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Soil Reinforcement in Road Construction Using Geosynthetics Material

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Abstract: ***Soil reinforcement can be described as the technique to increase the engineering properties of the soil. In this way, using natural fibers to reinforce soil is quite popular. The main purpose of the soil reinforcement is to increase the bearing capacity of the soil. In soil reinforcement, the reinforcement elements are of different materials and various forms based on the intended use. To increase the strength of adjacent structures, the reinforcement can be provided permanently or temporarily. Various materials, forms, and applications of soil reinforcement have been included in the current topic of discussion.***

Keywords: Soil reinforcement, Geosynthetics

1. Introduction

In soil reinforcement, Improvement is done in the engineering characteristics of the soil. Geosynthetics is a polymer product that we can use in civil engineering to strengthen fasting in various types of construction work. Geosynthetics have various types of major products categories. Where there is a high level of need for stability, we can use geosynthetics materials because the nature of polymer present in them suitable for use in the field. Properly formulated, however, geosynthetics can be also used in exposed applications. Geosynthetics are present in a broad range of forms and materials, each to suit a slightly different end use. These products have a broad area of applications and are presently used in various civil, geotechnical, transportation, geoenvironmental, hydraulic, and private development applications including roads, airfields, railroads and embankments, retaining structures etc.

2. Function of geosynthetics

2.1 Separation

To prevent the two materials from the mixture of soil, a Geotextiles has been placed between a fine soil and a coarse material. With the introduction of this barrier, the uneven materials are each able to working properly Fig. 1(a).

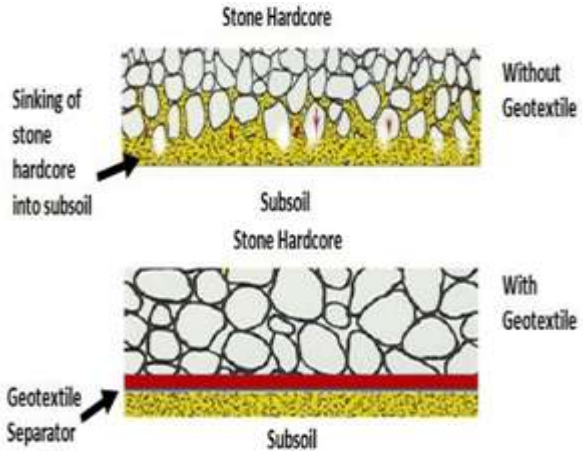

Figure 1a: Separation function

2.2 Filtration

Geotextiles placed in contact with the soil, it allows passage of water during the preventing the soil particles. Permittivity and soil retention are required simultaneously over the design life of such application Fig. 1(b).

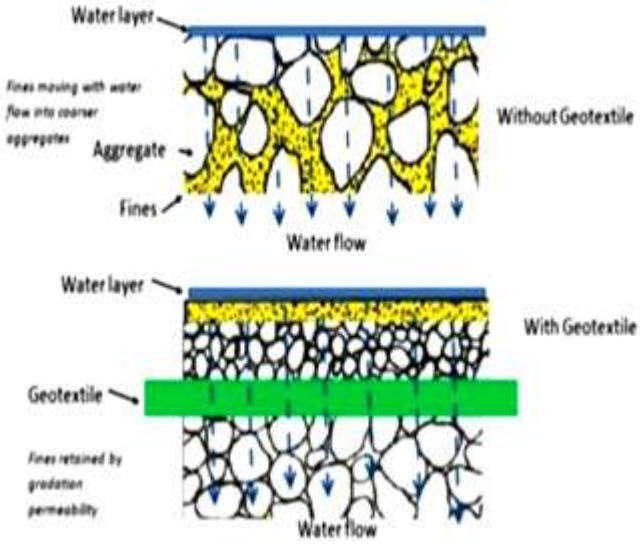

Figure 1b: Filtration function

2.3 Drainage

Drainage is the system or process by which water or other liquids are drained from a place.

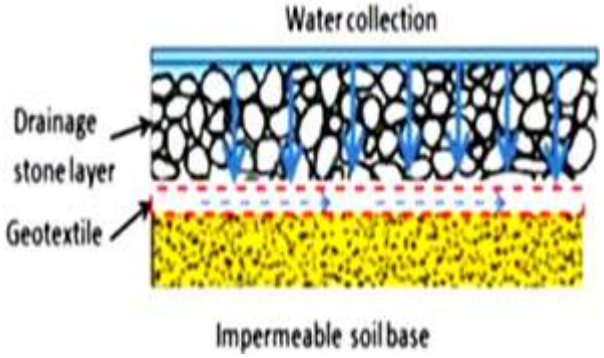

Figure 1c: Drainage function

2.4 Reinforcement

A Geotextiles used to develop the mechanical properties of an earth structure by interacting with soil through interface shear Fig. 1(d).

