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COMPARISON OF GEOGRID REINFORCED SOIL RETAINING WALL WITH R.C.C. RETAINING WALL WITH RESPECT TO COST & TIME

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Abstract: From year soil retention has been a problem faced by mankind. In his research for better results man has tried several ways to retain massive masses of soil ranging from bamboo, wood, and alternative materials to random detritus masonry. As time progressed RCC retaining wall has become the foremost commonly sought after solution .With the appearance of recent concepts and materials, technology has found better methods to retain heavy masses of soil. RE wall using Geogrid is new soil retaining technology have been widely used in recent years worldwide but the implementation is not up the mark in India. Here the paper focuses on the study of RCC wall and retaining walls using Geogrid for the purpose of cost and time consumption comparison.

Keywords: Retaining Wall, Geogrid, Construction Cost & Time

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

There have been situations where high retaining walls are required to resist the lateral earth pressure. Reinforced soil walls may be a possible solution for such cases, Now a day's RE wall using geogrid technology used in Europe and North America. . The process was adopted all over the world and become popular

In India RCC retaining wall construction uses widely but Geogrid reinforced soil retaining wall technology implementation is not up the mark as per compared to other Asian countries because of lack of knowledge about construction process, cost of construction, time consumption for construction process about that Hence in this research, detailed study about construction process, types, construction cost, quality, uses, advantages and disadvantages of geogrid reinforced soil retaining wall and its economic analysis with RCC retaining wall for 6m, 8m heights.

AIM - This research focused on comparison of RCC wall and geogrid reinforced soil retaining wall on the basis of Cost and time.

OBJECTIVES –

1) To compare R.C.C. retaining wall and Geogrid reinforced soil retaining wall for the analysis of cost of construction.

2) To compare R.C.C. retaining wall and Geogrid reinforced soil retaining wall for the analysis of time consumption for the construction process.
3) To suggest an environmental friendly technology, this can be beneficial for the society.

LITERATURE REVIEW

In the past several researchers have studied, the differentiation between the walls.

Mena I. Souliman and Claudia Zapata (2011),

This papers researches Geo synthetics have become well established construction materials for geotechnical applications in most parts of the world. Because they constitute manufactured materials, new products and applications are developed on a routine basis to provide solutions to routine and critical problems alike. Results from recent research and from monitoring of instrumented structures throughout the years have led to new design methods for different applications of geo synthetics. Because of the significant breath of geo synthetics applications, this paper focuses on recent advances on geo synthetics products, applications and design methodologies for reinforced soil using geo synthetics reinforced walls.

Harangad Singh and Dr. Saleem Akhtar (2015),

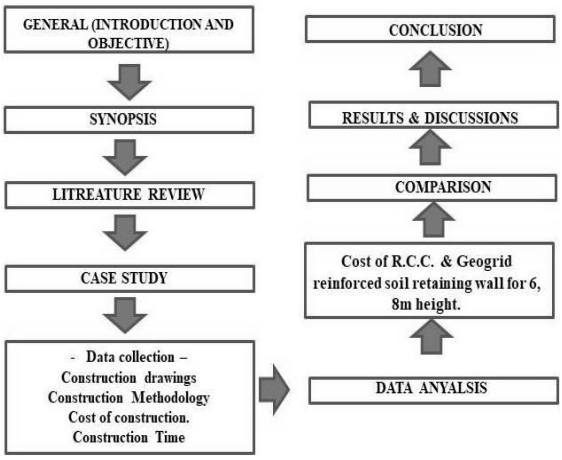
This paper gives the cost analysis of the reinforced earth walls with different types of reinforced materials for different heights. Retaining walls as earth structures are frequently constructed for a variety of applications, most common being bridge abutments and road construction. When selecting a retaining wall type, mechanically stabilized earth (MSE) walls should always be considered. MSE walls are composed of reinforcing elements, e.g. geo synthetics in the soil fill to resist lateral earth pressures. The use of geo grids or geotextiles rather than metallic strips (ties) is a further development of the Reinforced Earth concept. Geo synthetics offer a variable and often economical alternative to metallic reinforcements for both permanent and temporary walls, especially under certain environmental conditions.

Tamadher Abood, Hatem E.Younis Eldawi, and Faeza R. Elnaji Abdulrahim(2015),

This papers research that the cantilever is the most common type of retaining wall and is used for walls in the range. This study presents analyses and design of cantilever retaining wall which is made from an internal stem of steel-reinforced, cast-in-place concrete (often in the shape of an inverted T). In this work a detailed analyses and design for this type of walls which include estimation of primary dimensions of the wall, then these dimensions were checked. Calculation of reinforcement for each part of the wall were done. All analysis and design are based on the ACI code.

METHODOLOGY

In this study analytical work is done with respect to construction cost and time. For this, bridge construction site selected as a case study. In this construction geogrid reinforced soil retaining wall was used. Data related to construction of geogrid reinforced soil retaining wall in terms of cost and time consumed was identified. The height of retaining wall was 6 m and 8 m. same height of R.C.C. retaining wall was designed. Comparison between these walls was done based on cost and time parameter.



