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REVIEW ON GEOTEXTILES IN ROAD CONSTRUCTION

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ABSTRACT- *Textiles were first applied to roadways in days of Pharaohs. Even they struggled with unsuitable soils, which rutted or washed away. They found that natural fibers, fabrics or vegetation improved road quality when mixed with soils, particularly unstable soils. Only recently however textiles have been used and evaluated for modern road construction. In 1920's state of Carolina used a cotton textile to reinforce the underlying materials on a road with poor quality soils. Evaluation several years later found the textiles in good workable condition. They continued their work in area of reinforcement and subsequently conclude that combining cotton and asphalt materials during construction reduced cracking, raveling, and failure of pavement and base course. Synthetic fibers became more available in 1960's. Dr. Jean Pierre Giroud created the original term geotextile using Latin word geo meaning soil.*

KEYWORDS- *Geotextile, Fabric,* geosynthetics

I. INTRODUCTION:

A geotextile is any permeable textile material used with foundation, soil, rock earth, etc. that is an integral part of a constructed project, structure or system. It may be made of synthetic or natural fibers. Geotextiles are also known as filter fabrics, road rugs and geosynthetics. They are generally associated with high standard all season roads, but can be used in low standard logging roads. Geotextile-related materials are fabrics formed into mats, webs, nets, grids or formed plastic sheets Modern geotextiles are usually made by weaving or bonding from synthetic polymers – polypropylenes, polyesters, polyethylenes, and polyamides which do not decay under biological or chemical processes. Some geotextiles are made of biodegradable materials such as mulch matting and netting. Mulch mattings are jute or other wood fibers that have been formed into sheets and are more stable than normal mulch. Netting is typically made from jute, wood fiber, plastic, paper, or cotton and can be used to hold the mulching and matting to the ground. Netting can also be used alone to stabilize soils while the plants are growing; however, it does not retain moisture or temperature well. Mulch binders (either asphalt or synthetic) are sometimes used instead of netting to hold loose mulches together. Geotextiles can aid in plant growth by holding seeds, fertilizers, and topsoil in place. Fabrics are relatively inexpensive for certain applications. A wide variety of geotextiles exist to match the specific needs of the site.

1.1 Classification Of Geotextiles:

Geotextiles are classified based on the method of production as:

1 Non-woven fabric
2. Woven fabric
3 .Knitted fabric

1.2 Functions:

Geotextiles perform three basic functions in stabilizing aggregate sections: separation, drainage and reinforcement. Some agencies hesitate to specify geotextiles for these functions because of a belief that the material adds to the cost of a project. However, with a good design method for geotextile use, and proper installation, most projects realize a 30 percent to 40 percent drop in required aggregate base thickness. This leads to a drop in production costs because the nonwoven geotextile only costs a fraction of that saved from the reduction in required aggregate.

1.2.1. Seperation:

The use of a geotextile for the separation of aggregate and the soil sub base is easily justified to anyone who has placed an aggregate section and has seen it lose its effectiveness over time from the intermixing with underlying sub grade soil. Investigations of failures in unpaved and paved surfaces generally reveal the presence of fine-grained soils intermixed with the aggregate base.

As an aggregate layer is loaded, the bottom loosens with tension cracks allowing the underlying fines, under pressure, to migrate up into the aggregate. As little as 10 percent to 20 percent fines can completely destroy the structural strength of the aggregate by interfering with the hard, stone to stone contact.

Geotextiles provide a separation layer between the aggregate and the sub grade soil, to prevent migration of fines and thus indefinitely preserve the original aggregate structural thickness.