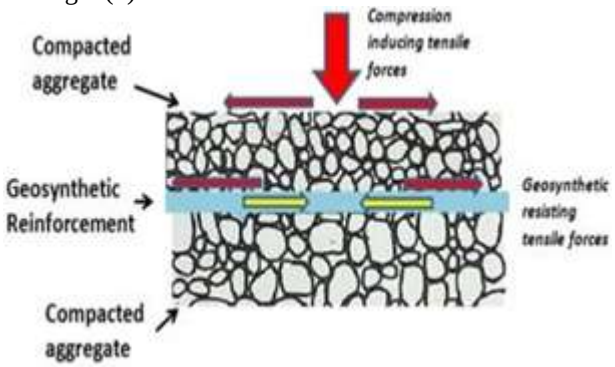

Figure 1d: Reinforcement function

3. Mechanism

As shown in fig 2(a), an aggregate layer is loaded by a wheel or track, the aggregate tends to move as unless it is prevented from Geosynthetics reinforcement. Geotextiles with best frictional abilities can provide tensile resistance to lateral aggregate movement.

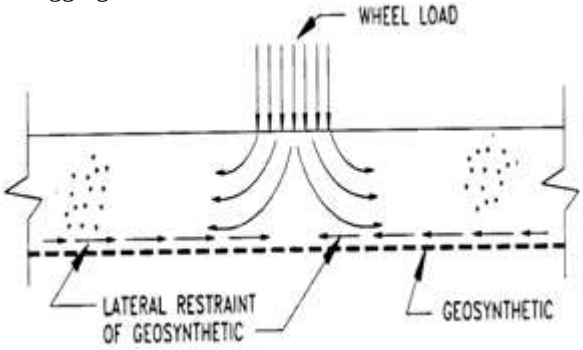

Figure 2a: Lateral restraint

As shown in fig 2(a), an aggregate layer is loaded by a wheel or track, the aggregate tends to move as unless it is prevented from Geosynthetics reinforcement. Geotextiles with best frictional abilities can provide tensile resistance to lateral aggregate movement.

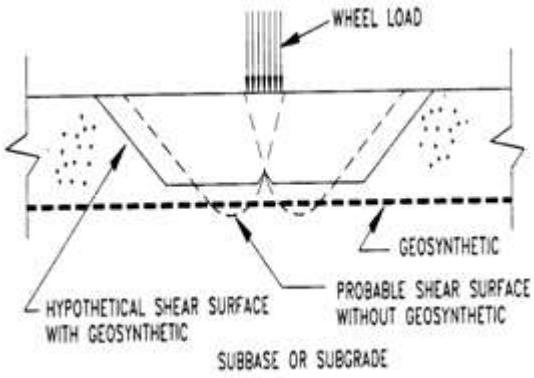

Figure 2c: Bearing capacity increase

To move the analogy of a wheel load to a footing, to follow an alternate higher strength path, the Geosynthetics reinforcement forces the potential bearing capacity failure surface. This tends to increase the bearing capacity of the roadway in fig 2(c).

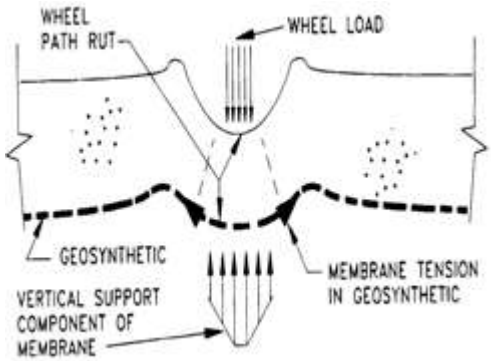

Figure 2c: Membrane tension support

4. Design methodologies

4.1 Design-by-experience

This method is based on previous experience. It is recommended that the application is not operated by the any original function or an unrealistic test method.

4.2 Design-by-cost-and-availability

In this method, by dividing the funds available by the area to the covered by the Geosynthetics, the maximum unit price of Geosynthetics is calculated

4.3 Design-by-specification

Where common application areas are listed along with minimum (or sometimes maximum) property values, in this method often consists of a property matrix . On applications by most of the governmental agencies and other large users of geosynthetics, the property matrix is usually prepared.

4.4 Design-by-function

The common approach of this method consists of the following steps:

- Assessment of the particular application, define the primary function of the Geosynthetics,are as follows,

reinforcement, separation, filtration, drainage, fluid barrier or protection.

- The list of loads and constraints, imposed by the application should be made.
- Explain the design life of the geosynthetics.
- Determine the required functional property (e.g. strength, permittivity, transmissivity, etc.) of the Geosynthetics for the primary function.
- Test the allowable property of the Geosynthetics.
- Determine the factor of safety, using below equation;
- Check into Geosynthetics along more properties, if this factor of safety is not acceptable.
- Check if any other function of the Geosynthetics is also critical, and repeat the above steps, if this factor of safety is acceptable.
- If many Geosynthetics are found to meet the required safety factor, then select the Geosynthetics based on the cost-benefit ratio.

