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# Reinforced Soil Retaining Walls

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***Abstract:** Weak or soft soil is considered unsafe for construction of engineering structures. We need to adopt some technique to avoid adverse effect of such soil. To bring about improvement in such soil ground improvement techniques are utilized in these days. In case of retaining wall system, reinforced earth wall construction is becoming popular. In this type of construction soil is reinforced by using geosynthetics and other materials. Pressure due to both backfill and surcharge loading can be reduced about 50% by introducing reinforcement in soil (Saran et al. 1992). Lateral thrust on the wall is almost eliminated due to the development of soil-reinforcement interface friction and bearing. These types of walls are easy to construct and saves time. Geosynthetic Reinforced Wall is most economical among all wall categories (Koerner2000). Different forms of reinforcements are available as option for soil reinforcement like; geosynthetics, aluminium strips, bamboo strips and other material for the soil improvement. Use of planar geosynthetic reinforcement is most popular way of reinforcement used in retaining walls. Different studies are done to understand the potential and mechanism of soil reinforcement. Researchers have considered different soil parameters and reinforcement parameters and their impact on the behaviour of reinforced soil.*

***Keywords:** Retaining walls, optimum length, cost of wall, pressure on wall*

## I. INTRODUCTION

Retaining walls are used to provide lateral resistance for a mass of earth or other materials. These walls are used in a variety of applications including right-of-way restrictions, protection of existing structures that must remain in place, grade separations, new highway embankment construction, roadway widening, stabilization of slopes, protection of environmentally sensitive areas, staging, and temporary support including excavation or underwater construction support, etc.

Soil reinforcement is one of the most popular ground improvement techniques. Availability of different material and techniques for reinforcement is one of the major reasons for the continuous increase in the application of the soil reinforcement. Reinforcement may be incorporated into engineering fill, or inserted into the natural ground either to provide steeper slopes than would otherwise be possible or to improve load carrying capacity. Reinforcement may also be used to improve the performance of weak soils to support embankments or other resilient structures.

Soil has an inherently low tensile strength but a high compressive strength which is only limited by the ability of the soil to resist applied shear stresses. An objective of incorporating soil reinforcement is to absorb tensile loads, or shear stresses, thereby reducing the loads that might otherwise cause the soil to fail in shear or by excessive deformation. There is some similarity to the principle of reinforced concrete as the reinforced mass may be considered a composite material with improved properties, particularly in tension and shear, over the soil or concrete alone.

In the present study different outcomes of different researchers about the reinforcing of backfill of the retaining wall system is been presented.

## II. MECHANISM OF REINFORCEMENT

If a vertical stress ($\sigma_v$) is applied on a soil element, it undergoes a vertical compression ($\delta_v$) associated with a lateral deformation ($\delta_h$). If a reinforcement is added to the soil in the form of horizontal layers, the soil element will be restrained against lateral deformation as lateral force is taken up by reinforcement as shown in Fig. 1.

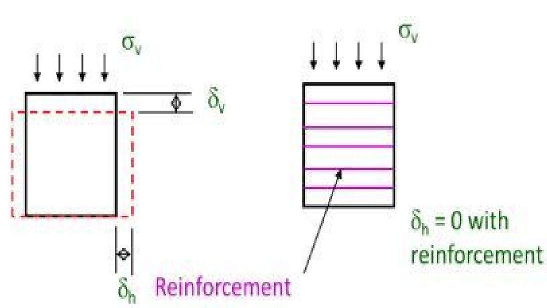


Fig.1- Reinforcement Mechanism

## III. SUMMARY OF LITERATURE

The summary of the available literature is presented in Table-1 which will give us a clear picture about the benefits of using reinforcements in Backfill.

