شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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Ain Shams University

Faculty of Engineering

Irrigation and Hydraulics Department

The Effect of Soil Layers Thickness and Characteristics on the Efficiency of Sheet Piles under Heading-Up Structures

A Thesis submitted in partial fulfillment of the requirements of the degree of Master of Science in Civil Engineering
(Irrigation and Hydraulics)

By

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B.Sc. in Civil Engineering – Irrigation and Hydraulics Dept. - 2018

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This thesis is submitted as a partial fulfilment of Master of Science in Civil Engineering (Irrigation and Hydraulics), Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Abstract

Using sheet piles under the floor of a heading-up structure decreases the flow rate, uplift force, and hydraulic gradient, and increases the structure's safety. The type of soil under the structure is an important factor in the seepage analysis. In this study, a 2D numerical model is used to simulate the flow under the floor of a heading–up structure resting on two soil layers of unequal thicknesses. The floor is considered to have vertical and inclined sheet piles with different configurations. The model was first validated using experimental data from a previous research, then applied to study different scenarios for the thicknesses and hydraulic conductivities of the soil layers. Various locations and inclination angles of the sheet piles are also studied. The study highlights the effect of the soil layers thicknesses and characteristics on the efficiency of the sheet piles in reducing the flow rate, uplift force, and exit gradient. The results show that such soil properties have a great effect on the efficiency of sheet piles. It is strongly recommended to consider the effect of the soil characteristics as well as the thickness of the upper soil layer relative to the sheet pile's depth in the floor's design.

Keywords: Heading-up structures; Seepage; SEEP2D numerical model; Soil layers thickness; Soil characteristics; Vertical and inclined sheet piles.

Table of Contents

List of Figures

List of symbols

d	depth of the sheet pile	[L]
E	exit gradient	[Dimensionless]
E_o	exit gradient in the reference case	[Dimensionless]
F	uplift force on the floor's bottom per unit width of the floor	$[MT^{-2}]$
F_o	uplift force on the floor's bottom in the reference case per unit width of the floor	$[MT^{-2}]$
g	gravitational acceleration	$[LT^{-2}]$
H	difference between the water head upstream and downstream the structure	[L]
K_1	hydraulic conductivity of upper soil layer	$[LT^{-1}]$
K_2	hydraulic conductivity of lower soil layer	$[LT^{-1}]$
L	length of the floor	[L]
q	total flow rate per unit width of the floor	$[L^2T^{-1}]$
q_o	total flow rate in the reference case per unit width of the floor	$[L^2T^{-1}]$
R^2	Coefficient of determination	[Dimensionless]
T_1	thickness of the upper layer of soil	[L]
T	total thickness of the soil under the floor	[L]
X	location of the sheet pile measured from the beginning of the floor	[L]
θ	inclination angle of sheet pile	[Dimensionless]
ρ_w	density of water	$[ML^{-3}]$