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Experimental evaluation of stabilizad excavated wall using composite soil nailing and anchor

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Abstract

Stabilizing of vertical slopes is one of the important problems in civil engineering. Different methods are being used for slope stabilizing that composite soil nailing is one of them. By using this method, shear resistance of soil increases that led to increases the stability of system.
In this study a small-scaled physical model was prepared in which a strip footing adjacent to excavated wall was considered. Composite soil nailing including two row nails and one row anchors has been used in order to stabilize the excavated wall. Particle image velocimetry (PIV) has been undertaken to investigate the behavior of composite soil nailing with pre-stressed anchor system. First, the model has been prepared and elements were located in specific positions. Digital photographs were taken after each step of excavating and also after each step of footing loading. Using image processing on sequences of digital images, behavior of system was observed.
Results show that for special length of anchors located in middle row, bearing capacity of footing increases and horizontal displacement of wall decreases. It was also observed that maximum horizontal displacement of wall occurs in lower part of that by using composite soil nailing with pre-stressed anchors, although in soil nailing, maximum horizontal displacement occurs in top of the wall.

Keywords: *composite soil nailing with pres-stressed anchors, bearing capacity , failure surface, PIV*

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Extended Abstract:

One of the most important problems of civil engineering is how to stabilize the vertical and slopy soil walls. There are many different methods such as soil nailing and anchoring for stabilizing the these walls. Recently composite systems of nailing and anchoring that has technical and economical reasons, have been focused. For this reason, it is essential to understand the mechanism of behavior of reinforced soil structures under surchage of loading.

In this study an experimental investigation into a small-scaled composite soil nailed wall with anchorage have done.

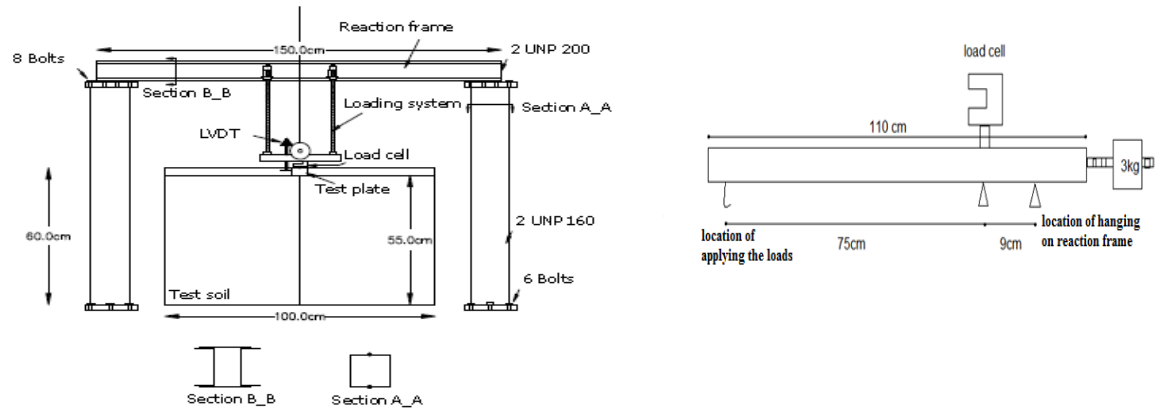
The soil was fine, dry sand with various intergrain color that is suitable for photographing and analyzing of deformation. It is classified as SP in unified soil classification system (USCS).

Soil nails and anchors were made of steel bar with 0.003 m diameter and 0.3 m length. The end of bars was died to connect them to the facing by tightening the bolt nuts to end of bars. Washers were used as bearing plates in the system. Thin layer of sand was glued on the bar surface in order to model the grouting in the nailing system. Also for modeling the pre-stressing the anchors Elastic steel springs were used.

For modeling of facing, an aluminum sheet with following dimensions was used: 0.0015× 0. 3× 0. 3 m^3. It was punched, to place 2 row nails and 1 row anchors by 3×3 arrangement. The strip footing was made of steel box with length of 0.3m, width of 0.06m and 0.03m depth.

After filling the box with sand till the level of facing, it was placed and the sand was poured in both side offacing. Nails, anchors and footing were placed in determined location. After placing the load cell between footing and hydraulic jack, front side of facing was excavated in 9 steps. When anchors were appeared, springs were being compressed. Because the connection of spring and anchor bar was series, the saved power of springs made the anchors to pre-stress. After excavating to bottom level of facing, footing was gradually loaded by 200gr weights. The schematic model of test box and loading system are shown in Figure1. After each test, the model was photographed until the failure was occurred.

The images were processed using the GeoPIV8 software, developed at Cambridge University



a) **b)**

Figure 1: (a) schematic model of test box (b) schematic model of loading system

Results show that for special length of anchors located in middle row, bearing capacity of footing increases and horizontal displacement of wall decreases. Also horizontal displacement of facing in the bottom middle of height is great and it is less in the top part of facing but in the case of soil nailing, maximum horizontal displacement of facing is related to upper part of facing and it is decreasing by moving downward.

Also It can be seen that in this system, soil particles slipping starts from bottom part of facing and continues to ground surface. In that case, slip surface is approximately linear. By increasing the failure surchage in system, curvature of slip surface is decreasing and it tends to be linear.

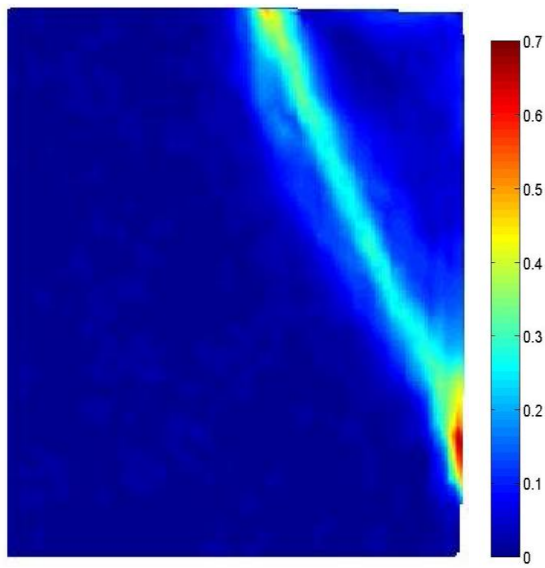


Figure 2: shear strain distribution of composite soil nailing

Results show that for special length of anchors located in middle row, bearing capacity of footing increases and horizontal displacement of wall decreases. It was also observed that maximum horizontal displacement of wall occurs in lower part of that by using composite soil nailing with pre-stressed anchors, although in soil nailing, maximum horizontal displacement occurs in top of the wall.

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