5. Advantage of geosynthetics

Geosynthetics used in roadways on soft sub grades, may provide several cost and performance benefits, including the following Fig 3,

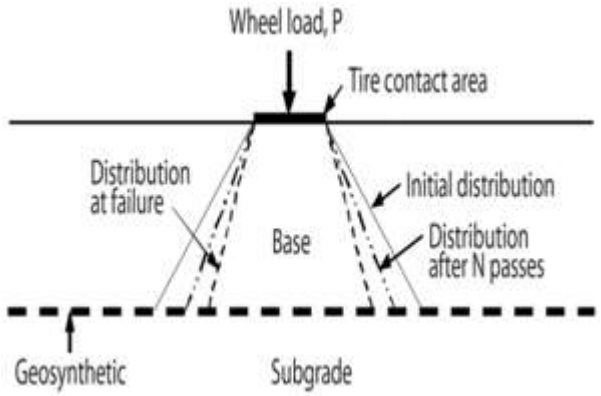

Figure 3: Dealing with problematic subgrade material

- By reducing the intensity of stress on the subgrade and preventing the base aggregate from penetrating into the subgrade.
- Controls subgrade fines from pumping.
- Control contamination of the base materials which may grant more open- graded, free draining aggregates to be supposed in the design.
- Decreasing the depth of excavation required for the removal of unsuitable subgrade materials.
- Decreasing the thickness of aggregate required to stabilize the subgrade.
- Decreasing disturbance to the subgrade during construction.
- Allowing rise in subgrade strength over time.
- Decreasing the differential settlement of the roadway.
- Decreasing maintenance and extending the life of the pavement

$$FS = \frac{\text{Allowable (or test) functional property}}{\text{Required (or design) functional property}}$$

6. Lifetime Cost Comparison over 15 year Period

The initial cost comparison over 15 yr periods in given below fig. 4.

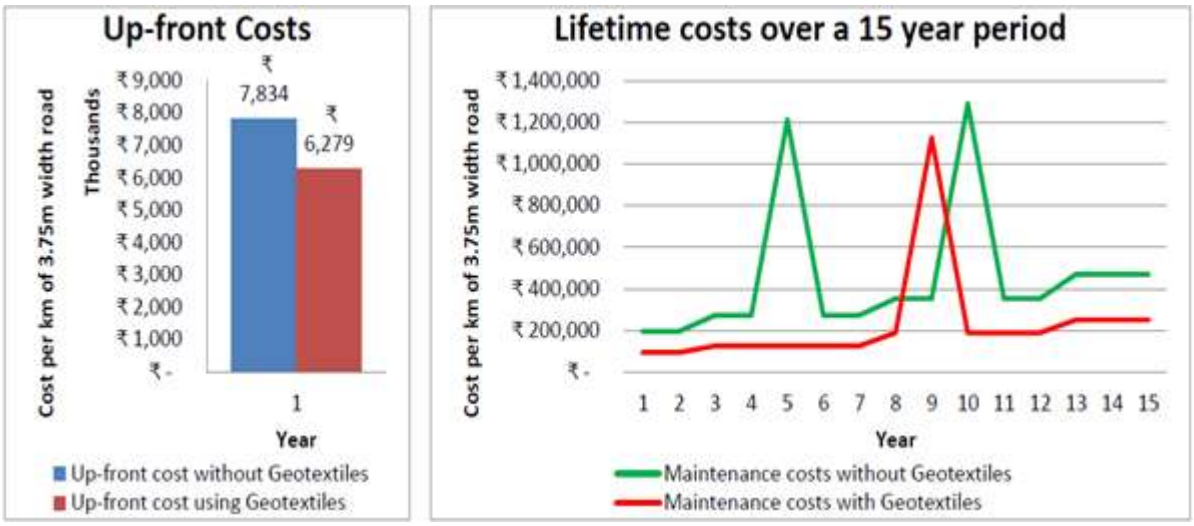

Figure 4: Lifetime cost comparison over 15 yr period

7. Conclusion

Geosynthetics material is used as excellent soil reinforcement materials for soils. It will be economical and more suitable for the road construction. Geotextiles is recommended for that section of the road, where CBR is less or it is a vulnerable section and water logged area. The use of geosynthetics sheet in road construction work initially is costly but in future reference it will be economical in life cycle. At low cost we can do better road construction if we use Geosynthetics sheet where CBR is minimum because it is less costly in comparison than geosynthetics use in whole construction work. Using Geosynthetics, the project cost might increase slightly but considering long term planning the road will be serve has a efficient road in comparison to other traditionally techniques.

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Author Profile

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