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RE Wall: A Review On An Innovation In Construction Industry

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***Abstract*- Weak or soft soil is considered unsafe for construction of engineering structures. We need to adopt some technique to avoid adverse effect of such soil. To bring about improvement in such soil ground improvement techniques are utilized in these days. In respect to retaining wall, RE wall construction is quite favorable as it is economical as well as easy to construct. In this type of construction reinforcement is done by Geosynthetics or Geotextiles. Pressure is reduced effectively by introducing these items (Saran et al. 1992). Lateral thrust on the wall is nearly eliminated because of the development of soil-reinforcement interface friction and bearing. These varieties of walls are easy to assemble and saves time. Geosynthetic Reinforced Wall is most economical among all wall categories (Koerner2000). Different sorts of reinforcements are to be had as alternative for soil reinforcement like; geosynthetics, aluminium strips, bamboo strips and other cloth for the soil improvement. Use of planar geosynthetic reinforcement is most popular way of reinforcement used. Different studies are done to understand the potential and mechanism of soil reinforcement. Researchers have considered different soil parameters and reinforcement parameters and their impact on the behaviour of reinforced soil quantity which takes a huge amount of time and resources.**

***Key Words*:- Retaining walls, optimum length, cost of wall, pressure on wall**

I. INTRODUCTION

Retaining walls are built generally to hold soil mass. However, they can also be constructed for architectural or landscaping purposes. Retaining walls are structures that are constructed to hold/retain soil or any such granular substance that are generally unable to withstand on their own. They are also provided to maintain the grounds at two different levels.

1. Classification of Retaining Walls

Following are the different types of retaining walls, which is based on the shape and the mode of resisting the pressure.
1. Gravity wall-Masonry or Plain concrete
2. Cantilever retaining wall-RCC (Inverted T and L).
3.Counterfort retaining wall-RCC
4.Buttress wall-RCC

2. Cantilever Retaining Wall

This is a most common type of retaining wall and used for 3 to 8 m height. It consists of three cantilever slabs known as Stem, Heel, and Toe. The wall may be an inverted 'T' or 'L' shaped where toe projection is missing. The stem acts as a vertical cantilever and stability is provided by the weight of earth on base slab and self-weight of wall. Sometimes a Key is provided in base slab for stability against sliding.

3. Geosynthetic Retaining Wall General Introduction

A flexible wall made of geosynthetics, usually a geotextile or geogrid. A geosynthetic wall is built by putting sequential layers of fill material, each on a geosynthetic layer with the geosynthetic folded over and covering the face of the wall. the load of succeeding layer of fill material then holds the folded-up geosynthetic from the previous layer in position. Geotextile-reinforced soil walls somewhat correspond the popular sandbag walls that are used for a few decades. However, geotextile-strengthened walls are often made to important height owing to the geotextile's higher strength and a straightforward mechanized construction procedure.

4. USES

1. Geo-textile application to walls is comparatively new, long term effects like creep, ageing, and sturdiness aren't known relied on actual experience. Therefore, a brief life, serious consequences of failure, or high repair or replacement prices may offset a lower initial price.
2. Applications of geotextile-reinforced walls vary from construction of temporary road embankments to permanent structures remedying slide issues and widening, highways effectively. Such walls may be built as noise barriers or perhaps as abutments for secondary bridges.

5. Advantages of Geotextile-Reinforced Walls

Some advantages of geotextile-reinforced walls over conventional concrete walls are the following:

- They are economical.
- Construction usually is easy and rapid. It does not require skilled labor or specialized equipment. Many of the components are prefabricated allowing relatively quick construction.
- Regardless of the height or length of the wall support of the structure is not required during construction as for conventional retaining walls.
- They are relatively flexible and can tolerate large lateral deformations and large differential vertical settlements.

II. RESEARCH FINDINGS

A few studies are done on RE Wall and the outcomes of the researches are as following:-

Swami Saran et al.(1992) mainly focused on the Stability of an element of the failure wedge with changing the length of the Reinforcing spacing coefficient (Dp). It concluded that optimum length of reinforcing strips is around 0.6 times the height of wall & the usage of reinforcement reduced the tension in structure by 50% due to surcharge and backfill loading.

Robert M. Koerner et al.(2000) compared the data on the design methodology on the design of retaining structures. It was stated that the Rankine's method of analysis is very conservative and use of geosynthetic RE wall are least expensive.

Laba, Kennedy and Seymour (1983). A study was administered on the structural response of reinforced earth wall model subjected to the action of a surcharge strip load aligned parallel to the wall head. Effects of both vertical and horizontal load elements were investigated. Horizontal forces were applied in 2 directions, i.e, towards the wall face and away from the face. The stress distribution pattern within the reinforcing parts and variation in stress distribution occurring in the reinforced earth medium were also studied.