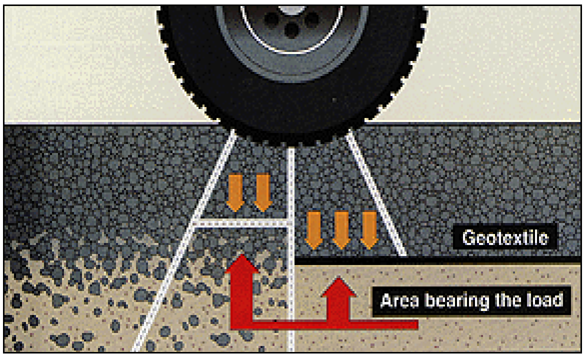

Fig. No.1 .Separation Of Road

The geotextile usually costs no more than 2 inches to 3 inches (50 mm to 75 mm) of compacted, in-place aggregate, but can save several inches (millimeters) of aggregate. The separate function is more dramatic over weak sub grade soils, but is economically practical in the long run to use even on more competent sub grades.

Geotextiles are recommended for this separation function because of their low cost, coefficient of friction, elongation and drape to conform to any surface, effective filtering even after elongation, abrasion and puncture resistance, and their high coefficient of permeability. Geotextiles are made of polypropylene, and, as such are basically inert and will last indefinitely in a buried application.

One extra benefit of using a geotextile for separation is that almost all the aggregate over the geotextile can be reclaimed and reused. This is particularly economical in temporary uses such as mine haul or logging roads or anywhere aggregate is expensive and equipment is available to reclaim the uncontaminated stone.

1.2.2 Drainage:

The drainage function of a geotextile can be critical to structural section performance.

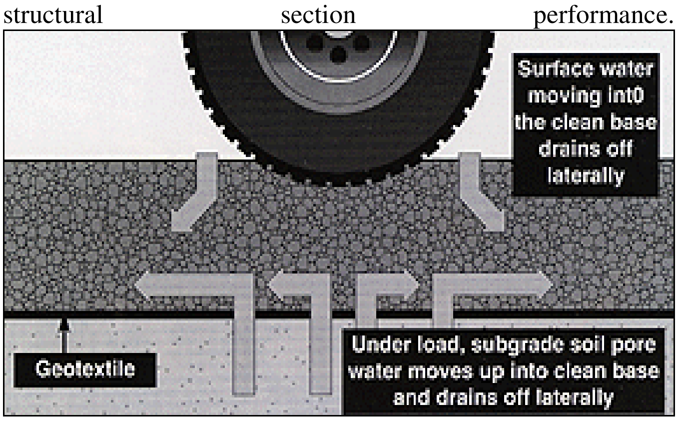

Fig No.2. Drainage Of Road

If the sub grade soil is subject to persistent or even occasional wet conditions, the geotextile placed over it must be highly permeable to allow rapid drainage of water from the loaded sub grade soils up into the free draining aggregate base. Otherwise, under the rapid loading conditions from traffic, water pressures in the soil can fail the sub grade by soil liquification.

Geotextiles provide this critical permeability as they filter or keep the fines from migrating upward into the aggregate. Maintaining drainage of the aggregate base and sub grade soil is very important to prevent accelerated failure of the support system. A geotextile also allows the use of more open, free draining aggregates instead of those with fines, which are weakened by moisture and are freeze-thaw sensitive.

1.2.3 Reinforcement:

Geotextiles are used in reinforcement through mechanisms of restraint or confinement, friction, membrane effect and local reinforcement.

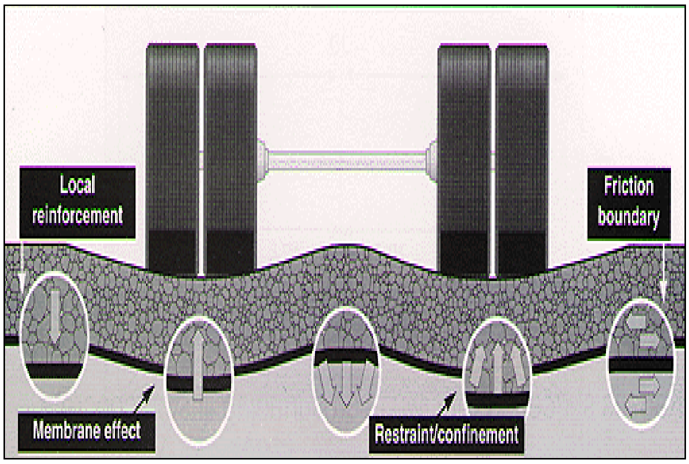

Fig No.3. Reinforcement Of Road

These reinforcement mechanisms, provided by all types of nonwoven and woven geotextiles, are widely recognized.

