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# An Experimental and Numerical Investigation of Mechanically Stabilized Earth Wall

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## ABSTRACT

Mechanically stabilized earth wall is geosynthetic reinforced technique, it has been widely used in civil engineering practice over the last two decades. Now a days, MSE wall has become a substitute solution to conventional retaining wall based on economy and easy construction. To ensure the safety of such structure intense analysis would require by experimental and numerical approach.

**Keywords:** Plaxis-2D, RE Wall, Geogride,

## I. INTRODUCTION

Mechanically stabilized earth wall is geosynthetic reinforced technique, it has been widely used in civil engineering practice over the last two decades. Now a days, MSE wall has became a substitute solution to conventional retaining wall based on economy and easy construction. To ensure the safety of such structure intense analysis would required by experimental and numerical approach The heavy soil mass is supported by retaining walls in various fields of civil engineering such as hydraulics and irrigation structures, highways, railways, tunnels, mining etc. and evaluation of lateral earth pressure is key factor to design retaining wall.The retaining walls are often classified in terms of their heavy mass and flexibility. Nowadays, 4 geosynthetic-reinforced soil technique Mechanically stabilized earth(MSE) is a method of reinforcing earthen materials so that they can support their own weight.

The wall constructed using the MSE method rely on reinforcing elements such as metal bars, welded wire mats, geosynthetics, or other anchorage systems to improve the mechanical properties of the soil mass (FHWA, 1995). MSE walls are typically constructed using four structural components:

1. geogrid reinforcement
2. wall facing
3. retained backfill

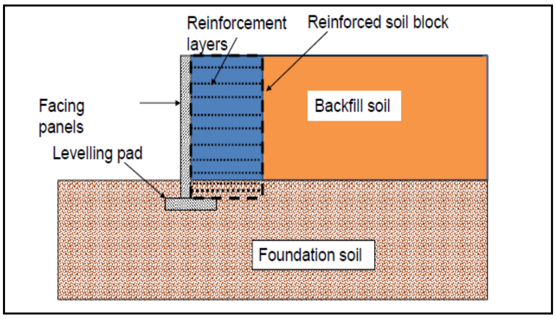



**Figure 1.** Component Parts of MSE Wall

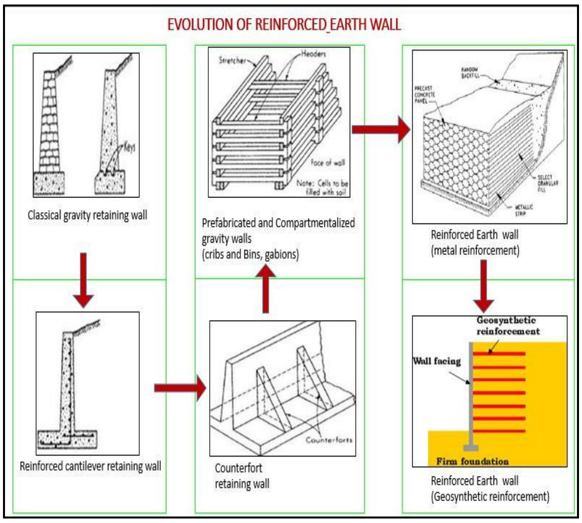



**Figure 2.** Evolution Of Reinforced Earth Wall


**Figure 3.** Failure Of Retaining Wall

## II. LITRETURE REVIEW

**Chalermyanont, T. and Benson, C.H (2005)–** A two phase approach was used to develop a reliability based design (RBD) method for external stability of MSE wall. Three modes of failure were considered: sliding, overturning and bearing capacity. External stability was assessed by treating the reinforced soil as a rigid mass using the same procedures employed for conventional gravity type wall systems. The probability of external failure is similar to inherent probability of failure reported by other investigators for similar geotechnical structures.

**Federal Highway Administration (FHWA), 2001**- Mechanically stabilized earth (MSE) walls, also called reinforced soil walls, are commonly used structures for retaining the earth under bridges, highways, railroads, water front ports, and various other types of infrastructure. These walls are constructed from the bottom up by placing alternating layers of soil and reinforcement. The reinforcement could be a relatively extensible product such as ageogrid or geotextile or a more rigid product such as steel ribbed strips. The reinforced soil is usually engineered granular material and the facing of these walls is typically inclined at greater than 70 degrees.

SadokBenmebarek (2016)- Back-to-back mechanically stabilized earth walls (BBMSEWs) are encountered in bridge approaches,ramp ways, rockfall protection systems, earth dams, levees and noise barriers. However, available design guidelines for BBMSEWs are limited and not applicable to numerical modeling when back-to-back walls interact with each other. The objective of this paper is to investigate, using PLAXIS code, the effects of the reduction in the distance between BBMSEW, the reinforcement length, the quality of backfill material and the connection of reinforcements in the middle, when the back-to-back walls are close. The results indicate that each of the BBMSEWs behaves independently if the width of the embankment between mechanically stabilized earth walls is greater than that of the active zone. This is in good agreement with the result of FHWA design guideline. However, the results show that the FHWA design guideline underestimates the lateral earth pressure when back-to-back walls interact with each other. Moreover, for closer BBMSEWs, FHWA design guideline strongly overestimates the maximum tensile force in the reinforcement. The investigation of the quality of backfill material shows that the minor increase in embankment cohesion can lead to significant reductions in both the lateral earth pressure and the maximum tensile force in geosynthetic. When the distancebetween the two earth walls is close to zero, the connection of reinforcement between back-to-back walls significantly improves the factor of safety.

