Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 2, No. 8, August, 2016

Shear Strength Behavior of Crude Oil Contaminated Sand-Concrete Interface

Amir Hossein Mohammadi [a], Taghi Ebadi [b*], Mehrdad Ahmadi [c], Arash Aliasghar [c]

[a] PhD student, Department of Civil & Environmental Engineering, Amirkabir University of Technology, Tehran, Iran

[b] Assistant Professor, Department of Civil & Environmental Engineering, Amirkabir University of Technology, Tehran, Iran

[c] M.Sc student, Department of Civil & Environmental Engineering, Amirkabir University of Technology, Tehran, Iran

Received 15 July 2016; Accepted 24 August 2016

Abstract

A laboratory investigation into crude oil contaminated sand-concrete interface behavior is performed. The interface tests were carried out through a direct shear apparatus. Pure sand and sand-bentonite mixture with different crude oil contents and three concrete surfaces of different textures (smooth, semi-rough, and rough) were examined. The experimental results showed that the concrete surface texture is an effective factor in soil-concrete interface shear strength. The interface shear strength of the rough concrete surface was found higher than smooth and semi-rough concrete surfaces. In addition to the texture, the normal stress and the crude oil content also play important roles in interface shear strength. Moreover, the friction angle decreases with increasing crude oil content due to increase of oil concentration in soil and it increases with increasing interface roughness.

Keywords: Sand-Concrete Interface; Pollution; Shear Strength; Bentonite.

1. Introduction

The thin layer between structures and soil is often called soil–structure interface which transfers loads from structures to soil mass. This layer plays influential roles in the bearing capacity of soils and load-displacement behavior of geostructures [1]. The shear strength of the interface between soil and structural material is important while designing geotechnical structures, including deep foundations (such as pile, drilled shaft, etc.), and shallow foundations (such as retaining wall, sheet pile, etc.) [2]. Although much more attention has been paid in recent years regarding soil-structure interaction for dynamic loading, highly conservative values of the static frictional resistance between soil and structure are used in the design. Not many research articles are available regarding the recommended soil-structure shearing resistance, so majority of the designs are based on empirical values, i.e. ratio of skin friction or adhesion to the internal friction or cohesion of foundation soil [2, 3]. Many studies have been conducted to evaluate the shear strength of soil and the frictional resistance between soils and structures, so far. Various types of soils and different types of construction materials were used in these studies to illustrate the difference of the interface shear resistance between different soils and materials. Different types of apparatus were used in the previous studies such as direct shear apparatus, ring shear apparatus, dual shear apparatus, and simple shear apparatus. As an early work which has been cited by many articles in the literature, Potyondy [4] conducted direct shear test on the interface of concrete, steel, and wood with sand, sandy silt, cohesive soil, rock flour (silt), and clay. He conducted tests for certain pre-set moisture contents as well as for dry specimens, and found that the frictional resistance of a soil depends on its sand content. He also revealed that the moisture content, soil composition, surface roughness, and normal load have significant influence on the interface strength [4]. In another work, Coyle and Sulaiman [5] investigated the frictional resistance between sand and steel pile whereas Kulhaway and Peterson [6] measured the frictional resistance between sand and concrete. Several other researchers such as Evgin and Fakharian [7], Hryciw and Irsyam [8], Uesugi et al. [9],

* Corresponding author: tebadi@aut.ac.ir