, and/or fibers. Fiber reinforcement (steel or synthetic) is also used for stabilization in applications such as slopes. Spraying of short Crete as shown in figure 7.

Grouting:

Injection of slurry or a liquid solution into a soil or rock formation is termed as grouting. The injected materials are referred to as the grout. The process of grouting was developed primarily as a technique for making vertical seepage barriers beneath building.
Structures by injecting cement slurry into voids of soil by using Grouting machine as shown in figure 8.

Fig. 8 grouting machine

4. RESULTS AND DISCUSSIONS

It is found that Geo grids and soil nails are installed successfully for the safe functioning of adjacent building. The properties of geo grids adopted are shown in the table 1. Soil nails are inserted into the ground and the adopted diameter of bars are shown in table. Grout mix adopted for the present problem is of 1:2 cement sand.

Table 1. Specifications & results

<table>
<thead>
<tr>
<th>Geogrids</th>
<th>Spraying</th>
<th>plates</th>
<th>Grouting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire standard as per ISI.</td>
<td>Cement+ Baby chips+ Water.</td>
<td>Length = 8 feet.</td>
<td>Cement+ Water.</td>
</tr>
<tr>
<td>ISO 9001:2000</td>
<td>weight =25 kg.</td>
<td>water/cement ratio is 0.45 – 0.60</td>
<td></td>
</tr>
<tr>
<td>Roll length 50ft/100ft.</td>
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The soil is strengthened successfully with the insertion of nails and the view of the strengthened soil is shown in figures

i. Geogrid is placed on the soil slope.

ii. Inserting of Nails (reinforcement) into the soil.

iii. Plates are fixed to the nails for support.

iv. Spraying of short Crete

v. Grouting process.

vi. Final output of nailing process.
5. CONCLUSIONS

1. Substructure of the building is retained efficiently using soil nailing.
2. Geo grids and soil nails of 10mm diameter bars with a grout mix of 1:2 is used effectively to retain the structure and strengthen the substructure of a building.
3. Substructure stabilization using soil nailing and geogrids is found to be the efficient method of retaining structures.

1. References

5. HILL, R.L., 2006. “The Impact of Fly Ash on Air Entrained Concrete”, High Performance Concrete Bridge Views, #43, National Concrete Bridge Council, Skokie, IL.