

# Investigating Destruction Reasons of Retaining Walls in Khost, Afghanistan

Bahram Amiri

**Abstract:-** Retaining walls usually use for the purpose of holding loose back soils and flood protection. Retaining walls can be constructed from different materials such as stone masonry, concrete (plain and reinforcement) materials, and gabions. Steel and wooden retaining walls can be also used in some cases. This study investigates the destruction causes of retaining walls constructed from different materials. We have used field data collected from different sites in the city of Khost, Afghanistan. The result revealed that the destruction level of stone masonry walls is lower than that walls constructed from reinforced cement concrete retaining walls while both of them were constructed by local people without design documents. It has been also found that reinforced cement concrete walls shown better result than stone masonry walls and gabion walls while they are properly designed.

**Keywords:-** Retaining Wall, Destruction Causes, Stone Masonry, Reinforced, Gabion.

## I. INTRODUCTION

Retaining walls are used to retain soil in the back of the walls, create level surface and protect land/homes from flood. The structure of retaining wall can be selected according to the function for which it is to be considered [8]. The soil and loose materials in the back of retaining wall create lateral and other forces. The essential job of the retaining wall is to resist against that forces and protect the back soils from sliding downwards. The continues forces as well as the environmental and other issues can both deteriorate and destruct the retaining walls. Different materials can be used for construction of retaining walls. For instance, reinforced cement concrete (RCC), stone masonry, gabion and others [1]. The selection of materials and design should be properly considered according the site condition, availability of construction materials and the function of the wall [2, 3, 4]. Several studies from developed countries have investigated the causes of retaining walls destructions. In the case of developing countries, limited studies have been addressed this issue. Therefore, in order to investigate this issue in developing countries, this study attempts to find the main causes of retaining wall destruction in the city of Khost, Afghanistan, as a case of developing countries. In other words, this study compares the destruction causes of different types in term of materials (e.g. gabion, stone masonry and

concrete), location, and design technics (e.g. privately constructed by local people without design, constructed by contractors with available design documents).

## II. METHODOLOGY

In order to achieve the objectives of this study, we have conducted field observations surveys of different retaining walls in Khost city, Afghanistan. We have surveyed the following mostly used retaining wall types in the district of Tani located in Khost province.

1. Stone masonry retaining walls
2. RCC retaining walls
3. Gabion retaining walls

Each of the above-mentioned type of retaining wall existed in the field is discussed as below:

**Stone masonry walls:** In the field, we have observed pure stone masonry walls (stone wall without grout) and retaining walls constructed from stone used in grout. The first type of walls was privately constructed by local people without design documents. Therefore, most these walls were destructed. While the second type of retaining walls was designed, constructed and control by the government. Therefore, the levels of destruction in this type of walls were smaller than the second than the walls constructed from stones without grout.

**RCC retaining wall:** These types of walls were constructed by local people for protecting their lands/homes against flood. Based on the explanation of the local people, they have not used any design documents and proper construction technology. Therefore, the walls were heterogeneously constructed.

**Gabion retaining walls:** These types of walls were constructed from stone covered in steel net. Such types of walls were also constructed by the local people. It is worthy to mention that the steel wire net was provided by the government. The results of lasting of such walls were also negative.

In addition to the field observation, we have interviewed the local people in order to gain their view with respects to the conditions of retaining walls constructed in the field.

**III. RESULT**

This study investigates the reason of destructions of retaining walls constructed from stone masonry, RCC and gabions. We have considered several factors in this study. For instance, time after construction, construction authority (e.g. local people or government), availability of design and drawing documents and so forth. The percentage of the destruction comes from the ratio of wall length destroyed over the total length of the wall. In this study, we made the following four types of comparisons:

1. Comparison of stone masonry walls: We have compared three between each others. Two of them were constructed by government having design documents. The destruction level in both walls was different. In addition, the third types of the wall were privately constructed by the local people without design documents. As shown in table 1, both the walls constructed by government have different level of distructions. Wall 1 is more likely to be durable

compared to wall 2. We have also compared the wall constructed by local people (wall 3) with the walls constructed by government (wall 1 and wall 2). As shown in table 1, the destruction amount of wall 3 was higher than wall 1 and smaller than wall2. . Based on the explanation of interviewees and the site observations, we can conclude that the back of wall 2 was not filled. From these findings we can conclude that construction of retaining walls with design document is important bu not enough. The reason for destruction of wall 1 is normal destructions that can be happen to every structure in a time span. While the dominant reason for destruction of wall 2 is no filling back of retaining wall after constructions. Please note that the local people explained that the design documents have no considerations regarding the back filling of that wall. In the case of wall 3, improper use of construction materials (e.g. using stones without grout) and less experience of skilled labors (e.g. stones bonding was not carefully considered).