## III. METHODOLOGY

**3.1 Numerical modeling**:-

- Modeling of RE wall in Plaxis 2D
- Plastic analysis
- Determination of outward movement of wall
- Stress in backfill
- Stress in Geogrid.

**Experimental testing** :-

- Modeling of RE wall in Laboratory (scale model)
- Determination of outward movement of wall
- Validation of outward movement

**Table 1.** Properties of backfill material

| Property | Values | IS- Codes |
|---|---|---|
| Unit weight (kN/m3) | 15.02 | IS :2770 (Part 14) – 1984 |
| Specific gravity (G | 2.64 | IS :2770 (Part 3/ Sec1) – 1980 |
| Coefficient of uniformity, Cu | 1.91 | S :2770 (Part 4) – 1983 |
| Coefficient of curvature, Cc | 1.24 | IS :2770 (Part 4) – 1984 |
| D10 | 0.24 | IS :2770 (Part 4) – 1985 |
| D30 | 0.37 | IS :2770 (Part 4) – 1985 |
| D60 | 0.46 | IS :2770 (Part 4) – 1985 |

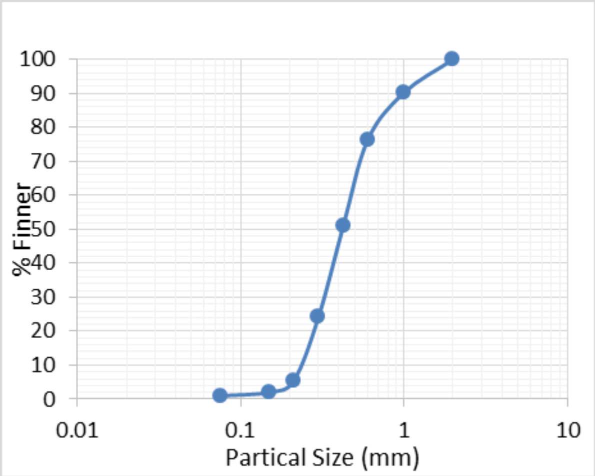



**Figure 4.** Particle size Distribution curve

**3.2 Analysis by Plaxis 2D**

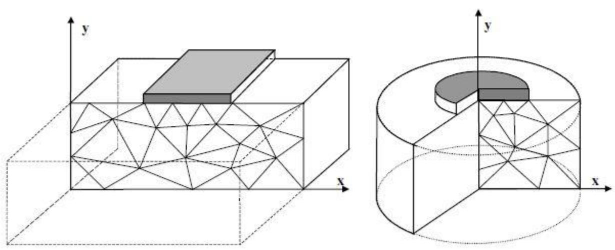
Plaxis is finite element software developed at the Technical University of Delft for Dutch Government. Initially, it was intended to analyze the soft soil river embankments of the lowlands of Holland. Soon after, the company Plaxis BV was invented, and the program was extended to cover a broader range of geotechnical issues. The Plaxis program started at Delft University of Technology in early 1970's when Peter Vermeer started to do a program of research on finite element analysis on the design and construction of Eastern re scope

Problem

Height of RE wall = 6m

Unit wt = 16.32, Fi of backfill = 35, Czi = 5, E= 30000, poisons = 0.3, Rinter = 0.7, thikness of plate = 0.35

Geogrid EA = 1500, foundation is soil (linear elastic)



