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EXTENDED ABSTRACT

Experimental Evaluation of Application of Demolition Waste Material to Improve the Interface Parameters of Geotextile and Sand

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1. Introduction

Mechanical properties of mechanically stabilized earth structures depend on the mechanical parameters of the fill material, tensile strength of reinforcement elements, and the interface properties of the geosynthetic and the fill material (Ouria and Mahmoudi, 2018). Optimal design of reinforced earth systems demands for a pullout capacity of reinforcements proportional to their tensile strength (Ouria et al., 2019) (Ouria et al., 2021) (Ouria et al., 2022). That is why the utilization of high strength reinforcements in reinforced earth structures has not been developed extensively. Anchorage of high strength reinforcements requires long anchorage length of mechanically anchored ends. On the other hand, rapid development of societies requires renewal of several structures and substructures (Ouria et al., 2020)(Ouria and Heidarly, 2021)(Ouria and Sadeghpour, 2022). The replacement of existing substructures requires new materials and also produces demolition waste material in large quantities (Vieira and Pereira, 2015). The huge rate of the production of demolition waste material in the recent years raised concerns about the harmful impacts of these material in the environment (Savadkoohi and Reisi, 2020). Recycling of these waste material and their utilization in new projects could be proper step in response to the raised concerns. In this study the applicability of demolition waste material in the reinforced soil structures was investigated in the laboratory.

2. Methodology

Recycled material consisted of three types of frequently used construction material namely: clay blocks, ceramic, and porcelain tiles have been used to improve the interface parameters of a woven geotextile and a fine sand. Two layers of demolition waste material were placed at the both interfaces of the geotextile and fine sand to create a coarse material sandwich at their interface. The thickness of the coarse material sandwich was 2cm, 4cm, and 8cm. The interface parameters of the geotextile and the sand with interface improved by coarse material sandwich consisted of demolition waste material were studied in the laboratory by conducting pullout tests. A specially test device used as the test device. The pullout device included a steel box with the dimensions of 40cm length, 40cm width, and 20cm height. The width of the strips of reinforcements was 5cm. The embedded length of geotextile in the box was 30cm. The pullout tests carried out under three different normal stress including 25kPa, 50kPa, and 75kPa. Sand was placed in the pullout box with a unit weight of 14.7kN/m^3. The layers of the coarse material sandwich were placed in the test box with their minimum unit weight. The pullout tests conducted with a pullout rate of 1mm/min. The pullout test was conducted using fine sand and sand with improved interface using recycled coarse material. The results were compared. The photograph and the schematic diagram of the pullout device are illustrated in Fig. 1.

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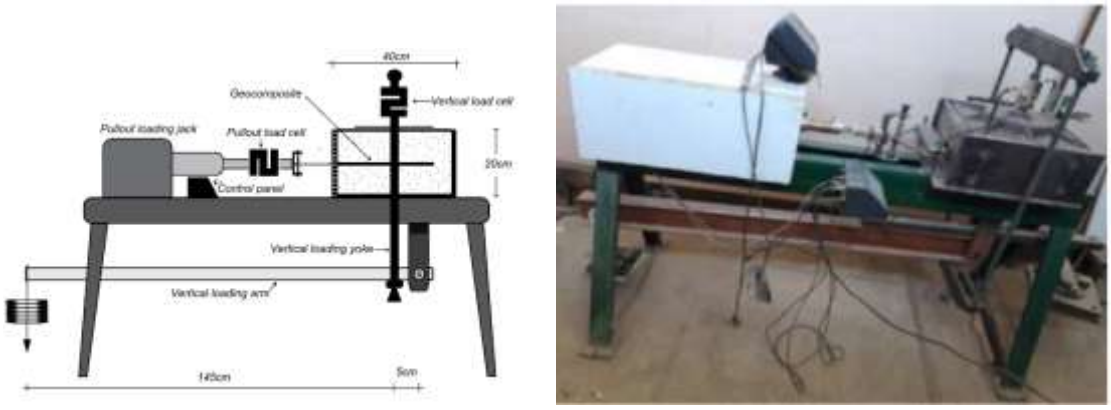

Fig. 1. The photograph and the schematic diagram of the pullout device used in this study

3. Results and discussion

Fig. 2. shows the results of pullout tests carried out on sand with improved interface by recycled materials with different thicknesses of the coarse material sandwich. As can be seen in Fig. 2, placement of a thin layer of coarse material sandwich resulted from recycling of demolition waste material improved the pullout capacity of the reinforcement considerably. As can be seen in this figure, the improvement of the pullout capacity depends on the type and the thicknesses of the sandwich layer and, the level of the normal stress at the interface. As can be seen the pullout capacity of the geotextile was improved by minimum and maximum factors of 1.2 and 3 depending on the stress level, thicknesses, the type of the coarse material sandwich.

