

# Gabion Wall—A Cost Effective Solution

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**Abstract**—Gabion walls are in the industry since many years now. However the use of Gabion walls in the Indian market has not gained as much popularity as in the foreign countries. Gabions are useful not only due to their aesthetic appearance but the cost consideration of this wall is also an important aspect that has to be considered while choosing the type of wall for construction.

India being a developing country, infrastructure development cost is a major issue. The reduction of cost in any infrastructural element along with increased construction speed is very valuable. From a general market survey, I have observed that the difference between the construction cost of RCC and gabion wall of medium height (1 to 4m) is around 40%. Many of the private builders have taken this option very seriously and implemented also. Due to the current trend in building construction tends to more environmental friendly. So reuse of excavated material also helps builder not only to get more points for environmental friendly project but also reduces construction and site development considerably.

In this paper, I am putting forward the various aspects of Gabion wall along with the study of cost comparisons of the Gabion retaining walls with the other conventional materials. I will also talk about the reasons why the Gabion wall should be preferred over the other types through the case study of the recent construction solution of using Gabion wall in Nagpur for a proposed project.

## 1. INTRODUCTION

Gabions are rectangular baskets fabricated from a hexagonal mesh of heavily galvanized steel wire. The baskets are filled with rock and stacked on top one another to form a gravity type wall. Gabions depend mainly on the interlocking of the individual stones and rocks within the wire mesh for internal stability, and their mass or weight to resist hydraulic and earth forces. Gabions are a porous type of structure that can sometimes be vegetated. Gabions are considered to be an economical construction solution without compromising on the aesthetics.

Gabions are employed widely majorly in the foreign countries for many years due to their versatility, which includes hydraulic structures in river training works and in protection works for roads and land reclamation. Gabion cages are not merely containers of stone since each unit is securely connected to each adjacent cage during construction. The wire mesh is monolithic through the structure in three dimensions, from top to bottom, end to end, and from outer face to inner face.

Efficiency in gabion structures, rather than decreasing with age, actually increases. During early periods of use, silt and vegetation will collect with the rock fill to form a naturally permanent structure and may be used to remove solid pollutants or "floatables" from the water.

In India now with the growing challenges to the construction industry, engineers are putting forward the option of Gabion wall and we will talk about the two projects where the Gabion wall is implemented as solution and cost comparison.

## 2. BACKGROUND

The studies on gravity type rigid retaining walls commenced along with the birth of the geotechnical engineering subject. Numerous studies have been conducted on the Gabion walls and their behavior being semi rigid in nature (due to the partial rigidity offered by the facing and flexibility offered by the reinforced portion) hence the behavior is quite familiar to the practicing engineer.

But the popularity of these walls is gaining high impetus outside India from long time. In India, the engineers have started now considering this option very positively. Being a developing country, the construction cost is a major consideration which we will talk about later in this paper.

## 3. CURRENT SITUATION DEMAND

The concept of retaining walls with gabion facing is gathering tremendous growth in the present time. They are gaining considerable attention as retaining structures and providing a valuable alternative to traditional concrete walls. Gabion faced walls present a low environmental impact and a good ratio between cost and effectiveness. This comes about for a number of reasons, among which are: no casting, ease of placement, good tolerance for foundation irregularities and descent aesthetics. Building architects, landscape developers, private property owners etc., have also readily accepted these wall systems in addition to geotechnical consultants. No longer confined to low and medium heights, gabion walls with mesh reinforcement now compete with other wall types in all height categories. (The highest wall located in Taiwan is approximately 38m high.) Therefore the use of Gabion wall as

a cost effective solution is highly recommended considering the above.

**4. USES AND ECONOMICAL CONSIDERATIONS**

Gabions are highly cost effective construction materials which are easy to install and maintain. With environmental issues now of more concern than in the past, gabions offer a more natural solution to previously designed concrete walls.

Gabion structures can be built quickly and economically under all conditions and are especially suitable for stabilizing slopes in mountainous regions and in regions with unfavourable soil characteristics. Gabion retaining walls are flexible, and soil movements do not result in the reduction of the load bearing capacity in the already constructed retaining wall structures, as opposed to retaining walls with a rigid concrete structure, where cracks and fractures may occur, which may result in the final deterioration of the retaining wall.

