International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 5 Issue 6, September-October 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Study of Cost Effectiveness of Reinforced Earth Wall Over Conventional Retaining Wall Considering Different Heights

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ABSTRACT
Reinforced Earth Wall (RE Wall) is an internally stabilized wall. Reinforced earth is a composite material formed by the friction between the earth and the reinforcement. By means of friction the soil transfers to the reinforcement the forces built up in the earth mass. The reinforcement thus develops tension and the earth behaves as if it has cohesion. Significant increase in the traffic and congestion across urban areas creates a demand for a better, efficient and economical soil retention system for bridges, underpasses, flyover and any other type of grade separator so the reduce the cost of the construction also to make structure more durable, reduce problem of the construction following points as has been studied. The objective of this study is to study the Cost Effectiveness between Retaining wall and Reinforced Earth Wall at different heights. The economic benefit achieved from the Reinforced Earth Wall increases with the increase in the height of the wall. Further, RE wall can be made more cost economical by using the combinations of different types of Geo grid and back fill material based on the soil and loading conditions.

KEYWORDS: *RE Wall, Cohesion, Cost Effectiveness, Cost economical, Geo grid, back fill material, loading conditions*

How to cite this paper: Sami Raj Sahu | Deeksha Shrotriya | Barun Kumar "Study of Cost Effectiveness of Reinforced Earth Wall Over Conventional Retaining Wall Considering Different Heights" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-6, October 2021, pp.1166-1169, URL: www.ijtsrd.com/papers/ijtsrd47577.pdf

IJTSRD47577

INTRODUCTION

Retaining wall or the Reinforced earth walls play a very critical role in the development of modern infrastructure due to following reasons such as safe environment and economy of the constructions. A variety of practices has been considered over the years. Planning, design and construction techniques are being developed regularly and refined to satisfy several parameters including feasibility, ease of construction, safety, maintainability, and economy of the better soil retention system.

With the Increase in the traffic and congestion across the urban areas has created a demand for an efficient, better and economical soil retention system for bridges, underpasses, flyover and any other type of grade separator. The construction of these Retaining wall or Reinforced earth walls plays a critical role in the development of modern infrastructure due to safety, environmental, and economic reasons. Along with this significant development, came in a variety of retaining wall types, design and construction methodology. Over time, the classic gravity retaining walls converted into the reinforced cement concrete type retaining walls, with supports such as counter forts or buttresses.

A paradigm shift occurred in the 1960s with the introduction of (MSE's) mechanically stabilized earth walls, i.e., reinforced layers of soil allowing for modular sequential construction, which were recognized as being advantageous at many places or in most of the situations. Initially the reinforcement was steel straps and then welded wire meshes were provided as an alternative. RE Wall panel has varied from metallic to reinforced concrete to segmental units with a variety of shapes and types.

Mitchell and Zornberg (1993) Experimental studies on poorly draining soil-reinforcement interactions were reviewed in a companion paper by Zornberg and Mitchell in 1994, leading to the conclusion that permeable geosynthetic inclusions are useful for reinforcing marginal backfills. This conclusion is strengthened by lessons learned from the case histories described in this paper. There are no design guidelines for reinforced soil structures using poorly draining backfills. Nevertheless, several of these structures have already been constructed, and the performance of some of them has been reported. Good structure performance is strongly dependent on maintaining a low water content in the poorly draining fill. Large movements occurred in reinforced structures when pore water pressures were generated, and failures were reported in marginal backfills reinforced with impermeable inclusions that became saturated after rainfalls. Benefits and applications of reinforcing poorly draining backfills are addressed, and research needs aimed at formulating a consistent design methodology for these structures are presented.

Gerald et al. (1994) The use of cohesive soils in geogrid-reinforced backfills requires consideration of the performance of these materials under both as-compacted and long-term conditions. Depending on the as-compacted conditions, the long-term performance, as a result of in service saturation, can lead to strength loss and failure of such structures. This paper documents the case history of a geo grid reinforced retaining wall, constructed with cohesive backfill, that failed. Several different failure modes were observed along the wall. The results of extensive field and laboratory testing programs and engineering analyses to investigate the causes of failure are presented. These studies permit the different observed failure modes to be explained. Deficiencies in design and construction quality control are identified. The need for site-specific design considerations rather than generic design procedures for such structures is demonstrated.

Bathurst (1994) In this Paper author studied the analysis, design and construction of geo-synthetic reinforced soil retaining walls that use dry-stacked modular concrete units as the facing system (geo-synthetic reinforced segmental retaining walls). The systems have gained wide popularity in North America for reasons of performance, aesthetics, cost and expediency of construction. However, the discrete nature of these modular block systems requires that special attention be paid to the design and construction of the facing elements. Some on sequences of the extension of limit-equilibrium (pseudo-static) methods to the stability of segmental retaining wall structures were reviewed.