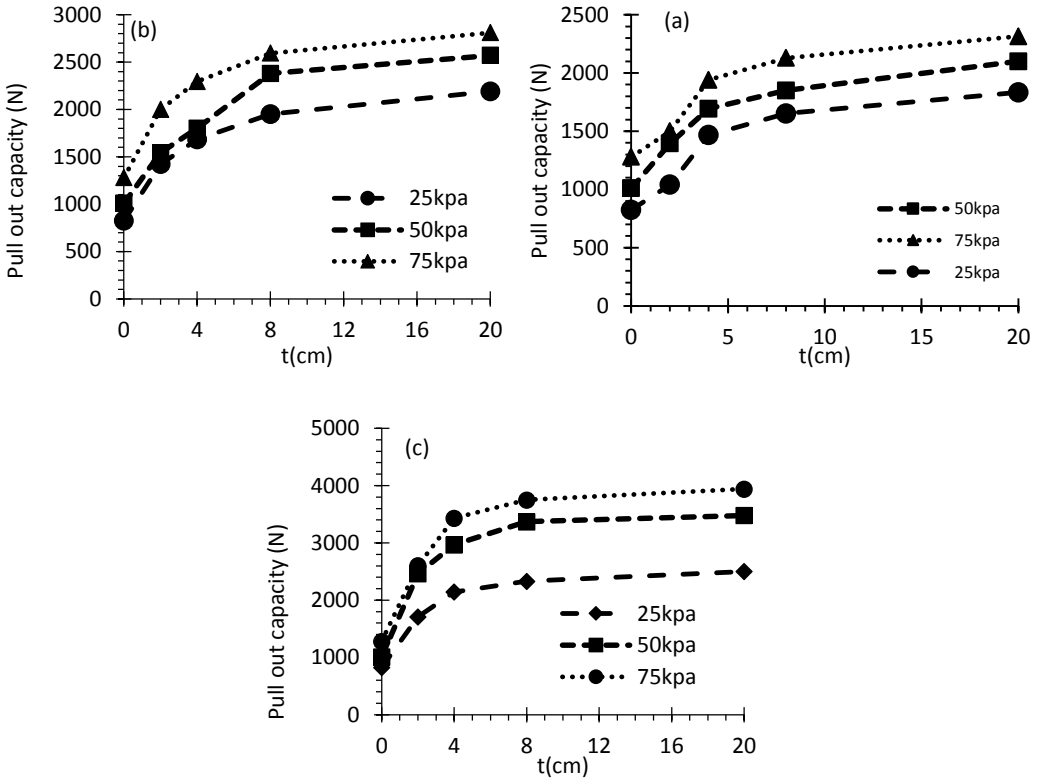

Fig. 2. Pullout capacity of geotextile in sand with reinforced interface by aggregates resulted from recycling of: a) clay block, b) ceramic tile, c) porcelain tile.

4. Conclusions

In this paper the application of recycled material resulted from demolition waste construction material in the reinforced soil systems was investigated in the laboratory conducting pullout tests. Three different types of aggregates recycled from waste clay blocks, ceramic and porcelain tiles was used to improve the interface of a fine sand and a woven geotextile. The results of the tests indicated that recycled material could be utilized as coarse material sandwich at the interface of the geotextile and soil. The effectiveness of the recycled material on the improvement of interface parameters depends on the thickness and the type of the recycled material and the level of the normal stress at the interface.

5. References

Ouria A, Emami S, Karamzadegan S, "Laboratory Investigation of the Effect of the Cement Treatment of Interface on the Pullout Capacity of Reinforcements", Amirkabir Journal of Civil Engineering, 2019, 52 (11), 2831-2846. https://doi.org/0.22060/CEEJ.2019.16191.6149

Ouria A, Heidarli E, Karamzadegan S, "Utilization of Recycled Concrete Aggregates as Coarse Material Sandwich to Improve the Pullout Strength of Geosynthetics in a Fine Sand", International Journal of Geosynthetics and Ground Engineering, 2022, 8 (5), 55. https://doi.org/10.1007/s40891-022-00401-2

Ouria A, Heidarly E, "Laboratory Investigation of the Effect of the Geotextile Placement Pattern on the Bearing Capacity of Footing on Reinforced Sand", Mdrsjrns, University of Mohegan Ardabili, 2021, 21 (3), 21-34.

Ouria A, Karamzadegan S, Emami S, "Interface properties of a cement coated geocomposite", Construction and Building Materials, 2021, 266, 121014. https://doi.org/10.1016/j.conbuildmat.2020.121014

Ouria A, Mahmoudi A, "Laboratory and numerical modeling of strip footing on geotextile-reinforced sand with cement-treated interface", Geotextiles and Geomembranes, 2018, 46 (1), 29-39. https://doi.org/10.1016/j.geotexmem.2017.09.003

Ouria A, Mahmoudi A, Sadeghpour H, "Effect of the Geotextile Arrangement on the Bearing Capacity of a Strip Footing", International Journal of Geosynthetics and Ground Engineering, Springer International Publishing, 2020, 6 (36). https://doi.org/10.1007/s40891-020-00219-w

Ouria A, Sadeghpour H, "Laboratory and numerical simulation of the effect of wraparound anchorage of reinforcements on the bearing capacity of spread footing", Sharif Journal of Civil Engineering, 2022, 37.2 (4.1), 93-104.

Savadkoohi MS, Reisi M, "Environmental protection based sustainable development by utilization of granite waste in Reactive Powder Concrete", Journal of Cleaner Production, 2020, 266, 121973. https://doi.org/10.1016/j.jclepro.2020.121973

Vieira CS, Pereira PM, Lopes MDL, "Recycled construction and demolition wastes as filling material for geosynthetic reinforced structures, interface properties", Journal of Cleaner Production, 2016, 124, 299-311. https://doi.org/10.1016/j.jclepro.2016.02.115