Details	Wall 1	Wall 2	Wall 3
Destruction	21%	41%	37%
Design documents availability	Avaliable	Avaliable but not completed	Not available
Constructed by	Government	Government	Local people
Dominant destruction causes	Natural	No back filled	Improper use of materials

Table 1:- Comparison of stone masonry walls

2. RCC walls: In this research, we have also reinforced concrete walls that were designed and constructed by government as well as the walls that were constructed by local people without design documents. As stated in table 2, the RCC 1 that was monitored by government (15%) shows better result than RCC 2 constructed by the local people (42%). We noticed from the interviewees due to limitation-of budget required for construction of walls, the quality of

the walls were partially ignored.

We have noted during the data collection that all the gabion walls constructed in research area were constructed by government. In addition, similar distruction were observed in gabion walls. Hence the comparison study between gabion walls is not considered here.

Details	RCC 1	RCC 2
Service period (year)		
Destruction	15%	42%
Design documents availability	Avaliable	Not available
Constructed by	Government	Local people
Dominant destruction causes	Natural	Low quality material and improper usage

Table 2:- Comparison of RCC walls

3. Comparison of stone masonry and RCC walls constructed by government: We have also compared all three different types of walls surveyd in this study. In the table 3, we have compared the stone masonry walls and RCC walls that were constructed by government. As stated in the table the RCC walls (15 % destructions) had shown better result

than stone masonry walls (31% destruction). From these findings we can conclude that RCC walls can stand longer while compared to the stone masonry walls. However, we have not considered the material and construction cost of these two types of walls.

Details	Stone masonry	RCC
Destruction	31%	15%
Constructed by	Government	Government
Dominant destruction causes	No back filled	Low quality materials (constructed by local people)

Table 3:- Comparison of RCC and stone masonry walls (constructed by government)

4. Comparison of stone masonry and RCC walls constructed by local people: The comparison of stone masonry and RCC walls constructed by local people were also considered in this study. As noted in table 4 the stone masonry

walls shown better result than RCC walls. From this study we can conclude that RCC walls need more considerations on having design documents and monitoring construction works than stone masonry walls.

Details	Stone masonry	RCC
Destruction	37%	42%
Constructed by	Local people	Local people
Dominant destruction causes	Improper use of materials	Low quality material and improper usage

Table 4:- Comparison of stone masonry and RCC walls (constructed by local people)

5. Comparison of stone masonry, RCC and gabion walls constructed by government: We have also compared the stone masonry, RCC and gabion walls that are constructed by government with design documents. The result reveals that RCC (15% destruction) walls shows lowest destruction level compared to stone masonry (32% destruction) and

gabion (38% destruction) walls. As shown in table 5, the dominant reasons for destruction of stone masonry walls and RCC walls were natural while gabion walls were destroyed due to no maintenance activities. In other words, wire meshes of gabion walls need to be maintained soon after noticing destruction of them.

Details	Stone masonry	RCC	Gabion
Service period (year)			
Destruction	31%	15%	38%
Design documents availability	Available	Available	Available
Constructed by	Government	Government	Government
Dominant destruction causes	Natural	Natural	No maintenance

Table 5:-Comparison of stone masonry, RCC and gabion walls

#### IV. CONCLUSION AND RECOMMENDATIONS

This study focuses on the destruction causes of retaining walls in the city of Khost, Afghanistan. In term of materials, the retaining walls constructed from stone masonry, RCC and gabion were compared. In addition, the effect of availability of design document on destruction level is also investigated. The result revealed that design document according the site condition is important. It was also found that stone masonry walls were more durable than RCC walls while both of these types are constructed without design.

In the city of Khost, the retaining walls were constructed by local people without availability of design and drawings. The people used their own experience and skill for selection of materials as well as construction process. Considering the findings from this study, the recommendations are listed as following:

1. It is essential to prepare design and other related documents according the site conditions.
2. The local governmental sector should control the design, material selection and construction process of retaining walls.

3. Public awareness of local people with respect to the construction techniques and material selection is also recommended.

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