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## Article Info

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# Design & Study of Reinforced Earth (RE) Panel

Mr. Ankit Bisen<sup>1</sup>, Prof. Ashutosh Kohad<sup>2</sup>

<sup>1</sup> Research Scholar (Master of Technology in Structural Engineering), Department of Civil Engineering, Sardar Patel School of Engineering & Technology, Balaghat (M.P.)

<sup>2</sup> Assistant Professor, Department of Civil Engineering, Sardar Patel School of Engineering & Technology, Balaghat (M.P.)

**Abstract:** The present study entitled “Design & Study of Reinforced Earth (RE) Panel” focuses on the analysis, design, construction methodology, stability evaluation, and performance assessment of reinforced earth wall systems. The study includes detailed literature review, understanding of reinforcement mechanisms, construction procedures, reinforcement strip behavior, precast wall panel systems, stress analysis, displacement analysis, and numerical modeling using PLAXIS 2D software. The reinforced earth structure considered in the study was analyzed under highway loading conditions as per IRC: 6-2014 and stability criteria recommended in BS 8006:1995. The analysis and design of the reinforced earth embankment were carried out using Excel calculations and PLAXIS 2D finite element software. The study included evaluation of external stability, internal stability, lateral earth pressure, reinforcement tension, stress distribution, pore pressure, displacement behavior, shear force, and bending moment. The results obtained from the study indicated that the reinforced earth structure is stable and safe under all loading conditions. The maximum reinforcement tension obtained was 52.86 kN, maximum stress developed in the structure was 200 kN/m<sup>2</sup>, extreme active pore pressure was 60 kN/m<sup>2</sup>, extreme total principal stress was 91 kN/m<sup>2</sup>, and total displacement was  $18 \times 10^{-3}$  mm. The displacement and stress values remained within permissible limits, indicating satisfactory structural performance. The study also highlighted the advantages of reinforced earth wall systems such as rapid construction, flexibility, reduced maintenance, improved seismic resistance, economy, and better aesthetics.

**Keywords:** Reinforced Earth Wall, Mechanically Stabilized Earth (MSE), Reinforced Earth Panel, Retaining Wall, Geogrid Reinforcement, Geosynthetics.

## I. INTRODUCTION

Retaining structures are one of the most important components in civil engineering and transportation infrastructure projects. These structures are used to retain soil at different ground elevations and provide stability to embankments, slopes, highways, railways, bridge approaches, flyovers, and hill roads. Conventional retaining structures such as gravity retaining walls, reinforced cement concrete (RCC) cantilever retaining walls, and counterfort retaining walls have been used for many years in infrastructure projects. However, conventional retaining walls have several limitations. These walls are rigid structures and require a strong foundation system. The construction cost increases significantly with increase in wall height. Large quantities of concrete and steel reinforcement are required, which increases the dead load and environmental impact. Conventional retaining walls are also sensitive to differential settlement and may develop cracks under weak soil or seismic conditions. To overcome these problems, Reinforced Earth (RE) wall technology or Mechanically Stabilized Earth (MSE) wall technology has been developed. Reinforced earth walls are modern retaining structures formed by the interaction between compacted backfill soil and reinforcing materials such as geogrids, geotextiles, steel strips, welded wire mesh, or polymeric straps. The reinforcement layers improve the tensile strength of soil and convert the soil mass into a stable composite structure. Reinforced earth walls are highly flexible structures and can accommodate large settlements without failure. These walls provide better seismic resistance, rapid construction, lower maintenance, reduced environmental impact, and economical performance compared to conventional RCC retaining walls.