Fannin (1994) Field data are reported that describe the load–strain–time relationship of geogrid reinforcement in a reinforced soil structure. The data are for a period exceeding 5 years and reveal a continued strain in the reinforcement, which occurs at nearly constant load. The response to loading is attributed to creep of the polymeric material. A comparison of the field

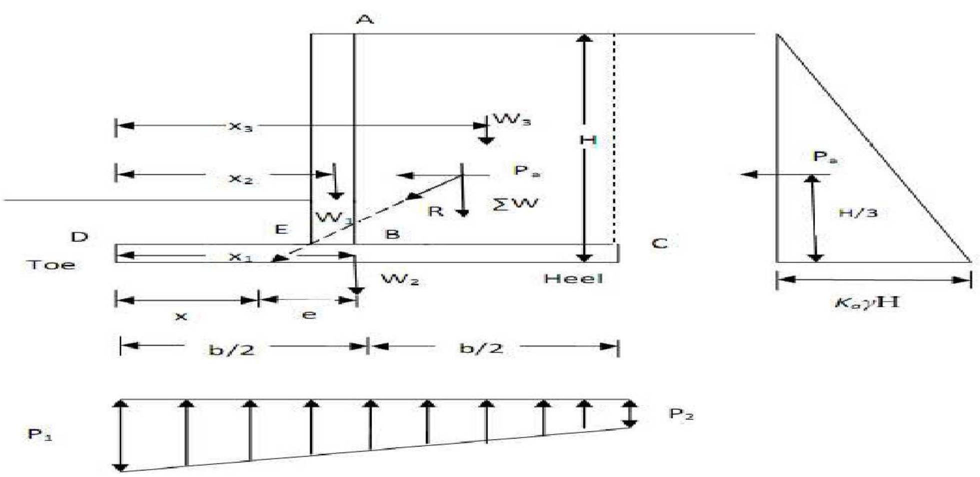
OBJECTIVE OF THE PRESENT STUDY

A. Design of Reinforced Earth wall and R.C.C Retaining Wall for different heights.
B. Calculating the Quantity of various components of the retaining wall and reinforced earth wall
C. Calculating the cost of Retaining wall and Reinforced Earth Wall at different heights.

FORMULATION & Methodology

The examples of the externally stabilized walls are reinforced concrete cantilever and reinforced concrete counterfort walls. These walls are essentially characterized by the concept that the lateral earth pressures due to self weight of the retained fill and accompanied surcharge loads are carried by the structural wall. This necessitates a large volume of concrete and steel to be used in such walls.
standard code.

Stability Check



Setting a Half-Height Panel:
- Set the first half-height panel at its proper location.
- Align the panel with the control line.
- Space the next half-height panel the proper lateral distance from the previous half-height panel using the spacing tool.
- Spacing tool left in place, ensuring proper distance.
- Batter of the half-height panel is set with wedges.

RESULTS AND DISCUSSION

Table 1.RETAINING WALL for 4m Height

Sl. No.	Description of works	Unit	Length	Width	Height	Qty	Total Quantity
A	Earth work in Excavation						
		cum	10.000	3.000	1.000	30.000	
				TOTAL Earth work		30.000	30.000
B	PCC M-15 Grade Concrete						
	M-15 G. Con.	cum	10.000	2.500	0.150	3.750	
				TOTAL M-15		3.750	3.750
C	RCC M-30 Grade Concrete						
i	M-30 .G. con Raft	cum	10.000	2.500	0.400	10.000	
ii	M-30 WALL	cum	10.000	0.417	5.000	20.850	
				TOTAL M-30		30.85	30.85
D	TOTAL Quantity of Steel	MT					2.71

CONCLUSIONS

- To study the cost effectiveness of the Retaining wall and reinforced earth walls the Retaining wall has been designed for a height of 4, 5 and 6 m. As it is a well known fact that the retaining wall tend to fail after a certain height. To stabilize the Retaining walls, counter forts are added to the retaining wall and the same has been designed for the height of 7m, 8m and 9m. Similarly the Reinforced Earth walls also known as RE walls have been designed for the heights of 4, 5, 6, 7, 8 and 9 m.
- The major contribution in the cost difference is attributed to the huge amount of concrete and steel bars usually required in the retaining walls as compared to RE walls due to the basic design difference. The retaining wall is designed on the basis that the earth is retained behind the wall and major loading is on the wall due to earth back fill. Whereas, in its counterpart i.e. the Reinforced Earth Wall the friction between the earth and the reinforcement shares the loadwhich is then transferred to the ground. The reinforcement thus develops tension and the earth behaves as if it has cohesion.
- The economic benefit achieved from the Reinforced Earth Wall increases with the increase in the height of the wall. The percentage savings of the internally stabilized walls i.e. RE wall may range from 40 to 65%. Further, RE wall can be made more cost effective by using the combination of different types of Geo grid and back fill material based on the soil and loading conditions.