This design approach is based on the reinforcement function in general and years of experience gained with the use of geotextiles. According to most researchers, the reinforcement function of a geotextile comes into effect when the sub grade soil is weak, generally less than 12 psi shear strength, or CBR 3. However, most of the research to date has dealt with limited loading and the reinforcement function may well be effective in stronger soils when designing for very heavy wheel loads.

Fabrics are used in road construction with locally available aggregate such as a crushed stone, quarry or shotrock, sand, gravel, or sea shells to develop a structural layer. In reinforcement, fabric improves the performance of the aggregate-fabric-soil (AFS) system under repetitive vehicular loading from mechanisms including restraint on the aggregate and sub grade layer, membrane effect, friction developed at the fabric interfaces that creates a boundary layer, and local reinforcement. These mechanisms are often measured by resistance to permanent deformation or rutting.

As the roadway undergoes large deformation the fabric is stretched and develops tensile stress, the magnitude of which depends on fabric strain and fabric modulus. The net effect is a reduction under the wheel load and an increase outside of the wheel path.

II. Installation:

Installed properly, these materials stabilize stone bases
The four basic steps involved in placing geotextiles:
1 Sub grade preparation
2 Geotextile placements
3 Aggregate placements
4 Aggregate compaction

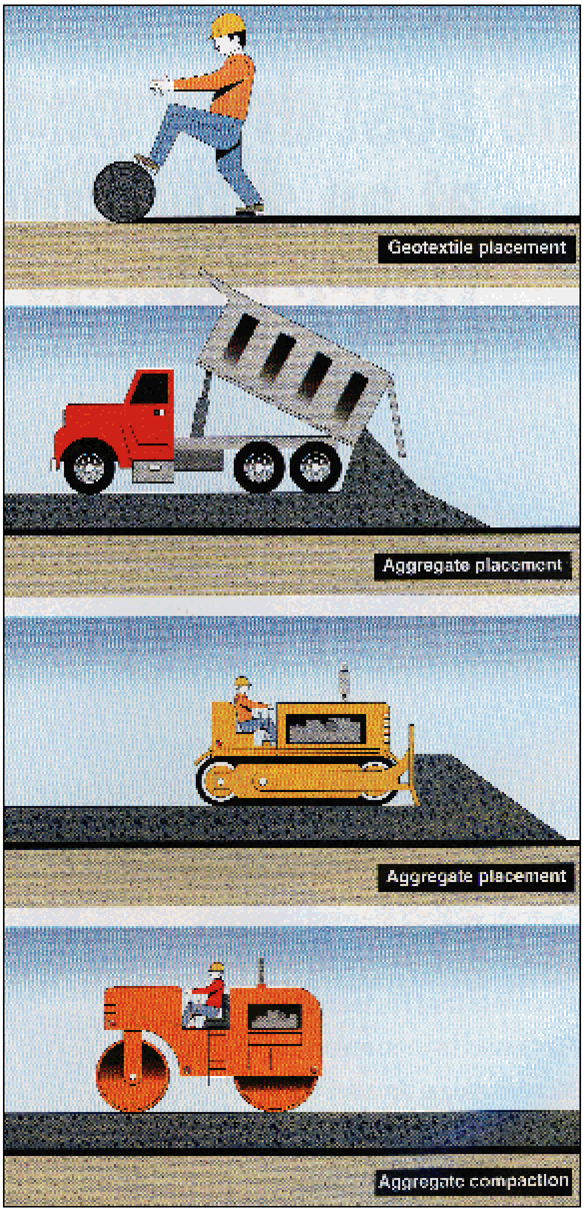

Fig No.4.Installation Of Geotextile

Preparation affects job success. The successful use of geotextiles in soil stabilization requires proper installation.