## II. RESEARCH METHODOLOGY

The design of reinforced earth structures generally consists of three major phases:

1. Stability Analysis
2. Design of Reinforcement Strips
3. Design of Reinforced Earth Wall

The analysis and design procedures adopted in the present study are mainly based on:

1. IRC: 6-2014
2. BS 8006:1995
3. FHWA Guidelines
4. Geotechnical design principles

### REINFORCEMENT DETAILS OF RE WALL:

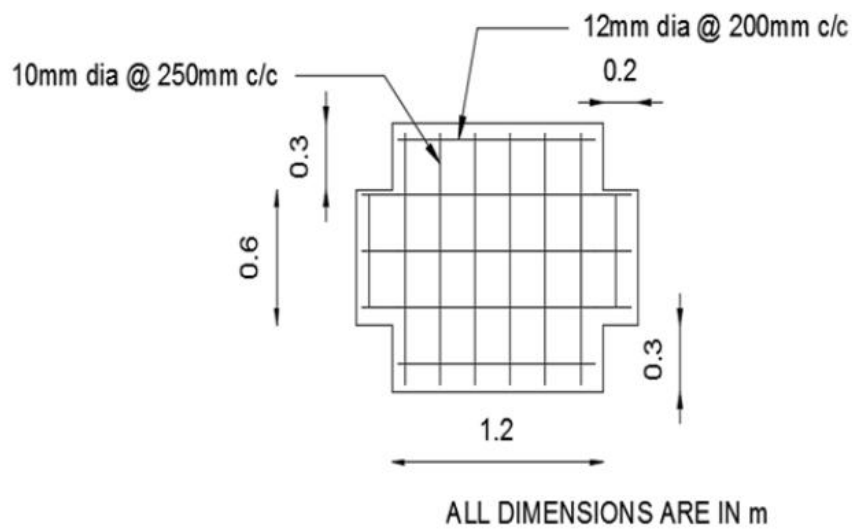


Figure 2.1 Reinforcement Details of RE Wall

### ANALYSIS USING PLAXIS 2D:

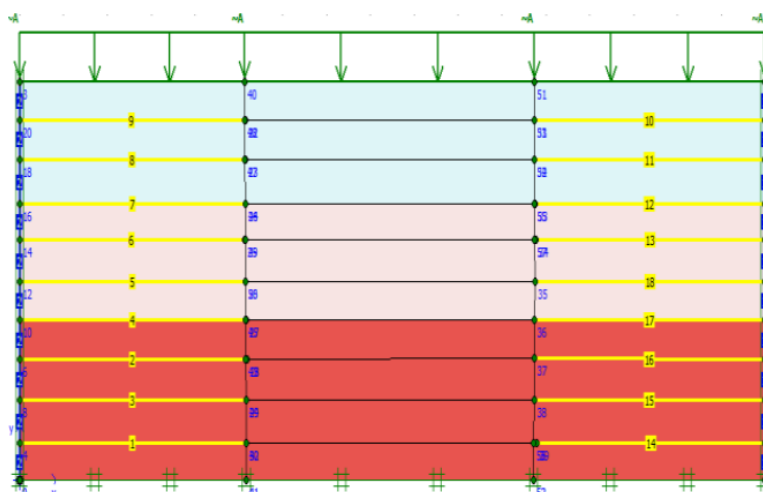


Figure 2.2 Input Data Model in PLAXIS 2D

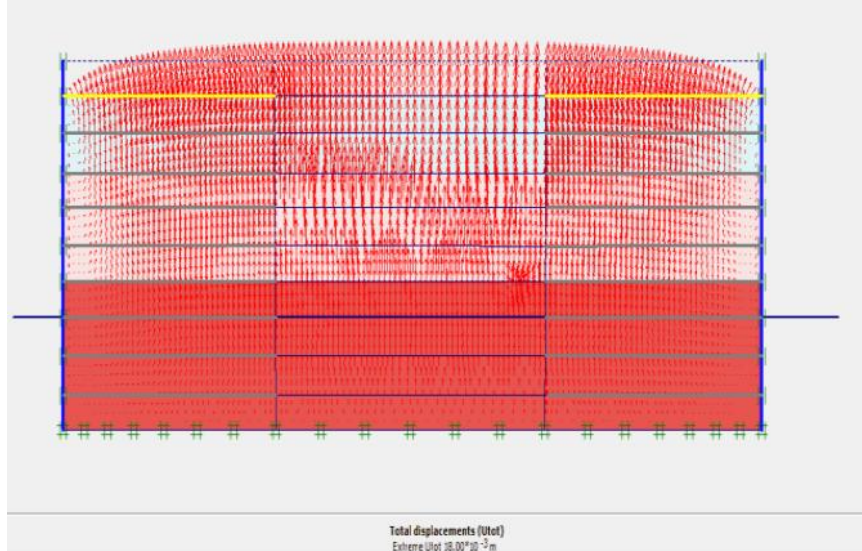


Figure 2.3 Total Displacement of Structure

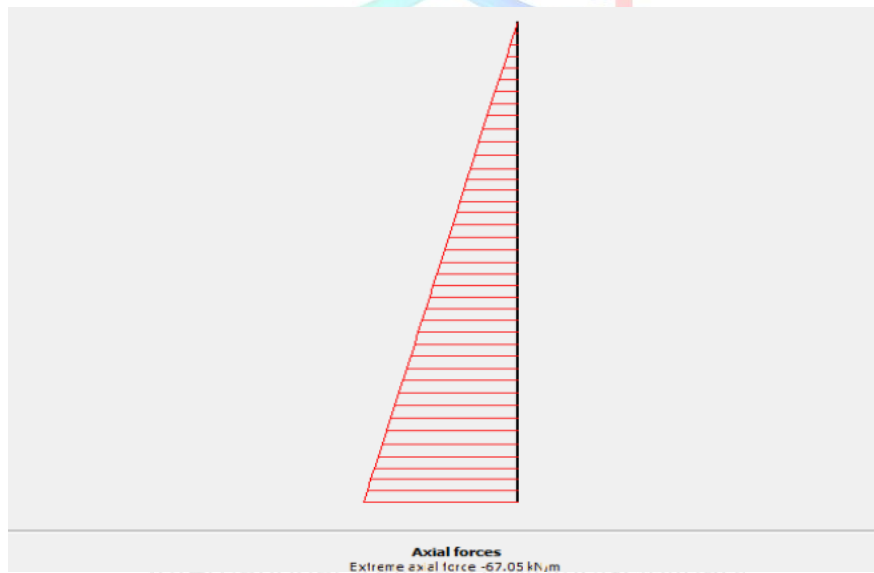


Figure 2.4 Distribution of Axial Forces on Wall

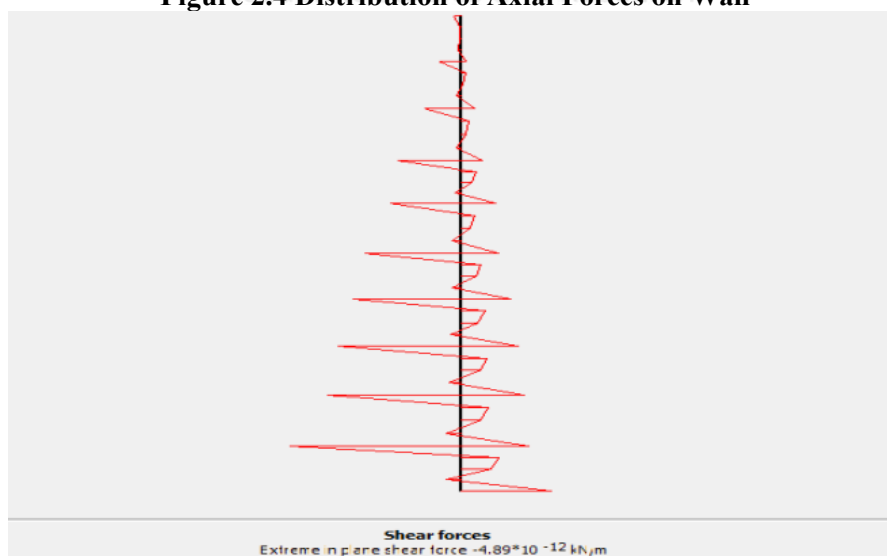


Figure 2.5 Shear Force Diagram

