

Study of Geogrid Reinforced Soil Retaining Wall & Its Comparison with R.C.C. Retaining Wall with Respect To Cost & Time

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Abstract

From yesteryear 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

I. INTRODUCTION

At present situation, all over the world due to increase in competition in construction industry. Quality, Cost and Time are the biggest priorities of construction industry and this is only obtainable when modern construction techniques are implemented by construction industry. To retain large and heavy masses of soil retaining walls are structure which are used to retain it. There are various materials that may be accustomed to construct retentive walls like treated timbers, concrete blocks, rocks or boulders. From a number of them are easy to use and others have a shorter life span, however all will retain soil. Retaining walls are usually designed to retain soil mass and even be made for landscaping functions. Retaining walls are structures that are created to retain soil or any such materials that are unable to withstand vertically by themselves. They're additionally provided to take care of the grounds at two completely different levels.

Earlier everyone uses RCC retaining wall for soil retention. 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 Asia (e.g., Japan, China, Korea, Taiwan, Singapore, Vietnam, Thailand, Malaysia and India)

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.

Hence in this research, detailed study about construction process, types, construction cost, quality, uses, advantages and disadvantages of RCC retaining wall and geogrid reinforced soil retaining wall for comparing both this walls on the basis of cost and time consumption.

The previous research studied about the history, design, uses, properties of RCC retaining wall and geogrid reinforced soil retaining wall but comparison of cost analysis of both retaining wall is not done up till now. Hence this research focused on comparison of RCC wall and geogrid reinforced soil retaining wall on the basis of Cost and time.

II. OBJECTIVES

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

III. 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 were identified. The height of retaining wall was 6m and 8m. Same height of R.C.C. retaining wall were designed. Comparison between these walls were done based on cost and time parameter.

IV. CASE STUDY: GEOGRID REINFORCED SOIL RETAINING WALL

A. Details of Project

- Name of project: Road over bridge at dombivli of level crossing gate no.38-c between dombivli and thakurli station.
- Title: Reinforced soil wall with geogrid reinforcement & panel facing.
- Owner: Kalyan dombivli municipal corporation
- Consultant: Best geotechnics pvt. Ltd.

1) Construction Cost

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	6.64115881	Nos.	18	Rs. 119.54
2	Hooks	0.96343402	Nos.	10	Rs. 9.63
3	Connecting Rod	1.02292881	Nos.	250	Rs. 255.73
4	EPDM pad	0.96343402	Nos.	47	Rs. 45.28
5	Geo Textiles	0.4	Sqm	55	Rs. 22.00
6	Geo Grid	5.39545455	Sqm	135	Rs. 728.39
7	Pvc Pipe	0.00966667	Nos.	450	Rs. 4.35
8	Hydra		Sqm	74.61	Rs. 74.61
9	Labour		Sqm	250	Rs. 250.00
10	Office staff Visit at site		Sqm	10	Rs. 10.00
11	Wedges		Sqm		Rs. 16.00
12	Tools		Sqm		Rs. 5.00
13	Over Head		Sqm		Rs. 100.00
14	Mobilization & De mob		Sqm		Rs. 11.75
15	Salary	108	Sqm		Rs. 108.00
16	Labour Camp		Sqm		Rs. 5.69
17	Mould		Sqm		Rs. 100.00
18	Mould Foundation		Sqm		Rs. 10.00
19	Security	18	Sqm		Rs. 18.00
20	Staff Accommodation	10.8	Sqm		Rs. 10.80
21	Concrete	3600	Cu m.	5500	Rs. 990.00
22	Steel	150000	Kg	45	Rs. 337.50
23	Excavation Works	92000	Cu.m.	110	Rs. 506.00
24	Back Filling Murum	220000	Cu.m.	180	Rs. 1,980.00
25	Filter Madia	13000	Cu.m.	1400	Rs. 910.00
			Total		Rs. 6,628.28
			GST	18.00%	Rs. 1,193.09
			Profit	15%	Rs. 994.24
			Proposed Rate/sqm.		Rs. 8,815.61
			Total construction cost		8815.61 x 1064.832 = RS. 93,87,143.62

2) V.R.C.C. Retaining Wall

Table – 2
Dimensions of Counter fort Retaining Wall

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)

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

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	1172.70	φ20 @150mm

			@150mm		
8	450	297.07	Φ12 @150mm	1538.54	φ20 @150mm

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 mm ²	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	
	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	20327.85
Sum	39414.8		70212.51	

V. 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 Excavation	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 Excavation	Cum.	110	9	990
Levelling Pad (M15 Grade Concrete)	Cum.	5500	0.0656	360
RE wall with Facia Pannel	Sqm.	1350	6	8100
Back Filling (Murum) in Reinforced Zone	Cum	180	44	7920
Geogrid	Sqm.	135	72	9720
Total				27,090

B. Cost Analysis of Counterfort Retaining Wall

Table – 9

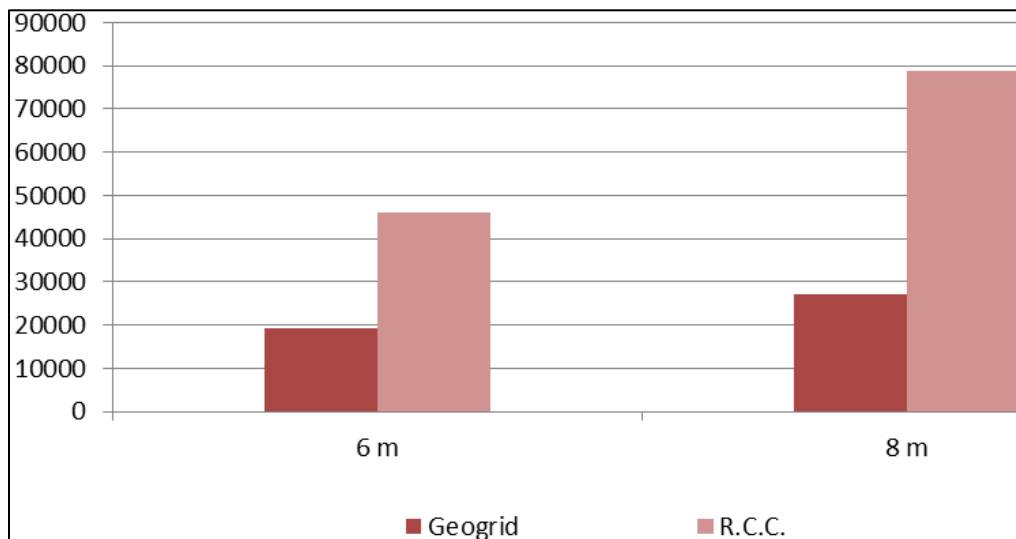
Total Cost per Running Meter for Counter Fort Retaining Wall of 6m Height.

Description	Unit	Rate (Rs./ Unit)	Quantity	Amount (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

VI. 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.

VII. 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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