Study Finite Element Modeling of RCC Retaining Wall Under Dynamic Forces With Soil Structure Interaction using Ansys

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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

Retaining wall systems, consisting mainly of a retaining wall and backfill soil, is a prevalent structure used in our built environment including basement wall, bridge abutments, residential elevations, highway walls and so on. The engineering essence of retaining wall is to keep the retained soil in certain shape and prevent it from falling (stability), or to restrain the deformation of the wall and the backfill to maintain its service function (serviceability). Lateral earth pressure generated by retained backfill on the wall and relevant soil / wall deformations are two main facets of engineering design and analysis of retaining walls. Dynamic/seismic response of such system is one of the major areas due to the influence of dynamic force on the lateral pressure, soil / wall deformation. There are quite a number of analytical solutions, experimental investigations and numerical studies that have been conducted in this area due to different soils, wall structures, dynamic and structural conditions etc. In the meanwhile, it is widely accepted that traditional methods have insufficiencies especially under certain circumstances. As a result, there is a diversity of research to address this issue and try to accurately capture the dynamic response of various retaining systems. However, there is currently no comprehensive and categorized review of current research for dynamic retaining walls. As a result, it is valuable to produce a review of current theoretical solutions and their features; also, significant experimental findings and numerical studies are listed and evaluated. The purpose is to provide peer researchers an overview of the types of research in this area and provides introductive descriptions and critical comments for past studies.

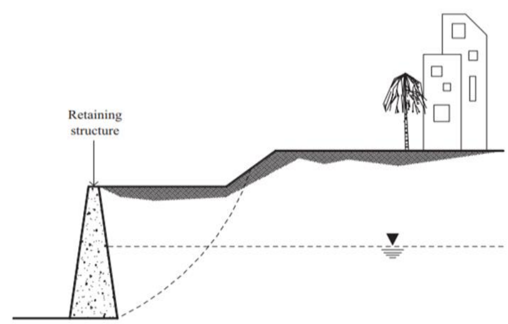


Fig 1 Application of retaining walls in civil engineering.

A. OBJECTIVES

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

II. LITERATURE SURVEY

Mahmoud Yazdani the results are true in its assumption range only, and in many other practical cases, M-

O method is not applicable. No continues backfill slopes, cohesive soils, and rising water behind the wall are some well-known examples in which the M-O theory is irrelevant. Using the fundamental framework of M-O method, this study proposes an iterative method to overcome the limits of the M-O method. Based on trial and error process, the proposed method is able to cover many of the defects which regularly occur in civil engineering when M-O has no direct answer.

T. Manda In the static analysis, the Coulomb's theory and Kötter's equation have been adopted for the determination of passive earth pressures under varying height of wall. These results are plotted and found to be matching well. In the dynamic analysis, Kötter's equation has been used. The coefficient of seismic passive earth pressure is computed for different soil and wall properties. For the same cases, the seismic passive earth pressure with varying height of wall are plotted and reported in the present paper.

Su Yang experimental investigations and numerical findings for retaining walls subject to dynamic excitations are reviewed. Brief features of each method, and experimental and numerical methods are introduced and compared. Tables are listed after each section for a clear and brief view of methods in a categorized manner. Conclusive comments plus current concerns and future expectations of this area are made at last. This review aims at shedding light on the development and concepts of different researches in dynamic retaining wall design and analysis.

Syed Mohd Effect of different parameters involved in the analysis has also been studied and it has been observed that quite a few of them like kh, kv, φ, δ, ru have a significant effect on the stability of the wall. Comparison with a previously existing methodology using pseudo-static approach suggests that the present pseudo-dynamic approach is more realistic and comparatively less conservative and hence can be used as a handy simple economic method for the design of the waterfront retaining walls exposed to the combined effects of earthquake and tsunami.