2.1 How to install geotextiles?

Regardless of sub grade strength, the site should first be cleared of all sharp objects, tree stumps, and large stones that could puncture the fabric. Unless it is necessary to achieve final grade, the vegetative mat need not be removed, because it can provide extra support during aggregate placement until final compaction. Brush or cushion layers under the nonwoven fabric are usually necessary, since the fabric prevents soil fines from pumping into the aggregate layer.

Geotextiles should be rolled out onto the sub grade by two people, beginning at a point that allows easy access for construction equipment, yet is consistent with the layout plan. On very soft sub grades, the fabric layout and aggregate placement should begin on the firmest soil on the site perimeter, as an anchor point. From there the fabric can be rolled onto softer sections.

Fabric overlaps and seams should be made as specified. In windy weather, soil or rocks should be placed on the fabric to hold it down until aggregate is placed. Ground securing pins are sometimes used in the overlap sections of the geotextiles.

Compactable, non-moisture, sensitive aggregate is then back dumped onto the fabric beginning on firm soil at a point just in front of the fabric. This should anchor the fabric firmly. The aggregate is then spread in one lift to a thickness greater than that needed for stabilization to allow for subsequent compaction.

If the thickness from one lift is too great for satisfactory compaction, place more than one lift.

Over very soft sub grade, care must be taken during aggregate placement to insure the fabric is not moved out of position nor the sub grade overstressed. The bulldozer operator can best determine which spots need additional aggregate for good stability by watching for rutting in the aggregate layer.

Over very soft soil conditions, mud waves may appear during aggregate placement or use. Normally, mud waves are not a problem if they do not heave above the surface of the aggregate base. Stress on the sub grade during fill placement causes subsurface soil to move away and up from the loaded area.

Vehicles should not be allowed to drive directly on the fabric. If the fabric is damaged during installation, the damaged section should be exposed and a patch of fabric placed over it. The patch should be large enough to overlap onto unaffected areas by 3 to 4 feet (1 to 1.25 meters). The aggregate is then replaced and compacted by the bulldozer.

For full stability, the aggregate must be compacted to required density for the design thickness. The surface is initially compacted by walking the tracked bulldozer back and forth over the aggregate while waiting for the next aggregate load.

From that point on, construction traffic compacts the aggregate until stability is obtained.
Final compaction is achieved with a vibratory compactor, first without vibration for several passes, then with full vibration. Any weak spots found during final compaction usually indicate inadequate aggregate thickness at those spots. Do not grade ruts down. Instead, fill them with additional aggregate and compact. This rule applies to any future rut maintenance required .After these steps are completed, the road or area is ready for use. Stability will increase as traffic and the confining action of the fabric continue to density the aggregate and consolidate the sub grade.

2.2 Maintenance Considerations:

Regular inspections should be made to determine if cracks, tears, or breaches have formed in the fabric; if so, it should be repaired or replaced immediately. It is necessary to maintain contact between the ground and the geotextile at all times. Trapped sediment should be removed after each storm event.

III. LIMITATIONS:

1 Geotextiles (primarily synthetic types) have the potential disadvantage of being sensitive to light and must be protected prior to installation.
2 Some geotextiles might promote increased runoff and might blow away if not firmly anchored.
3 Depending on the type of material used, geotextiles might need to be disposed of in a landfill, making them less desirable than vegetative stabilization.
4 If the fabric is not properly selected, designed, or installed, the effectiveness may be reduced drastically.
However all the above limitations can be overcome if proper care is taken in selecting the type of geotextile, method of installation and finally proper maintenance after installation.

IV. CONCLUSION:

Geotextiles effectiveness depends upon the strength of the fabric and proper installation. Geotextiles are a cost effective way to insure better drainage & stabilization of sub grades. Hence it can be concluded that use of geotextile in road construction is very effective if proper care is taken and is a material which is here to stay.

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