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CASE STUDY: GEOGRID REINFORCED SOIL RETAINING WALL

Name of project: Road over bridge at Solapur-Dhule road,

Near , R.T.O Office ,Beed

Owner: P.W.D

Table – 1

Construction Cost of Geogrid Reinforced Soil Retaining Wall Case Study

Sr. No.	Items Name	Cons. /sqm.	Unit	Rate/ unit	Rate /sqm
1	Loops/Sqm	6.64	Nos.	18	119.54
2	Hooks	0.96	Nos.	10	9.63
3	Connecting Rod	1.02	Nos.	250	255.73
4	EPDM pad	0.96	Nos.	47	45.28
5	Geo Textiles	0.4	Sqm	55	22.00
6	Geo Grid	5.39	Sqm	135	728.39
7	PVC Pipe	0.00966	Nos.	450	4.35
8	Hydra		Sqm	74.61	74.61
9	Labor		Sqm	250	250.00
10	Office staff Visit at site		Sqm	10	10.00
11	Wedges		Sqm		16.00
12	Tools		Sqm		5.00
13	Over Head		Sqm		100.00
14	Mobilization & De mob		Sqm		11.75
15	Salary	108	Sqm		108.00
16	Labor Camp		Sqm		5.69
17	Mould		Sqm		100.00
18	Mould Foundation		Sqm		10.00
19	Security	18	Sqm		18.00
20	Staff Accommodation	10.8	Sqm		10.80
21	Concrete	3600	Cu m.	5500	990.00
22	Steel	150000	Kg	45	337.5
23	Excavation Works	92000	Cu.m.	110	506.00
24	Back Filling Murum	220000	Cu.m.	180	1,980.00
25	Filter Madia	13000	Cu.m.	1400	910.00
			Total	6,628.28	
			GST	18.00 %	1,193.09
			Profit	15%	994.24
	Proposed Rate/sqm.		8,815.61		
	Total construction cost		8815.61 x 1064.832 = **RS. 93,87,143.62**		

R.C.C. Retaining Wall

Table – 2

Dimensions of Counter fort Retaining Wall

Height of Wall m	Bending moment (KN.m)		Depth of base slab required mm	Depth of base slab Provided mm
	Toe	**Heel**		
6	12.67	158.98	240.03	400
8	47.58	232.12	290.00	450

Ht of wall m	Total Base Slab m	Width of Toe Slab	Width of Heel slab	Base slab Thk. m	Stem Thk. m	
					Top	Bottom
6	3.5	0.3	3.0	0.28	0.2	0.2
8	4.25	0.5	3.45	0.35	0.3	0.3

Table – 3

Structural Analysis of Counter-fort Retaining wall (Base slab)

Table – 4

Design of Base Slab of Counter Fort Retaining Wall

Ht. Of Wall m.	Base slab Thick. Mm	Main Steel.			
		Toe slab		Heel slab	
		Ast. mm2	Bar Dia. & Spacing	Ast. mm2	Bar Dia. & Spacing
6	400	168.73	ϕ10@150mm	1172.70	ϕ20@150 mm
8	450	297.07	Φ12@150mm	1538.54	ϕ20@150 mm

Table – 5

Moment & Reinforcement Details along Length of Stem for Counter Fort Wall

Ht. of wall m.	**Moments (KNm)**	**Stem Thickness**		**Steel prov. In Vertical wall**	
		Dreq. Mm	**Dprov. mm**	**Ast mm2**	**Bar Dia. & Spacing**
6	72	161.51	200	1130.09	Φ10 @70mm
8	73.5	163.19	300	1736.00	Φ12 @65mm

Table – 6

Cost per Running Meter for Counter fort Retaining Wall

Ht. of wall	**6m**		**8m**	
Location	Concrete m^3	Steel kg	Concrete M^3	Steel kg
Stem	1.2	76.08	2.4	137.6
Base slab	0.98	66.16	1.49	80.08
Counter Forts	2.7	137.2	5.18	234.05
Total	4.88	279.44	9.07	451.73
Rate	5500	45	5500	45
Amount	26840	12574.8	49885	20327.8
Sum	**39414.8**		**70212.51**	

DATA ANALYSIS

A. Cost Analysis of Geogrid Reinforced Soil Retaining Wall

Table – 7

Total Cost per Running Meter for Geogrid reinforced soil Retaining wall of 6m height

Description	**Unit**	**Rate (Rs./Unit)**	**Quantity**	**Amount (Rs.)**
Earth Work Excavtion	Cum.	110	9	990
Levelling Pad (M15 Grade Concrete)	Cum.	5500	0.0656	360
RE wall with Facia Pannel	Sqm.	1350	4	5400
Back Filling (Murum) in Reinforced Zone	Cum	180	33	5940
Geogrid	Sqm.	135	48	6480
Total				**19,170**

Table – 8

Total Cost per Running Meter for Geogrid Reinforced Soil Retaining Wall of 8m Height

Description	**Unit**	**Rate (Rs./ Unit)**	**Quantity**	**Amount (Rs.)**
Earth Work Excavtion	Cum.	110	9	990
Levelling Pad (M15 Grade Concrete)	Cum.	5500	0.0656	360
RE wall with Facia Panel	Sqm.	1350	6	8100
Back Filling (Murom) in Reinforced Zone	Cum	180	44	7920
Geogrid	Sqm.	135	72	9720
Total				**27,090**

B. Cost Analysis of Counterfort Retaining Wall.

Table – 9

Total Cost per Running Meter for Counter Fort Retaining Wall of 6m Height.

