Performance Evaluation of RCC Retaining Wall Under Dynamic Forces With Soil Structure Interaction

Mr. Sachin Maruti Lavate[1], Prof.S. S. Kadam[2]
[1, 2] Dept of Civil Engineering
[2]Assistant Professor, Dept of Civil Engineering
[1, 2] SKN Sinhgad College of engineering Korti, Pandharpur - 413301

Abstract- *In current engineering practice the design methods for earth retaining walls under seismic conditions are mostly empirical. Dynamic earth pressures are calculated assuming prescribed seismic coefficient acting in the horizontal and vertical directions using time history analysis Structural dynamic deals with method to determine the stresses and displacement of structure subjected to dynamic loads .the dimension of structure are finite. It is thus rather straight forward to determine dynamic model with finite no of degree of freedom. The corresponding dynamic equation of motions of the discretized structure is then formulated, and highly developed methods for solving them are radially available) In this study nonlinear analysis of retaining wall is studied including soil structure interaction for various type of walls for silty soil, clay soil and sandy soil . The data collected for time history analysis is Koyana,Bhuj, Kobe,Uttrakashi and El Centro. The software used for analysis is ANSYS in which we can model any type of material for soil structure interaction upon this study.*

I. INTRODUCTION

The determination of seismic earth pressure acting on a retaining wall is a particularly important problem in the design of many geotechnical engineering structures in the seismic zone. For many decades, a number of investigators have developed several methods to estimate the seismic earth pressure on a rigid retaining wall due to earthquake loading. Okabe, Mononobe and Matsuo provided a solution to determine the earth pressure on the basis of limit-equilibrium approach, which is an extension of the Coulomb sliding wedge theory. This pseudo-static method is widely known as the Mononobe-Okabe method. Later, this approach, modified by Saran and Gupta, is applicable to cohesive soil backfill. They presented an expression of the total seismic active earth pressure by adding the separately calculated maximum pressure contributions caused by the weight of soil wedge, cohesion of the soil backfill, resulting in different failure planes, which is not compatible with practical situations. Rao and Choudhary the pseudo-static method assumes that the magnitude and phase of acceleration are uniform throughout the backfill, which could not consider the real dynamic nature of earthquake acceleration. In order to remove this deficiency, Steedman analyzed the seismic earth pressure in soil considering composite failure surface following the same approach. All of the mentioned studies applied the pseudo-static method to estimate seismic active force, which considered the seismic loading induced by earthquake to be time-independent.

A. DESIGN EVALUATION

The analysis of a rigid wall with reinforced backfill is carried out by considering the different parameters which are discussed below. Wall geometry: (height of wall and Roadway width) the rigid wall with reinforced backfill technology is suitable particularly for the construction of flyover approach roads and road construction in hilly areas. Hence, height of wall always varying. The width of roadway of 12 m is considered in the present investigation as per IRC: 6 as referred in references.

Backfill soil: As reported in the literature, granular soils are preferred for the construction for reinforced earth walls. They have the advantage of free drainage and also because of higher frictional resistance at the interface of soil and reinforcement; there is no slippage of reinforcement. In the present investigation three types of backfill soils having soil modulus 1.00E+04, 5.00E+04, 1.00E+05 (kPa) as reported in literatures as granular soils are selected for investigation.

Soil in foundation strata: The soil in foundation strata covers large variations from soft and stiff clay to moderate and compact granular formation. Hence, seven types of soils are considered having soil modulus 1.00E+01 to 1.00E+07 (kPa) as reported in literatures.

Steel reinforcement: The reinforcement considered in the analysis is galvanized iron strips of 40 mm wide and cross sectional area of 100 mm2 placed at 500 mm vertical spacing. The elastic properties of reinforcement assumed in the analysis are: modulus of elasticity (E) 200 GPa, and Poison's ratio (m) 0.30

B. OBJECTIVES

1. To Study Finite Element Modeling of Retaining Wall Using FEA based software.
2. To Study the behavior of Retaining Wall with variation of Height under various loads.
3. To Validate FEM Model with Approximate Method For Checking Accuracy
4. To Compare Various Design Parameter For Retaining Wall In Accordance with codal provisions

II. METHODOLOGY

Retaining walls are those structures which are usually constructed to form roads, stabilize trenches and soil slopes, and support unstable structures. Figure 1 shows one of the common configurations of retaining structures, schematically. Lateral earth pressure model is belonging to the first group of theories in classical soil mechanics. Coulomb and Rankine proposed their theories to estimate active and passive lateral earth pressures. These kinds of theories propose a coefficient which is a ratio between horizontal and vertical stress behind retaining walls. Using the ratio, lateral pressure is simply calculated by the horizontal stress integration. Mononobe-Okabe method (M-O), a seismic version of coulomb theory, was proposed based on pseudostatic earthquake loading for granular soils. This method applies earthquake force components using two coefficients called seismic horizontal and vertical coefficients. Beside other complex theoretical models and numerical methods, M-O theory is one of the best initial estimates.

A. PROBLEM STATEMENT

A R.C.C. retaining wall with counter forts is required to support earth to a height of 9 m above the ground level. The top surface of the backfill is horizontal. The trial pit taken at the site indicates that soil of bearing capacity 220 kN/m2 is available at a depth of 1.25 m below the ground level. The weight of earth is 18 kN/m3 and angle of repose is 30°. The coefficient of friction between concrete and soil is 0.58.Use concrete M20 and steel grade Fe 415. Design the retaining wall.