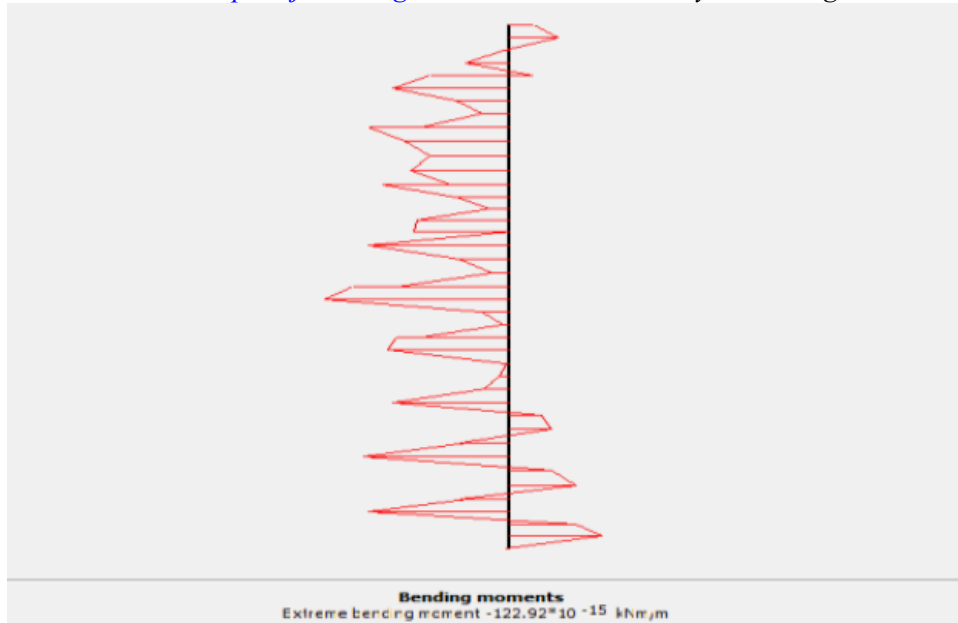


Figure 2.6 Bending Moment Diagram

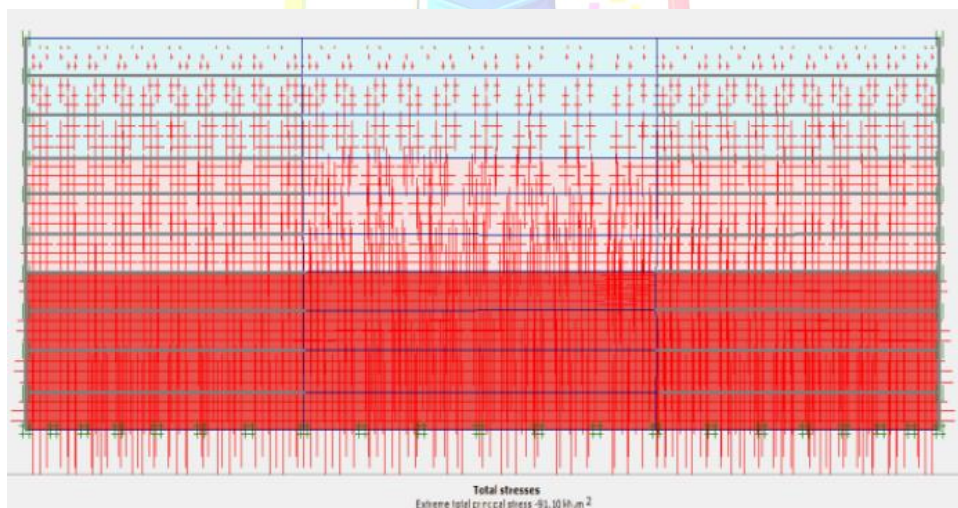


Figure 2.7 Total Stress Distribution

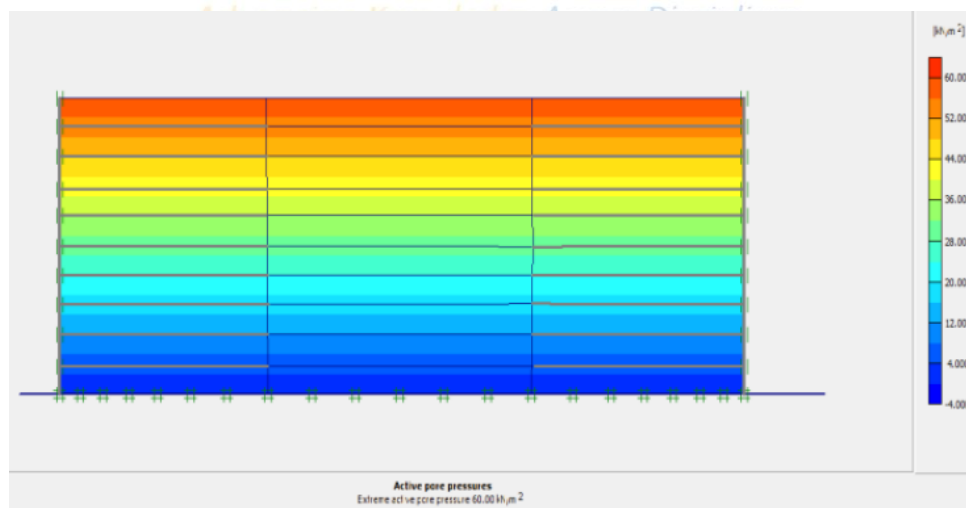


Figure 2.8 Pore Pressure Distribution

### III. RESULTS AND DISCUSSION

**Table 3.1 Reinforcement Tension Results**

Parameter	Value
Maximum Reinforcement Tension	52.86 kN
Reinforcement Type	Geogrid/Strip Reinforcement
Reinforcement Performance	Safe

**Table 3.2 Stress Analysis Results**

Parameter	Value
Maximum Stress	200 kN/m <sup>2</sup>
Stress Condition	Within Safe Limits
Structural Performance	Stable

**Table 3.3 Pore Pressure Results**

Parameter	Value
Extreme Active Pore Pressure	60 kN/m <sup>2</sup>
Drainage Performance	Satisfactory
Stability Condition	Safe

**Table 3.4 Principal Stress Results**

Parameter	Value
Extreme Total Principal Stress	91 kN/m <sup>2</sup>