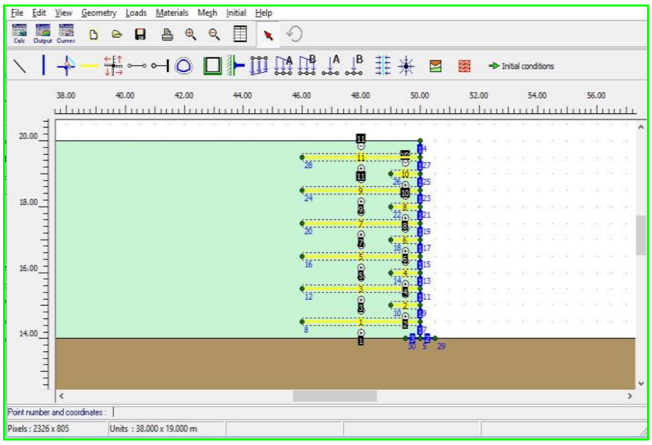


Figure 5. Geometric model of RE wall

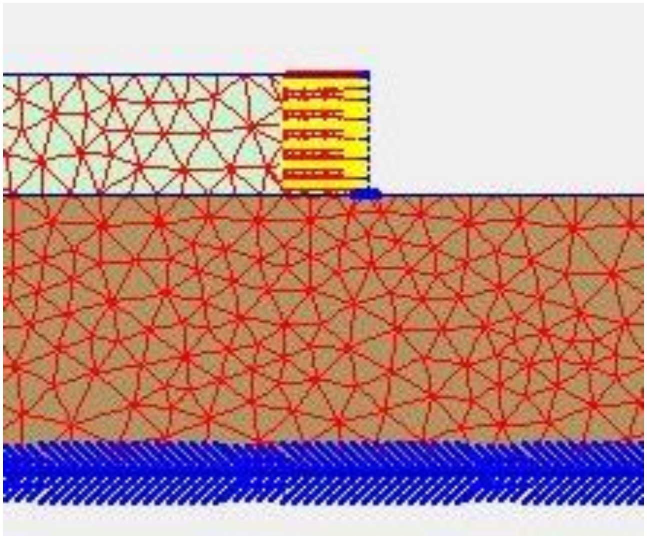


Figure 6. Mesh of model

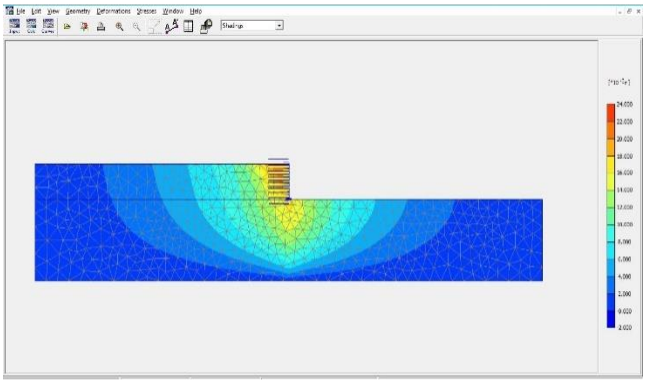


Figure 7. Deformed model

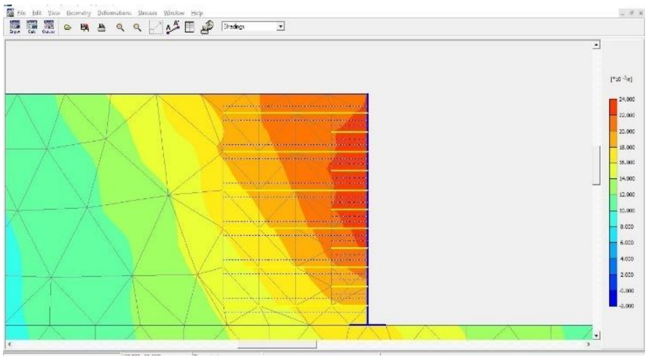


Figure 8. Maximum deformation at top of wall

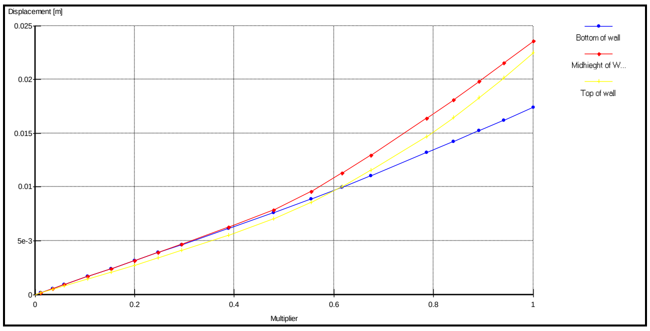



Figure 9. Deflection at different points on wall

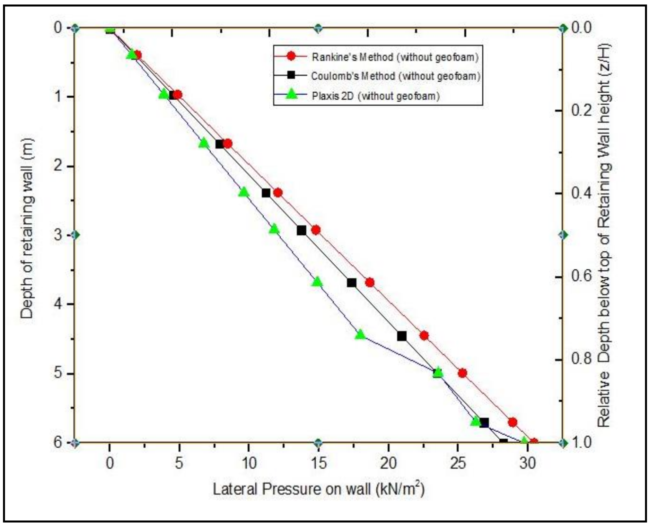



Figure 10. Pressure on wall

## IV. CONCLUSION

The RE wall is easy to construct and provide economical retaining structure in civil engineering used as retaining wall, bridge abutment, Earth slope Protection. Numerical Analysis shows, the wall deflect 25mm at 0.65 times height of wall from bottom which should be taken into account while construction of such wall. Outward bulging is major problem encountered in reinforced earth wall, this numerical analysis shows the same.

## V. REFERENCES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