Results were generated for numerous loading conditions, as well as variations within the load distance from the wall face. Contour diagrams showing the ratio of reinforcing stress to be applied as horizontal load intensity. Experimental results were compared with the theoretical stress distribution, and conjointly with analysis and design procedure presently in use for RE walls beneath horizontal surcharge strip loading. Major differences were observed between the results based on the design method popularly in use and those obtained from the model study.

Durukan et. al. (1992) conducted an cost comparison on the retaining structure having varying height and were of different kind. The analysis of this cost using cost as a parameters for all here types of walls with different height and different reinforcing elements. It was observed that RE walls, are cheaper and more sustainable than regular Retaining structure. Even if the reinforcing elements are changed the results does not vary greatly up to a ht. of 6m. The cost of the structure also become significant when foundations are seated on bored piles and hence the cost efficiency of the conventional retaining wall decreases as the ht. of structure increases

(Belal and George, 2000) A typical geogrid reinforced soil retaining wall constructed with and without facing units was analyzed for seismic response. The walls are proportioned using the Pseudo-Static design method. A finite element method—ABAQUS-code—was employed using Drucker- Prager model to characterize sand and nonlinear elastic reinforcement material. This paper presents the wall responses to a typical seismic spectrum. Of particular interest in this study are: (1) the acceleration response, (2) the wall displacement, (3) the tensile stress in the reinforcement, and (4) the slippage at the soil-reinforcement interface. Probable failure modes were also sought in this study. Specifically, three possible failure mechanisms were investigated, namely, wall displacement, tensile stress in reinforcement, and slippage between soil and reinforcement.

Having designed for peak acceleration of 0.25g in conjunction with a factor of safety of two, the walls withstood a base excitation of 0.5g ground motion. While imposing surcharge loads of different magnitudes, however, those responses begin to accumulate over the duration of the simulated seismic event, indicating imminent failure in one mode or another. Slippage at the interface seems to the probable failure mode of the wall without facing whereas the wall with facing would fail by breakage of the reinforcement.

Magdy M. EL-EMAM et al. experimented with a reduced scale shaking table test & numerical simulation of a wall using FLAC which were subjected to base acceleration i.e. seismic forces.

It was concluded that soil plane-strain material properties back-calculated from numerical simulation of physical direct shear tests on backfill samples were required to generate good agreement between physical and numerical wall response features. A constant reinforcement stiffness value was shown to be a reasonable assumption for numerical modeling of the geogrid reinforcement. However, reinforcement-soil slip for layers with shallow overburden depth was not considered in numerical simulations and this is thought to have led to some discrepancies in reinforcement load response close to the top of the wall.

Notwithstanding the comments made above, the numerical model was found to give reasonably accurate predicts of the experimental results despite the complexity of the physical models under investigation. Both numerical and physical models demonstrated that the toe boundary condition has a large influence on wall performance and stability under both static and simulated seismic loading conditions.

Vignesh et.al.(2012) constructed a RE wall at Saritakunj, New Delhi.It was concluded that reinforced earth technique is particularly advantageous in urban areas where land is scarce and land values are high. Reinforced earth allows construction of walls on the boundary of the world accessible without intruding upon the adjacent land. The technique is straightforward and simple to install. There are solely 3 parts i.e. facing panels, resistance anchors and soil/pond ash. With slight expertise, construction may be allotted with a really quick pace of construction. Pond ash could be used as an alternative to conventional earth as a backfill material. Since there is very little transfer of load to the ground and system being flexible in nature, it can be used on soils with low bearing capacity.

Liyan Wang et.al.(2014) modelled numerically a RE wall in FLAC3D and used FEM based calculation to determine the effect of seismic forces on a HDPE geogrid strengthened RE wall. It had been summarized that the reinforced wall is in inclined deformation state outward, and therefore the residual deformation at the top of wall is that the largest. The coupling shear stresses on the interface between geogrid and soils are smaller within the middle of these layers and bigger in 2 ends of geogrid layers. The reinforced stresses of geogrid placed on higher layers and bottom layers are comparatively smaller. The reinforced stresses of geogrid placed within the middle layers are comparatively larger. The reinforced internal forces of geogrid decrease with the decrease of the reinforcement spacing. The perfect reinforcement spacing is thought of as H/7.5 in unstable styles. The reinforced internal forces of geogrid decrease with the rise of the reinforcement length. The perfect reinforcement length is valued as 1.0 H in unstable designs.

III. CONCLUSIONS

RE walls have been came as a top contender for the mass usage of Retaining walls. It has a fast speed of construction, is a cheap alternative and is aids to aesthetic of landmass. Including the reinforcement in the form of geogrids, geofabrics etc. has improved the retaining system as for example, the lateral earth pressure on the wall decreases with reinforcing soil with reinforcements. It is a technology that needs to be adopted and implemented as it has huge cost cutting tendency in the construction cost. However some failure are also reported in RE walls which needed to be investigated. RE walls perform well under seismic loads than non-reinforced soil structures.

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