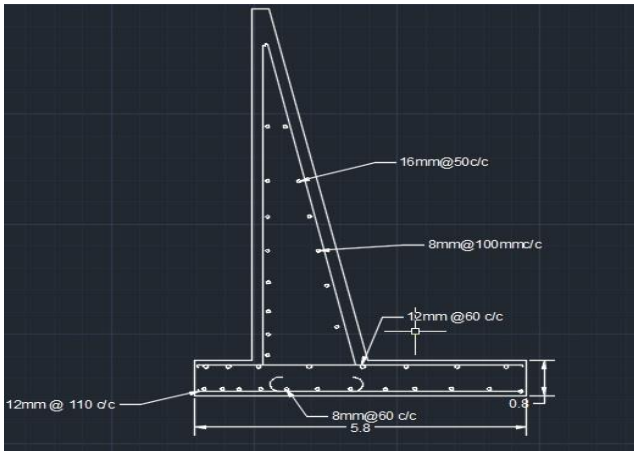


Fig 1 Reinforcement Detail In Retaining Wall

III. RESULTS AND DISCUSSION

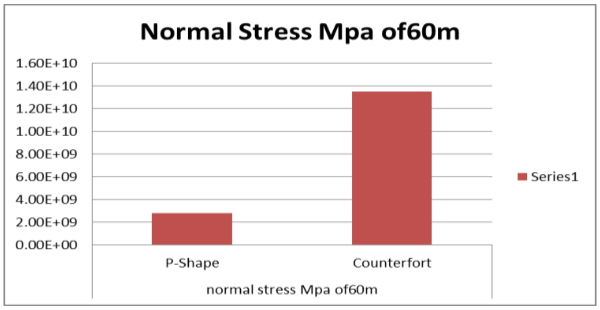
Prepare models of following retaining walls in ANSYS for the different spans

- P-shaped Retaining Wall
- Counterfort Retaining Wall

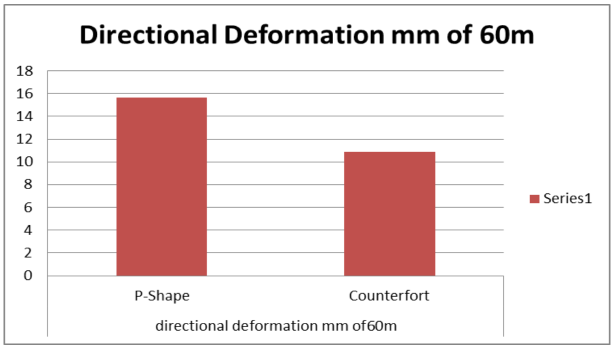
A. RETAINING WALL IN ANSYS

B. RESULTS FOR RETAINING WALL WITH SPAN 60M

normal stress Mpa of60m	
P-Shape	Counterfort
2.79E+09	1.35E+10

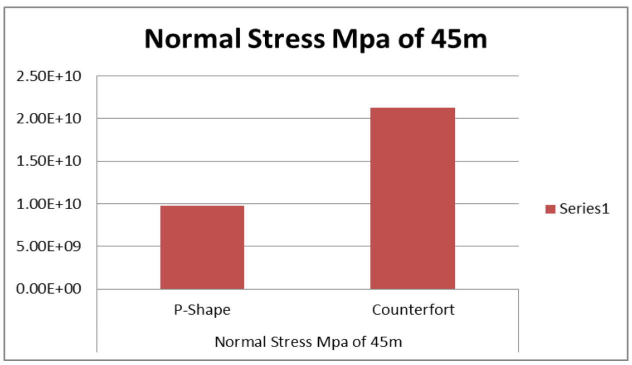


directional deformation mm of60m	
P-Shape	Counterfort
15.664	10.896

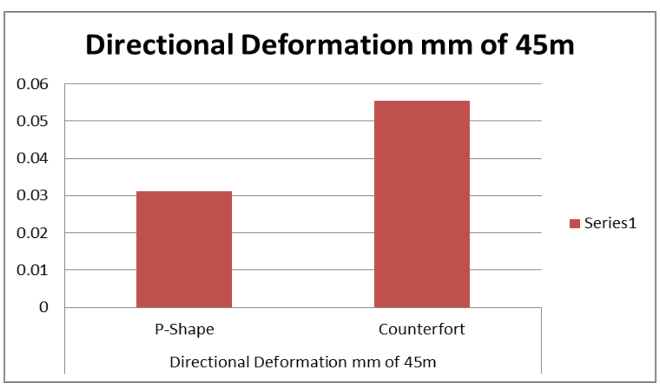


C. RESULTS FOR RETAINING WALL WITH SPAN 45M

Normal Stress Mpa of 45m	
P-Shape	Counterfort
9.82E+09	2.13E+10



Directional Deformation mm of 45m	
P-Shape	Counterfort
0.03117	0.055595



IV. CONCLUSIONS

- It has been observed by parametric study that active earth pressure coefficient are almost identical by different methods, it can be noted from the graphical representations of the results obtained from the application of the different theories.
- Height of Retaining wall more than 10 m will give sufficient result for the deformation, shear stress, normal stress, strain energy etc value give satisfactory result.
- It is observed that counter fort retaining wall has more capacity than P-shaped retaining walls.

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