Table i. Literature review

| Author/Year | Focus | Variable Parameter | Findings |
|---|---|---|---|
| Swami Saran et al.(1992) | Stability of an element of the failure wedge. | Length of reinforcement, Spacing Co-efficient ($D_p$). | -The optimum length of reinforcing strips is found to be around 0.6 times the height of wall.<br>-Pressures due to both backfill and surcharge loading are reduced about 50% for all practical values of the spacing coefficient $D_p$. |
| K.G. Garg (1998) | Design, construction and cost economics. | Methodology of Designing. | Retaining wall with geogrids reinforced earthfill was constructed only at 79 per cent of the cost of the retaining wall with conventional earthfill. |
| Robert M. Koerner (2000) | Evolution of retaining walls. | Methodology of Designing. | -Rankine method is the most conservative, the FHWA method is<br>Intermediate, and the NCMA method is the least conservative.<br>- 35,000 RS-RW exists and they cover the entire range of practical wall heights and it is seen that geosynthetic reinforced walls are the least expensive of all wall categories and at all wall heights. |
| Satyendera Mittal et al. (2004) | Stability of an element of the failure wedge. | Content of Reinforcement, Length of Reinforcement. | - The extent of reduction in the resultant pressure will depend on the amount of reinforcement present in the backfill.<br>- The optimum length of reinforcing strips is found to be around 0.6–0.8 times the height of wall for most practical cases.<br>-Unattached reinforcing strips, embedded in the cohesionless backfill behind a rigid retaining wall are effective in reducing the lateral earth pressure on wall.<br>-More the height of wall, more is the saving in cost of construction of<br>Wall. |
| Hoe I. Ling et al. (2005) | Earthquake performance of RS-RW. | Length of reinforcement, Spacing of Reinforcement, connection of wall and reinforcement. | -Earthquake performance of RS-RW improved by<br>- Increasing the length of top reinforcement layer.<br>- Reducing vertical reinforcement spacing.<br>- Grouting the top block to ensure firm connection to the reinforcement. |
| Iqraz Nabi Khan and Swami Saran (2006) | Earth pressure and Deflection of wall. | Loading. | - Deflection of the retaining wall under gravity and surcharge loads is similar to the deflection due to a rotation about the wall toe.<br>- Rankine's earth pressure theory gives earth pressures very close to the observed values. |
| G. Madhavi Latha and A. Murali Krishna (2007) | Influence of backfill relative density on the seismic response. | Relative Density of Soil. | Damage to RS-RW will be more in case of stronger seismic events if the backfill is not properly compacted. |

| | | | |
|---|---|---|---|
| Iqraz Nabi Khan and Swami Saran (2007) | Effect of reinforcing the backfill | Reinforcement Type, Length of reinforcement, Spacing Co-efficient ($D_p$) | - Lateral pressure reduction is about 50 percent in case of bamboo strip reinforced backfill (Dp= 0.5) and 65 percent in case of geogrid reinforced backfill (Dp = 1.838) having L/H = 0.6.<br>- Value of L/H = 0.6 can be adopted for economical design of retaining wall with reinforced backfill. |
| H. Ahmadi and M. Hajialilue-Bonab. (2012) | Bearing capacity of footings located on the backfill | No. of Geotextile layers, Vertical spacing in Geotextile Layers (h), Distance of Footing From Wall. | Bearing capacity of footings located on the backfill can be increased significantly by including geotextile layers on the top of the backfill. Critical Values are:<br>- 3 layers of Geotextile.<br>- h/H=0.12.<br>- d/H=0.33.<br>- u=B.<br>Where H=height of wall.<br>d=depth upto which reinforcements are embedded.<br>u=depth of first reinforcement.<br>B=width of Footing. |
| Christopher Y. Tuan. (2013) | Dynamic interaction between soil and retaining wall panels. | Ductility and Tensile Strength of Reinforcement. | Wall panel Displacement can be minimized by<br>- Increasing Tensile strength and Ductility of Reinforcement.<br>- Increasing Tensile Modulus of Reinforcement. |

## IV. CONCLUSION

*A.* Reinforced soil retaining walls have evolved as viable technique and contributed to infrastructure in terms of speed, ease of construction, economy, aesthetics etc. With the introduction of reinforcements in the backfill several parameters of the retaining wall system have improved for example, the lateral earth pressure on the wall decreases with reinforcing soil with reinforcements.

*B.* It is a technology that needs to be understood well in terms of its response, construction features etc. Failures of RE walls have also been noted in a few places due to lack of understanding of behaviour of RE walls.