Gabion retaining walls offer an economical and attractive alternative to concrete retaining walls. They can be filled with local stone or even concrete rubble.

The advantages of these walls over the gravity type walls are added stability and the reduction in cost of the structure due to the reduction in facing width.

In general it is observed that the introduction of reinforced earth lowered the cost of structures. The savings over conventional retaining structures varied between 20% to 50% with an overall average savings in the walls and abutments of 32%. It can also be noted that there is an added advantage in the use of rock waste from the quarries in the sense that the otherwise colossal cost of the conventional retaining structures is reduced to a very low value.

**5. COST COMPARISONS**

The RCC walls are costlier than the gabion faced walls because of the immense cost involved in the steel and concrete components. The cost of concrete includes the rates of shuttering, placing and curing of concrete as well as those of materials. The cost of steel includes the placing and tying of steel bars apart from the material cost. As the height increases, it is seen that the RCC walls are costlier and the gabion faced soil retaining walls are the cheapest.

It is also seen that the gabion faced reinforced soil walls take the maximum space and the gabion faced gravity walls occupy the least space. The reason being, for reinforced soil walls, it is the friction between the soil and the reinforcement which acts as one of the stabilizing force.

So the facing section becomes thinner in this case and the reinforcement and the backfill takes more space. In the case of cantilever and counterfort walls, the stem is kept thinner and the base width is increased occupying more space. But in the case of gabion faced gravity walls, the entire cross section

becomes wider as the height of wall increases as in the case of random rubble masonry walls. Since the entire width increases rather than the base width alone, the total width required is less when compared to the RCC walls.

The elements comprising the total cost of the gabion faced walls consists of the following items:-

1. Gabion boxes (including assembly at site)
2. Basal extension material and reinforced soil fill (for gabion faced reinforced soil walls alone) (Cost includes hauling from source and compaction at site)
3. Stones for filling gabion boxes
4. Geotextile provided as a filter at the back of wall
5. Site clearance and earthwork excavation at site
6. Laboratory and in - situ testing of soil
7. Transportation of materials
8. Labour charges
9. Overhead and Profit

**GABION WALL**

SR.NO	ITEM	GRAVITY TYPE COST/m <sup>2</sup> (RS.)
1	EXCAVATION	300
2	GABION	2500
3	STONES	800
4	LABOUR	350
5	GEOTEXTILE	50
6	BASALT EXTENSION	0
	<b>TOTAL</b>	<b>4000</b>

**RCC WALLS (4MT. HEIGHT, CANTILEVER TYPE)  
(RATES INCLUDE LABOUR, SHUTTERING, MATERIALS & ALL FINISHES)**

SR.NO	ITEM	GRAVITY TYPE COST/m <sup>2</sup> (RS.)
1	EXCAVATION	300
2	REINFORCEMENT	3000
3	CONCRETE (M-25)	4500
	<b>TOTAL</b>	<b>7800</b>

**6. CASE STUDY – PROPOSED SOLUTION AT NAGPUR CITY, INDIA**

One of the prestigious and oldest lake protection walls will be reconstructed in Nagpur. In this case lake protection wall is also subjected to surrounding traffic surcharge pressure. Lake is very old and ecologically also sensitive. Height of

protection wall is around 4-5 meter. RCC/PCC retaining wall construction was least preferred due to its construction complications, time required (subsequently high cost involved) and due to disturbance it might have created to lake ecology. Thus after consideration of above points, Gabion Wall construction was selected. In that Gabion Wall with reinforced earth was final option.

## 7. CONCLUSION

Gabion faced retaining walls which are gaining fast momentum in construction recently are commonly built as either gravity walls or reinforced earth walls.

The cost comparisons show that there can be 25% replacement of rock pieces inside the gabions by a cheap and locally available material like rock waste without much altering the stability of the structure. In cases where deformation can be allowed to a certain extent, even a 50 - 50 combination of rock pieces and rock dust may be used. 25% of the gabion fill may be replaced with a locally available inexpensive material in order to bring down the cost of construction of the walls.

30 – 50% savings could be obtained by going in for gabion faced gravity walls while the percentage goes up to 60 - 70% for gabion faced reinforced soil walls.

So it can be seen that Gabion retaining walls are proving to be the cost effective and eco-friendly solution in the coming years.

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