Stress Condition	Safe

**Table 5.6 Displacement Results**

Parameter	Value
Total Displacement	$18 \times 10^{-3}$ mm
Deformation Condition	Very Low
Structural Safety	Satisfactory

### CONCLUSION

The present study concludes that Reinforced Earth (RE) wall systems are economical, durable, and efficient retaining structures widely used in modern infrastructure projects. Reinforced earth technology offers advantages such as faster construction, better aesthetics, improved seismic performance, reduced maintenance, and the ability to accommodate differential settlements. The use of precast concrete panels and polymeric reinforcements enhances structural stability, drainage, durability, and construction quality. The cruciform precast RE panel adopted in this study demonstrated satisfactory performance under design loading conditions. Fly ash was found to be a suitable filler material, contributing to improved strength and sustainable construction practices.

Stability analysis carried out using Excel and PLAXIS 2D software confirmed that the structure satisfies all requirements related to sliding, overturning, bearing capacity, and reinforcement pullout resistance. The maximum reinforcement tension was found to be 52.86 kN, while the maximum stress was 200 kN/m<sup>2</sup>. PLAXIS analysis showed that stresses, pore pressures, and displacements remained within permissible limits, indicating safe structural behavior. Overall, reinforced earth wall systems provide a reliable, flexible, sustainable, and cost-effective solution for highway, bridge, and infrastructure development projects with a service life exceeding 100 years when properly designed and constructed.

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