III. 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.

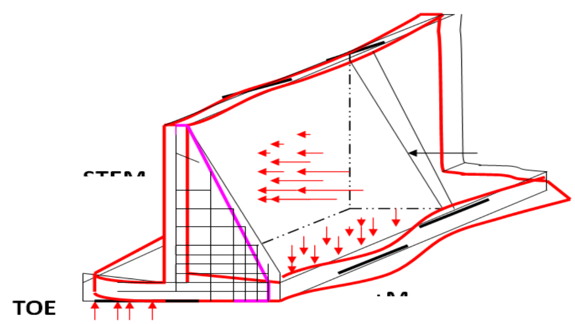


Fig 2 Pressure Diagram of Retaining Wall

IV. 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

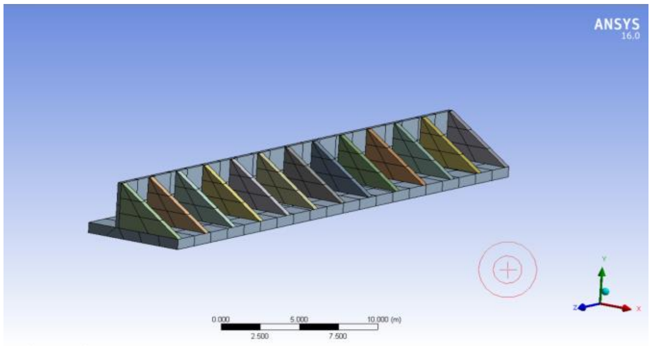


Fig 3 P-shaped Retaining Wall

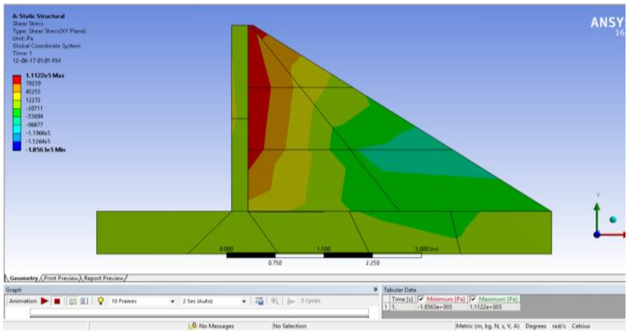


Fig 4 P-shaped Retaining Wall

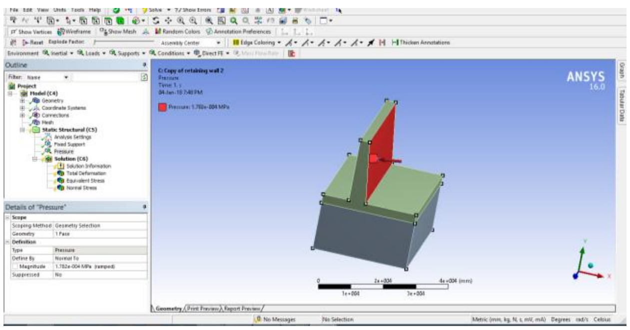


Fig 5 Counterfort Retaining Wall

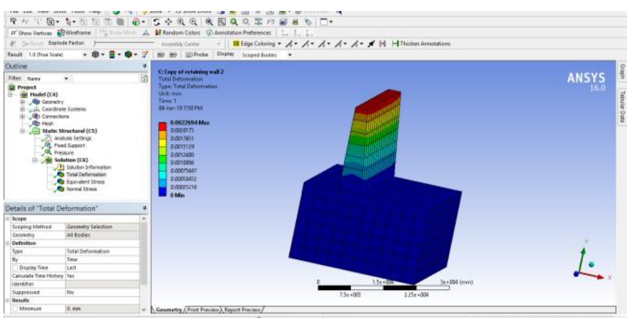
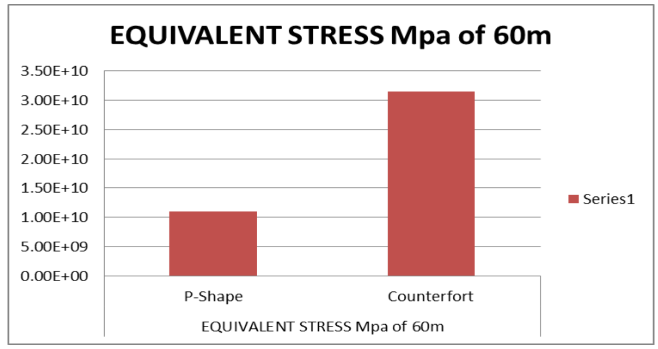