*C.* Fhwa, Ncma guidelines need to be studied in detail for seismic stability and deformation issues.

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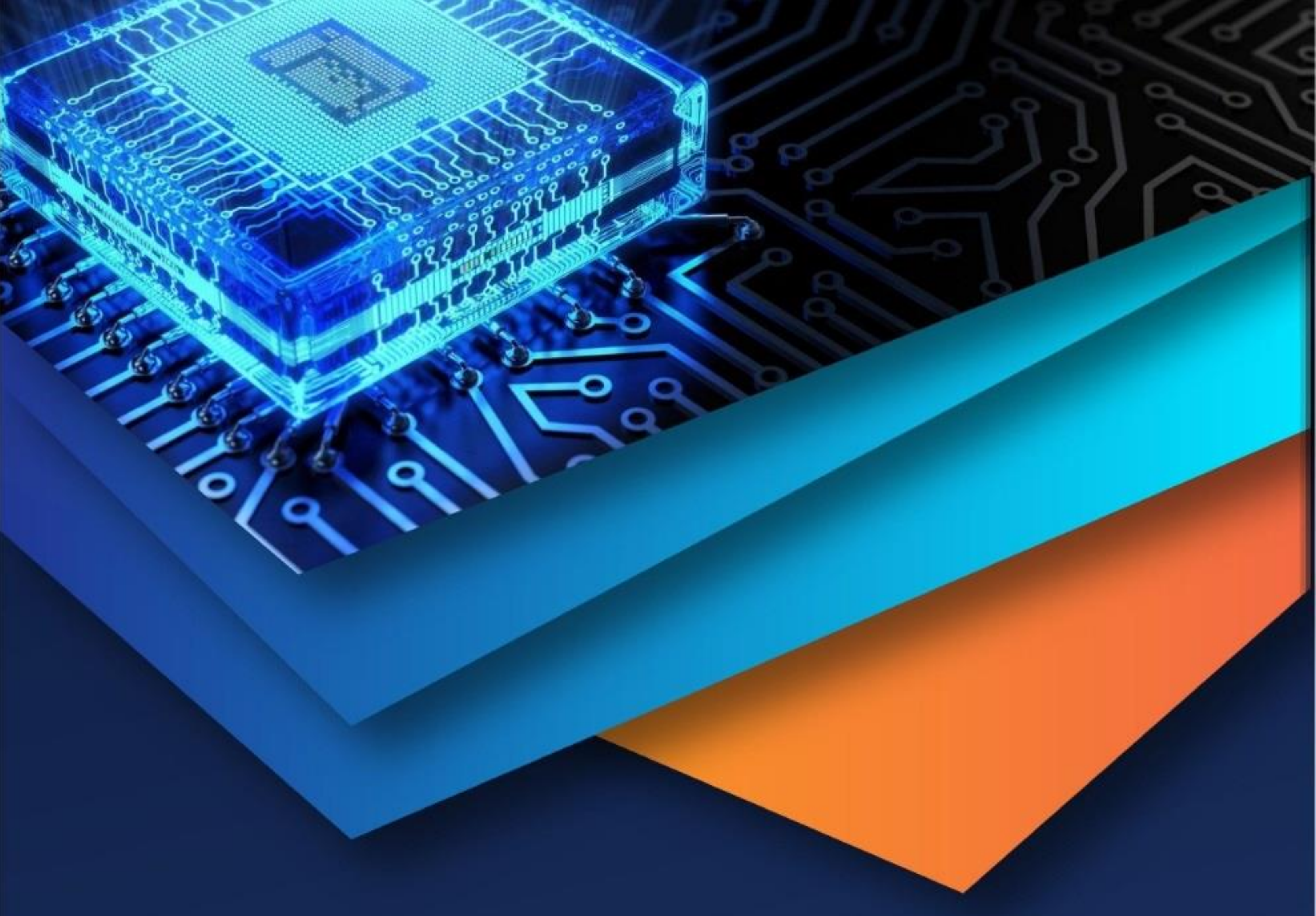

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