REFERENCES –

[1] AASHTO, (1997) Standard Specifications for Highway Bridges, Div. 1, Sect. 5, Retaining Walls, Washington, DC, 89pp, 1997.

[2] Al, H. O., Muhunthan, B., (2006) Numerical procedures for deformation calculations in the reinforced soil walls. Geotextiles and Geo-membranes 24 (1), 52–57, 2006

[3] Alborz, Siavash. (2016). STUDY ON HORIZONTAL DISPLACEMENT OF RESTRAINED EXCAVATION WALLS BY CANTILEVER RETAINING WALL. 10.5281/zenodo.56029. January 2016 DOI: 10.5281/zenodo.56029

[4] Al-Hattamleh, O., Muhunthan, B., (2006) Numerical procedures for deformation calculations in reinforced soil walls. Geotextiles and Geomembranes 24 (1), 52–57, 2006

[5] Allen, T. M., Christopher, B. R., Holtz, R. D., (1992) Performance of a 12. 6 m high

geotextile wall in Seattle, Washington, geosynthetic-reinforced soil retaining walls. In: Wu, J. T. H. (Ed.), Balkema, Proceedings of the International Symposium on Geosynthetic-Reinforced Soil Retaining Walls, Denver, Colorado, USA, pp. 81–100, 1992

[6] Anderson, R. B. (1993) Construction Considerations for Geogrid-Segmental Block Mechanically Stabilized Earth Retaining Walls, Transportation Research Record, 1414: 12–15, 1993

[7] Aylin Ece Kayabekir, Zülal Akbay Arama, Gebrail Bekdaş, Sinan Melih NigdeliZong Woo Geem(2020). "Eco-Friendly Design of Reinforced Concrete Retaining Walls: Multi-objective Optimization with Harmony Search Applications", Sustainability 2020, 12(15), 6087; https://doi.org/10.3390/su12156087 Received: 15 June 2020 / Revised: 11 July 2020 / Accepted: 27 July 2020 / Published: 29 July 2020

[8] Azad, A., Yasrobi, S., Pak, A., (2008) Seismic active earth pressure distribution behind rigid retaining walls. Soil Dynamics and Earthquake Engineering 28 (5), 365–375, 2008

[9] B. Ceranic, C. Fryer and R. W. Banies. (2001) An application of simulated annealing to the optimum design of reinforced concrete retaining structures. Computers and Structures, 79: 1569-1581, 2001

[10] Baker, R., Klein, Y., (2004) An integrated limiting equilibrium approach for design of reinforced soil retaining structures, part I: formulation. Geotextiles and Geomembranes22 (3), 119–150, 2004

[11] Bathurst, R. J., Jarrett, P. M., Benjamin, D. J. R. S., (1993) A database of results from an incrementally constructed geogrid-reinforced soil wall test. In: Proceedings of Soil Reinforcement: Full Scale Experiments of the 80's. ISSMFE/ENPC, Paris, France, pp. 401–430, 1993b

[12] Bathurst, R. J., Simac, M. R., (1994) Geosynthetic reinforced segmental retaining wall structures in North America. In: Proceedings of the Fifth International Geosynthetics Conference, Singapore, SEAC-IGA, Keynote Lecture Volume, pp. 29–54, 1994.

[13] Bathurst, R. J., Simac, M. R., Christopher, B. R., Bonczkiewicz, C., (1993) A data-base of results from a geosynthetic reinforced modular block soil retaining wall. In: Proceedings of Soil Reinforcement: Full Scale Experiments of the 80's. ISSMFE/ ENPC, Paris, France, pp. 341–365, 1993a

[14] Berg, R. R., Meyers, M. S., (1997) Analysis of the collapse of a 6. 7m high geosynthetic-reinforced wall structure. In: Proceedings of the Geosynthetics '97. IFAI, Roseville, MN, pp. 85104, 1997.

[15] Berg, R. R., Nelson, B., (2000) Practical implications of MBW unit-geosynthetic connection strength requirements. In: Proceedings of the 14th GRI Conference. GAI Publications. Folsom, PA, pp. 307–322, 2000