Fig 6 Counterfort Retaining Wall

B. RESULTS FOR RETAINING WALL WITH SPAN 60M

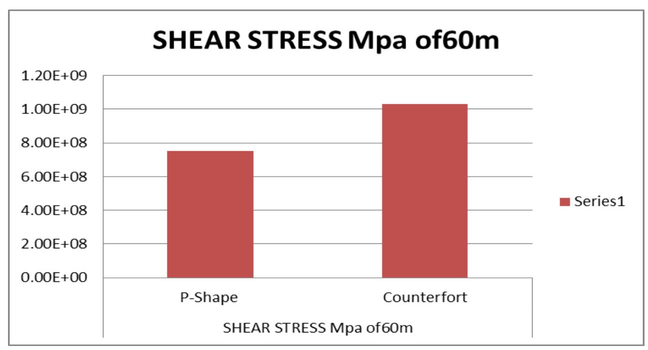
- **Equivalent Stress**

EQUIVALENT STRESS Mpa of 60m	
P-Shape	**Counterfort**
1.10E+10	3.15E+10
7.53E+08	1.03E+09
2.79E+09	1.35E+10
1.57E+01	1.09E+00
0.00E+00	0.00E+00



- **Shear stress**

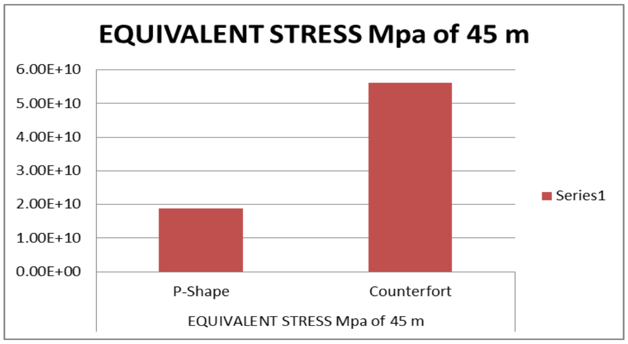
SHEAR STRESS Mpa of60m	
P-Shape	**Counterfort**
7.53E+08	1.03E+09



C. RESULTS FOR RETAINING WALL WITH SPAN 45M

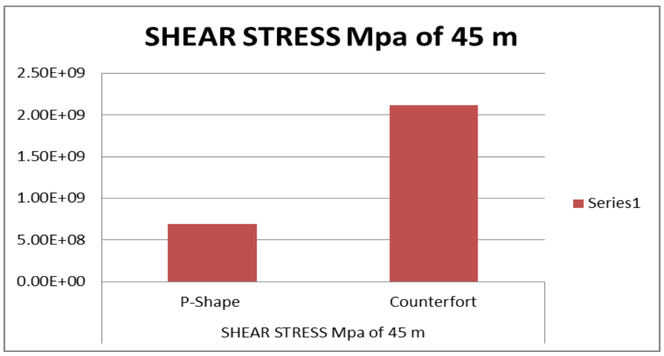
- **Equivalent Stress**

EQUIVALENT STRESS Mpa of 45 m	
P-Shape	**Counterfort**
1.88E+10	5.61E+10
6.88E+08	2.12E+09
9.82E+09	2.13E+10
3.12E-02	5.56E-02
0.00E+00	0.00E+00



- **Shear stress**

SHEAR STRESS Mpa of 45 m	
P-Shape	**Counterfort**
6.88E+08	2.12E+09



V. 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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