

# Damage type and recovery method of reinforced earth retaining wall constructed on the expressway

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**ABSTRACT:** Reinforced earth retaining walls are difficult to recover when problems occur. Therefore, it is necessary to develop and apply the stability evaluation and maintenance and reinforcement techniques to clarify the actual situation. In recent years, there have been increasing problems in reinforced earth retaining walls located in special situations such as multistage, half-bank half-cut and front embankment depending on the behavior characteristics of foundation ground and adjacent structures. Therefore, it is necessary to develop a stability evaluation and maintenance and repair technique through a clear understanding of the cause. In order to improve the stability of the reinforced earth retaining wall, increase the life span of the joint, and reduce the maintenance cost, it is necessary to apply the systematic stability evaluation and the repair and reinforcement technique.

Therefore, in this study, the damage type of reinforced earth retaining wall was investigated in order to establish mid - and long - term maintenance measures of reinforced earth retaining wall in employment, and the proper repair and reinforcement method according to the structure condition was proposed. The results of the study revealed the present problems of the design / construction / maintenance aspects of the reinforced earth retaining wall, and suggested some improvements. In addition, data on appropriate repair and reinforcement techniques were collected and analyzed for each type of damage.

*Keywords: Reinforced earth retaining wall, Damage type, Recovery method, Reinforcement technique*

## 1 INTRODUCTION

There are about 20,000 structures, including bridges, tunnels, culverts, and retaining walls, all over the Korean expressway. Of these, 1,100 retaining wall structures account for 5% of the total structures.

And the structure that occupies 80% of the retaining wall structure is reinforced earth retaining wall, which is about 800 places. And the structure that occupies 80% of the retaining wall structure is reinforced earth retaining wall, which is about 800 places. 800 reinforced earth retaining walls are currently used on the expressway, and about 1200 reinforced earth retaining walls are being designed and constructed. Therefore, more than 2000 reinforced earth retaining walls will be used in Korea's expressways in the coming years. Reinforced earth retaining walls in highway are mainly constructed adjacent to rigid structure (abutment, culvert, etc.), and problems caused by differential settlement are mainly occurring. In addition, there is also a problem caused by insufficient compaction of the backfill materials and settlement of the foundation ground. Also, depending on the construction conditions, when the curved part, the height of 10m or more, and the boundary between the cut soil and the embankment are installed, problems such as bulging, turning, and front wall damage occur. These problems have been constantly presented in design and construction by previous researchers, but they have not been solved until now.

In this study, it was analyzed the damage cases of reinforced earth retaining wall constructed on the expressway in Korea for 30 years based on the field survey and literature survey, and presented the problems and solutions of the design / construction / maintenance phase.

## 2 DAMAGE TYPE OF REINFORCED EARTH RETAINING WALL

The damage type of reinforced earth retaining wall could be classified into 10 kinds by the field survey and case study(see Figure 1)



Figure 1. Damage type of reinforced earth retaining wall(Some of these figures use press releases)

## 3 CAUSAL ANALYSIS OF REINFORCED EARTH RETAINING WALL DAMAGE TYPES

### 3.1 Errors in the design and construction phases

Damage to reinforced earth retaining walls occurs mostly due to failure to observe the basic things in the design and construction phases.

The most important problem in the design stage was to apply the material properties assuming that materials that are difficult to supply in the field were used. Problems such as reviewing activities on foundations and omitting drainage are frequently encountered. In addition, in the construction stage, problems such as failure of the foundation of the front wall, drainage layer for internal drainage, improper backfill material use, damage of the reinforcing material during construction and omission in the external drainage are the main causes of damage. Such errors in the design and construction stages are expected to remain difficult to solve until the change in the perception of reinforced earth retaining walls.

### 3.2 Errors in the maintenance phase

During the maintenance phase, the inspectors have limited access to the retaining wall. It can be done only to examine the exterior of the reinforced earth retaining wall and to inspect the drainage line. However, if the number of points to be managed is increased, it is difficult to do so. Therefore, it is a general phenomenon to develop serious damage such as creep, differential settlement, and wall collapse due to inadequate measures on frontal wall damage and separation occurring at the early stage of insufficient drainage system inspections and damage. The problem can be solved if it comes to realization of automation check combined with IoT (Internet of Thing) which is becoming a recent issue.

## 4 STEP-BY-STEP SOLUTION TO THE PROBLEM

Damage type of reinforced earth retaining wall and problem analysis by design / construction / maintenance stage show that it is not a cause but a complex problem from simple professional wall damage and separation to activity failure. Therefore, Table 1 summarizes the areas that are not well protected on site by design / construction / maintenance stage. In order for these to be observed, it is obvious that there must be the expertise of the designer, the quality control ability of the supervisor at the time of construction, and the commitment to preventive maintenance of the inspector.

Table 1. Solution for each step of design, construction and maintenance

Division	Explanation
Design	Review of foundation settlement and activities
	On-site use of backfill material properties
	Design of internal and external drains suitable for rainwater and underwater waterway
Construction	Complete front wall foundation construction
	Conducted according to the geotextile layout standard at the time of curved section construction
	Completion of backfilling
	Internal and external drainage construction
	Use proper backfill compaction material and geotextile
Maintenance	Damage repair and separation part charge
	Thoroughly check for damage and operation

## 5 CONSLUSION

In this study, the damage cases of reinforced earth retaining walls were analyzed based on site investigation and literature survey, and problems and solutions of design / construction / maintenance phase were suggested. The results are summarized as follows.

(1) The most important problem in the design stage was to apply the material properties assuming that are difficult to supply in the field were used. Problems such as reviewing activities on foundations and omitting drainage are frequently encountered. Therefore, a solution was proposed.

(2) In the construction phase, problems such as failure of foundation construction of the front wall, drainage layer missing for internal drainage, improper backfill material use, damage of reinforcing material during construction and omission in external drainage are the main causes of damage. Therefore, a solution is proposed.

(3) In the maintenance stage, it is a common phenomenon to develop due to insufficient drainage system inspections and damage to the front wall damaged at the early stage of damage, and serious damage such as creep, differential settlement, and wall collapse due to inactivity. Therefore, a solution is proposed.

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