Description	**Unit**	**Rate (Rs./Unit)**	**Qty.**	**Amt(Rs.)**

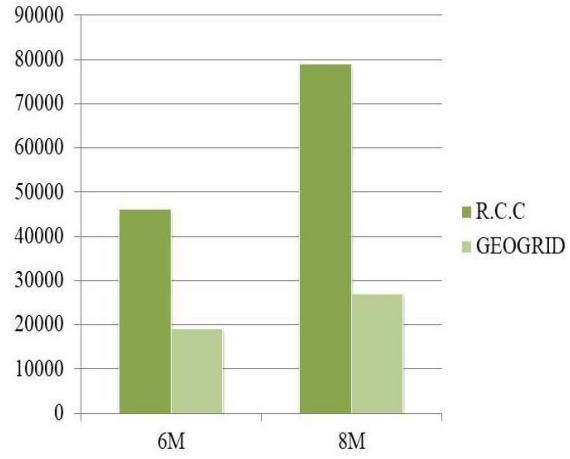
Earth Work Excavation	Cum.	110	7	770
Back Filling (Murum) material	Cum	180	33	5940
Concrete	Cum	4.88	5500	26,840
Steel Reinforcement	Kg	279.44	45	12,575
Total				**46,125**

Table – 10

Total Cost per Running Meter for Counter fort Retaining Wall of 8m Height

Description	Unit	Rate (Rs./ Unit)	Quantity	Amount (Rs.)
Earth Work Excavation	Cum.	110	7	770
Back Filling (Murum)material	Cum	180	44	7920
Concrete	Cum	9.07	5500	49,885
Steel Reinforcement	Kg	451.73	45	20,328
Total				**78,903**

Graph 1: Final Cost Comparison



RESULTS & DISCUSSIONS

A. Results

Geogrid reinforced soil retaining wall have many advantages compared with R.C.C retaining walls. They are summarized as follows:

- Use simple and rapid construction procedures and do not require large construction equipment.
- Do not require experienced craftsmen with special skills for construction.
- Require less site preparation than other alternatives.
- Need less space in front of the structure for construction operations (facia panels)
- Reduce the requirement of space.
- Cost effective.
- Required less time for construction.

B. Quality Control

In RCC retaining wall concreting is done cast-in-situ. Whereas in Geo-grid retaining wall precast panels are used to retain the earth.

Because of precast concrete products typically are made in a controlled plant environment, they exhibit high quality and uniformity. Problems affecting quality typically found on a job site-temperature, curing conditions, poor craftsmanship and material quality are nearly eliminated in a plant environment.

Precast concrete is less susceptible to vibratory damage while the surrounding soil is backfilled. Consequently, backfilling operations can usually proceed much faster around precast concrete structures.

The strength of precast concrete gradually increases over time. Other materials can deteriorate, experience creep and stress relaxation, lose strength, deflect over time and may not be able to withstand vehicular impacts.

The load-carrying capacity of precast concrete is derived from its own structural qualities and does not rely on the strength or quality of the surrounding backfill materials.

Prolonged exposure of geogrid reinforcement to sunlight should be avoided to prevent change in properties due to ultra violet rays. Hence, quality

control in construction of geo-grid reinforced soil retaining walls is better than RCC retaining wall.

C. Duration of Construction

The construction sequence of RCC Retaining walls involves casting of base and stem followed by backfilling with specified material.

This requires considerable amount of time as concrete has to be adequately cured and sufficient time spacing has to be allowed for concrete of previous lift to gain strength before the next lift is cast.

Geo-grid retaining walls have relatively fast speed of construction. This is firstly because of less volume of concrete and steel fabrication work, and secondly because the placing of wall panels, laying of reinforcements and compaction of reinforced fill are carried out simultaneously.

CONCLUSION

The overall cost of RCC retaining wall is Rs. 46,125 and the overall cost of Geo-grid reinforced soil retaining wall is Rs. 19,170 for 6m height. Hence the percentage saving in cost is around 58% for 6m height.

The overall cost of RCC retaining wall is Rs. 78903 and the overall cost of Geo-grid reinforced soil retaining wall is Rs. 27090 for 8m height. Hence the percentage saving in cost is around 65% for 8m height.

Hence the percentage saving in cost in geogrid reinforced soil retaining wall is 60%.

Geo-grid retaining wall requires less amount of time as all the construction processes are simultaneous. RCC retaining wall requires considerable amount of time as all the construction processes are sequential. Hence Geo-grid retaining wall consumes less time during construction.

Quality control is better in Geo-grid retaining wall as compared to RCC retaining wall.

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