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أ.د وعد عبد الستار زكريا

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Ministry of Higher Education
and Scientific Research
University of Diyala
College of Engineering

Behavior of Retaining wall due to the effect of machine foundation using finite Element method

A Thesis Submitted to the Council of College of Engineering University of Diyala in Partial Fulfillment of the Requirements for the Degree of Master of Science in Civil Engineering

BY

Fatima Mohammed Hassan

(B.Sc. Civil Engineering, 2020)

Supervised by

Prof. Dr. Waad A. Zakaria

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Chapter One

Introduction

1.1. General

Retaining wall is a structure made to resist the lateral earth pressure of soil caused by change in height and to maintain the stability of the ground, it keeps an earth mass's facing slope from rupturing in cuts and fills as well as from sliding. Structures are pushed by the retained material, which causes it to slide and overturn. In addition to self-weight the lateral ground pressure is the primary force considered in the study and construction of the retaining wall. The angle of internal friction, cohesiveness of the retained material, direction, and magnitude of stem movement all affect the lateral earth pressure behind the wall. (**Winkel et al., 2006).**

Dynamics of soil have evolved quickly over in the course of recent years because of numerous variables, for example, the need to construction of larger and progressively stable structure, the stringent requirements of cutting edge modern structures, and the destructive harm brought about commonly.

It seems as though progress is being pushed be perspectives and guided by them, soil dynamics may have been driven from static soil mechanics. different soil properties become more basic than soil union and angle of internal friction where modules of elasticity, shear wave velocity, shear modulus and different properties that have an immediate relationship to the pressure wave proliferation is a flexible medium**(Das and Ramana, 2011)**

1.2. Dynamic Response of Soil

Soil response to dynamic condition is an indispensable factor for some specialists and studies. The conduct of progressively loaded soil is represented by a few components inclusive **(Daghigh, 1993):**

1- Soil nature (shear modulus, soil permeability, soil density, damping).
2- Environmental factors in which the soil is in (static stresses state and ground water weight)

3- The nature of the dynamic loading (strain extent, the pace of strain and number of loading cycles).

The reaction of soil during dynamic loading varies from the statically loaded soils, which critical significance for balancing out the structures. The stress-strain of soil is typically observed to be hysteretic and highly non-linear**(Al-Sherefi, 2000)**, genuine soil conduct is by and large is generally is elasto plastic, it gives better estimates of displacement at work load exposure.

1.3. the Structures of Retaining Wall

Earth retaining wall structures are a fundamental element of underground transportation and facilities framework, and accordingly, the studies are a major concern for geotechnical engineering, particularly in earthquake prone inclined nations. One of the early an answers for the issue of earth pressure was development by Coulomb (1776), who presented the possibility of a "critical slip surface "and isolated soil quality into coherent and frictional segments. Afterward, Rankine (1857) built up a strategy dependent on the frictional steadiness of loose granular mass and created straightforward conditions for the coefficients of dynamic and detached powers on retaining structures. **(Lew et al.,2010)**

1.4. Loads and Forces Acting on Retaining Walls

Different sorts of loads and forces follow up on a retaining wall and their figuring is significant for its structure. These are forces on retaining wall and

rely upon different variables that are talked about .There are various types of loads and forces acting on retaining wall, which are:

1. Lateral earth pressure.
2. Surcharge loads.
3. Axial loads.
4. Wind on projecting stem.
5. Impact forces**. (Gambhir et al 2009)**

1.5.Machine Foundations

Machine foundations are one of the most important features of industrial structures. Industrial facilities like power plants, steel plants, petrochemical complexes, fertilizer plants etc., consist of a number of centrifugal and reciprocating machines and these play an important role to ensure smooth operation of the process and that the output product is of right quality. If any of these equipment starts malfunctioning or breaks down due to excessive vibration or settlement of the foundations, cascading effect on the overall performance on engineering could be catastrophic at times **(Chowdhury and Dasgupta, 2009)**.

Several factors such as: dynamic properties of soil supporting the foundation, static weight of the foundation and vibrating equipment, area of contact of the foundation with soil, static soil pressure, nature and magnitude of unbalanced force have major influence on the behavior of the machine foundations. The nature of dynamic loads and non-homogeneity of soil make the analysis and design of foundation subjected to dynamic loads to be more complex **(Ramesh et al., 2011).**

1.6 The Problem Statement of the Study

Especially part from the analysis and construction of retaining wall and its interaction with the ground and backfill due to effect of machine foundation which becomes operation too complex as a result of the dependence of this interaction on the construction technology ,and the determination of settlements and displacement in the surface of retaining wall is very significant .

In order to predict the reliably of deformations and distribution of stresses ,displacement, acceleration and velocity using a numerical method, the finite element method (FEM) analysis has become a popular tool which can simulate construction stages for retaining wall.

1.7 The Objectives of the Study

1- to measure stability of retaining wall if no loading with dynamic load as usual and effect of machine vibration on retaining wall.

2- to know the safe distance between machine and retaining wall.

3-to know amplitude and frequencies of machine foundation they can be used.

4-To calculate and analyze the behavior of settlement and stress of the soil beneath and beside retaining wall and beneath and beside machine Foundation.

1.8 Thesis Layout

The contents of this research work are presented in five chapters as outlined

Below**:**

Chapter one: presents a general introduction and information about retaining wall, machine foundation, and the objectives of the present study.

Chapter two: covers a brief review of the available literature related to the retaining wall, and machine foundation review about methods to predict the behavior of stresses and settlement of soil.

Chapter three: presents the methodology of the numerical model for retaining wall constructed stages and procedures for building model.

Chapter four: includes the presentation of test results and their discussions

Chapter five: reviews a summary of the main conclusions and recommendations for future work.

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ABSTRACT

In general a retaining wall system was developed to provide lateral support for soil and it is widely used in underground projects, highway barriers, and mines, as well as for aesthetic considerations and slope stabilization and other. Usually this type of earth structure can resist static or dynamic load or both, the dynamic reaction of the gravity type of retaining wall is quite complex.

In this study is carried out to predict of the behavior of retaining wall and the backfill under the effect of machine foundation. The finite element package (PLAXIS 3D – 2021) has been used to simulate the case study. The program include linear elastic model (LE) for model any concrete part, as well as the layers of soil represent by the Mohr-Coulomb model (MC). In addition this program utilize zero thickness interface element for soil-structure interaction. Two Amplitude of machine foundation (i.e. 25,40) kPa with three frequencies of (30,60,90)Hz are used. The distances between the machine and the retaining wall are 0.5m , 3m, 6m.

Results are presented in terms of displacement -depth and stress-depth curves. Five vertical sections are chosen to study the effect of machine foundation on retaining wall

Finally, The total lateral displacement in the point under the machine foundation is higher about 67% than the lateral displacement in the point beside and beneath the retaining wall as a result of the high vibration of the machine at this point. And The total vertical settlement in the point under the machine foundation is higher about

13% than the total vertical settlement in the point beside and beneath the retaining wall as a result of the high vibration of the machine at this point. and The total horizontal stress in the point under the machine foundation is higher about 35% than the total horizontal stress in the point beside and beneath the retaining wall.