Laboratory study of the feasibility of reuse of costruction and demolition wastes in civil projects (case study: waste of Hesar of Karaj)

Maedeh Kheirkhah[1]
Ali Ghanbari [2]

1- Introduction

There are a large amount of construction wastes around big cities in Iran such as Tehran and Karaj, which have caused environmental problems for the region. The results of the study of Bigdelou et al. 2019 showed that the average of 5973 tons of construction and demolition wastes (C&DW) is produced daily in Karaj, which is about three percent of the total volume of construction waste in the whole country.
The study area in the present study is located in Karaj city which is the site of accumulation of C&DW. this area is located in the east of Alborz province, the entrance to the Chalous road from Tehran to Karaj highway. This area was the location of a construction waste depot for 30 years until its capacity was completed in 2015 (Figure 1).
In the present study, three types of field test and eight types of laboratory test have been performed. In order to obtaining waste composition, bearing capacity, settling rate and shear strength variables of materials such as cohesion and friction angle of soil, modulus of subgrade reaction, soil density, relative soil density, modulus of elasticity as well as layer depth and uniformity of layers relevant tests were performed in the Hesar of Karaj zone area.
Also to investigate the effect of crushed concrete and geogrid on the shear strength of the studied materials a number of direct shear test by adding 10% crushed concrete and geogrid to the studied materials has been performed.

Figure 1= Location of C&DW depot in the study area in the present study

2- Research Methodology

In order to obtain the physical properties of materials and investigate the bearing capacity, the thickness of the layers and the amount density, laboratory and field tests such as plate loading, spt and in-situ density have been performed .
In the study area, two boreholes were drilled with sample obtain, the first borehole with a depth of 25 meters and the second borehole with a depth of 30 meters. Laboratory test of the present study was performed on samples obtained from drilled boreholes. Also, the composition of construction waste of this study in Figure 2 is presented based on the granulation test.
Accordingly, soil and filler have the highest percentage, and glass, plastic, gypsum, tiles and ceramics have the lowest percentage due to high stress on the materials over time.

[1] Master student of geotechnical engineering, The Kharazmi Univ
[2] Professor,Dept. of Civil Engineering,The Kharazmi Univ

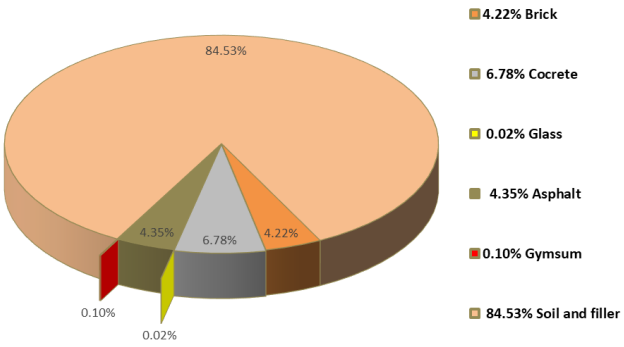

Figure 2= Composition of the first C&DW borehole separately

in order to investigate the effect of geogrid and crushed concrete on the shear strength of the C&DW, several direct shear tests have been carried out in this study. The results of the effect of the geogrid on construction debris show that with the presence of geogrid the cohesion is decreased and internal friction angle is increased Figure 3.

Also according to the results obtained from the effects of the presence of crushed concrete in construction waste, it seems that at least 15% crushed concrete should be added to the construction waste to affected the internal friction angle significantly.

But in order to increase the cohesion, the presence of 10% crushed concrete will also have an effect on the sample,which can be increased to 20% to increase this effect (Figure 4).


Figure 3= Use double-sided geogrid on nearthe cutting edge


Figure 4= Add 10% crushed concrete to C&DW

3- Conclusion and recommendations

The results of this study show that some C&DW in the Hesar area of Karaj have sufficient and suitable strength to use in construction projects directly. But for others, which have less resistant, better results can be achieved by reinforcing with geosynthetics or combining them with crushed concrete.

For example, construction waste in the Hesar of Karaj zone can be used in the construction of low-traffic side roads directly. In addition they have necessary conditions as subgrading materials for main road, flooring materials for building, soil cover for landfills, construction of the core of earth dams and also as foundation of the building.

However, it should be noted that the necessary studies on the effect of saturation of these materials on their strength need to be done because full saturation of these materials may weaken their strength. Also investigate the heterogeneity effect of C&DW has not been the subject of this study so it is recommended that this issue be considered in future studies because heterogeneity may cause differential settlement.

It should be noted that if these materials are used for road construction or dam construction additional tests should be performed in the design of the mentioned structures.

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